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Glucksman et al.

(54) HOT BEVERAGE BREWING APPARATUS

(75) Inventors: **Dov Z. Glucksman**, Danvers, MA (US); **Laura J. Nickerson**, Fitchburg, MA (US); **Gary P. McGonagle**, Lynn, MA (US)

Correspondence Address:
GEORGE A. HERBSTER
40 BEACH STREET, SUITE 303
MANCHESTER, MA 01944 (US)

(73) Assignee: **APPLIANCE DEVELOPMENT CORPORATION**, Danvers, MA (US)

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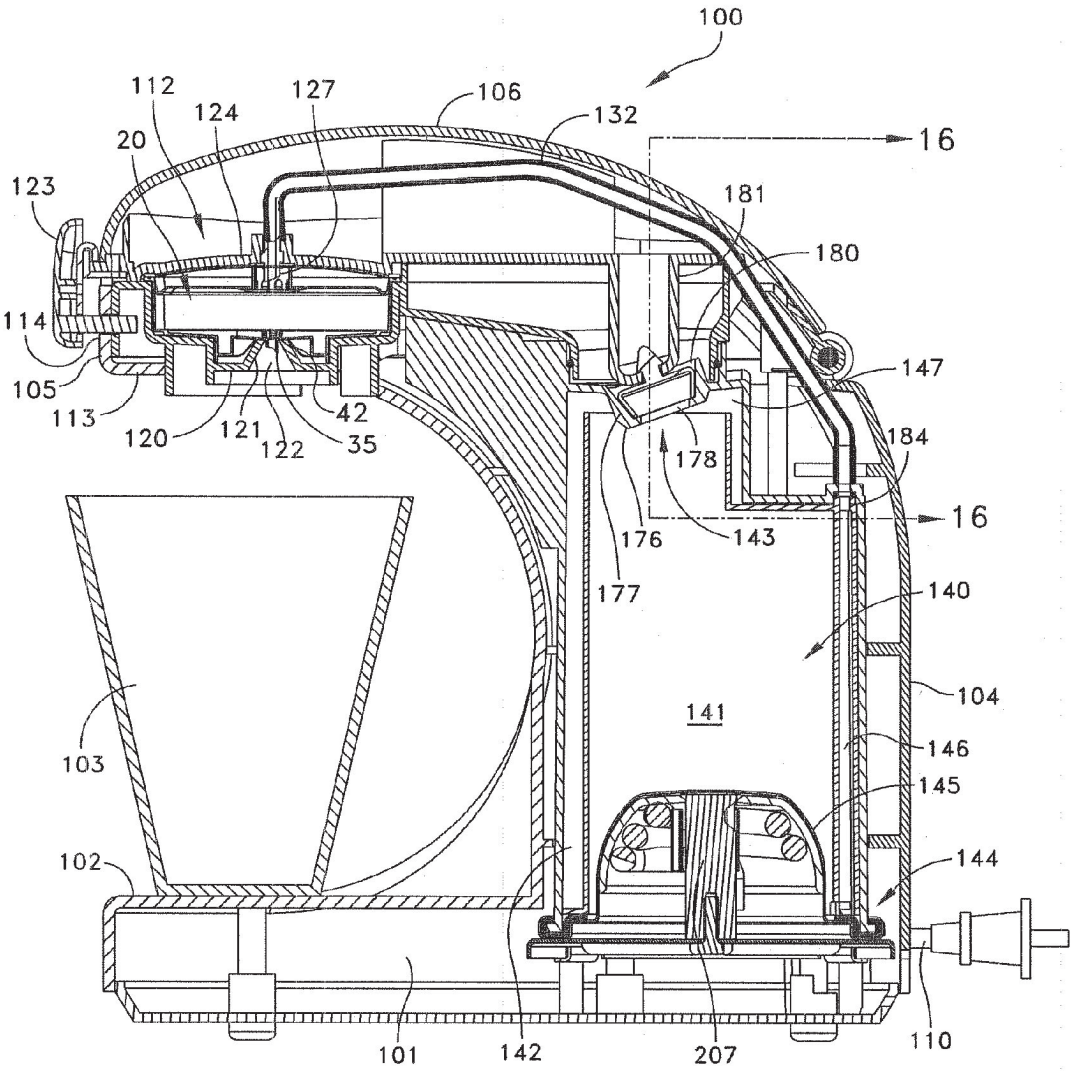
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(57) **ABSTRACT**

A hot beverage brewing apparatus. A pressurized hot liquid delivery system provides liquid under pressure within a range of acceptable brewing temperatures without any mechanical pump. Water is apportioned into sealable tank volumes, one of which is heated to boil the liquid and produce steam under pressure. The pressurized steam displaces the liquid from the tank volumes in proportion and at a temperature that is within the acceptable brewing range. The hot liquid under pressure is directed to a capsule receiving station to infuse a material in a capsule. The capsule dispenses the brewed beverage without contacting the brewing apparatus.



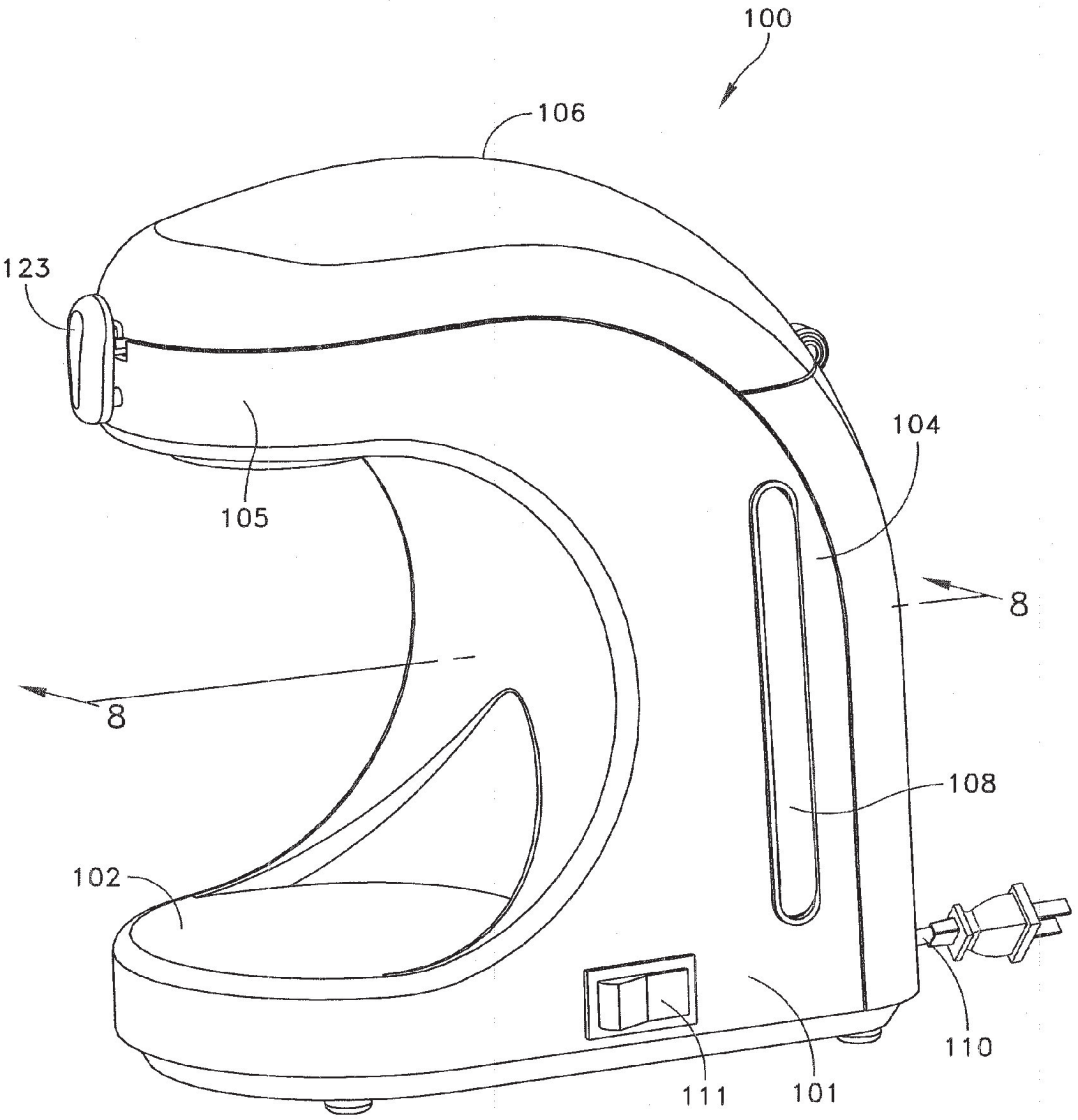


FIG. 1

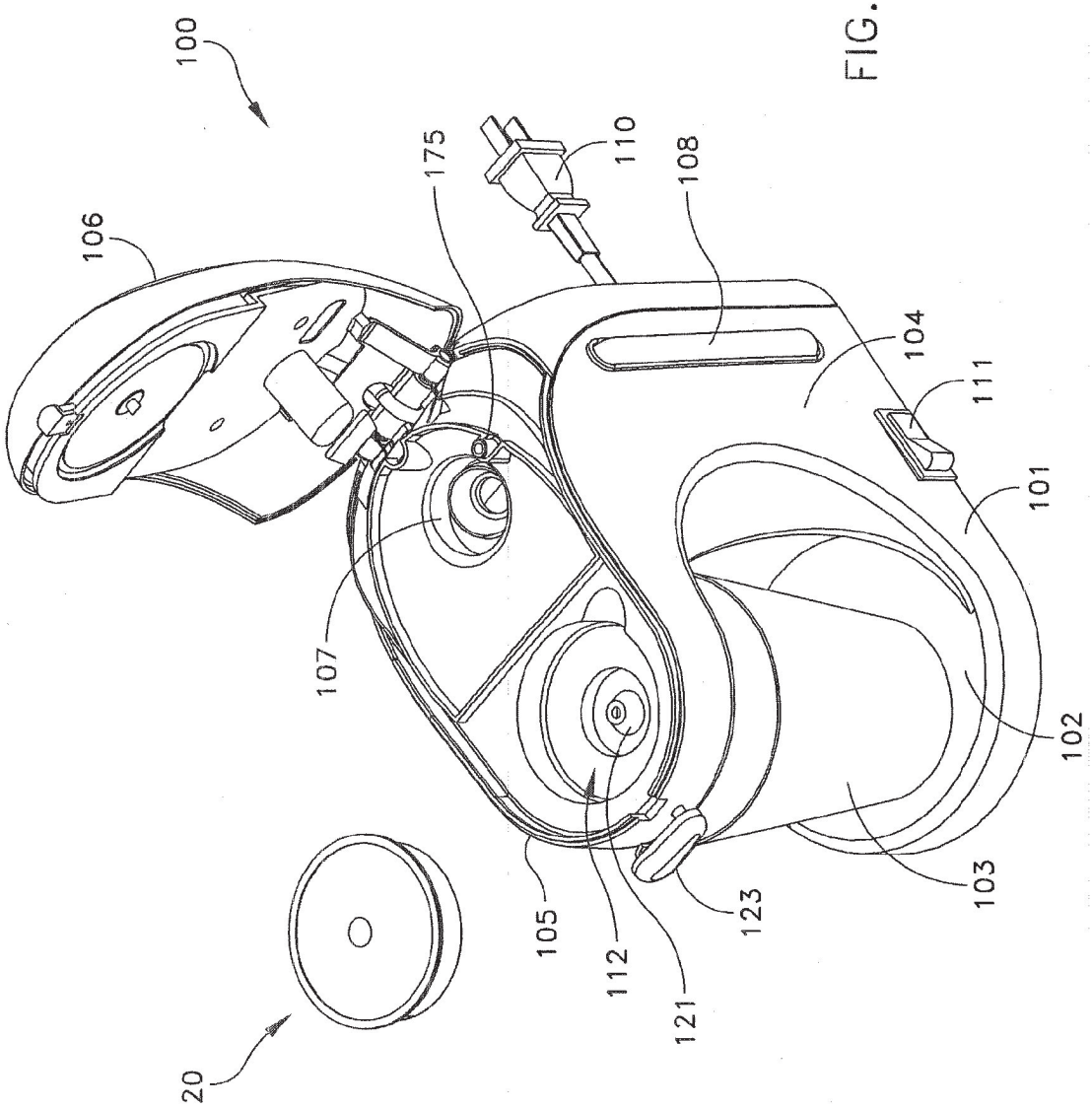


FIG. 2

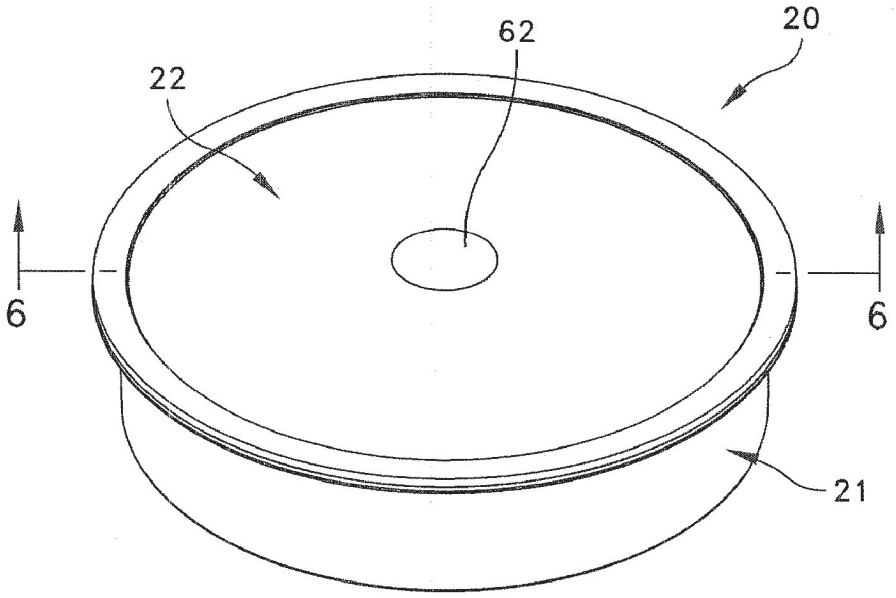


FIG. 3

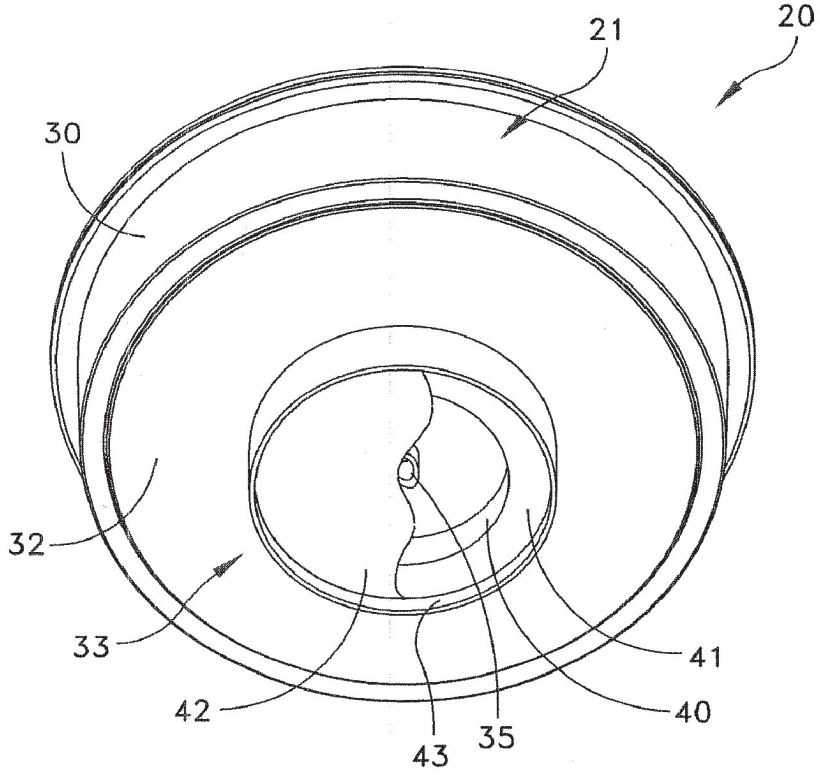


FIG. 4

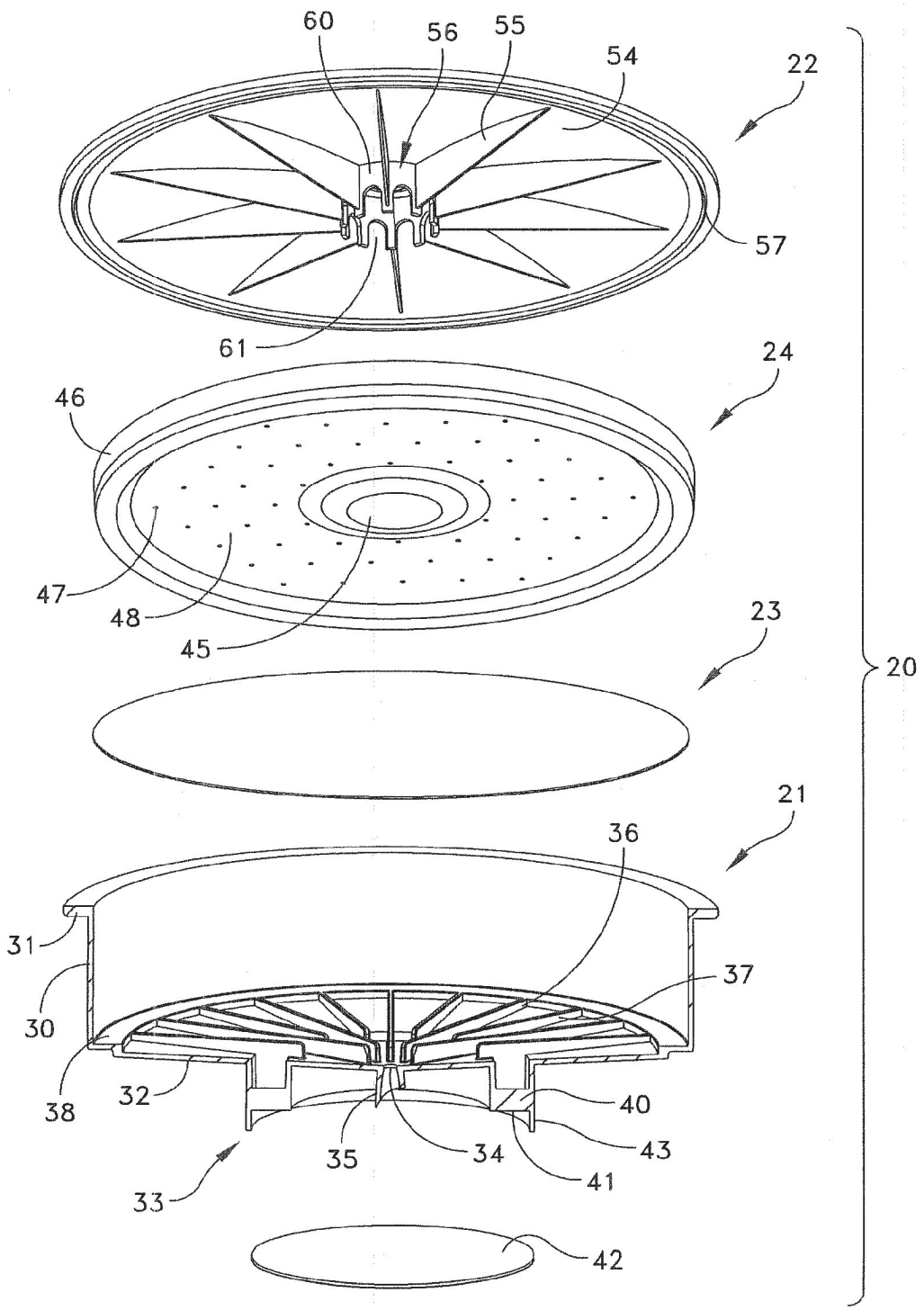

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FIG. 5

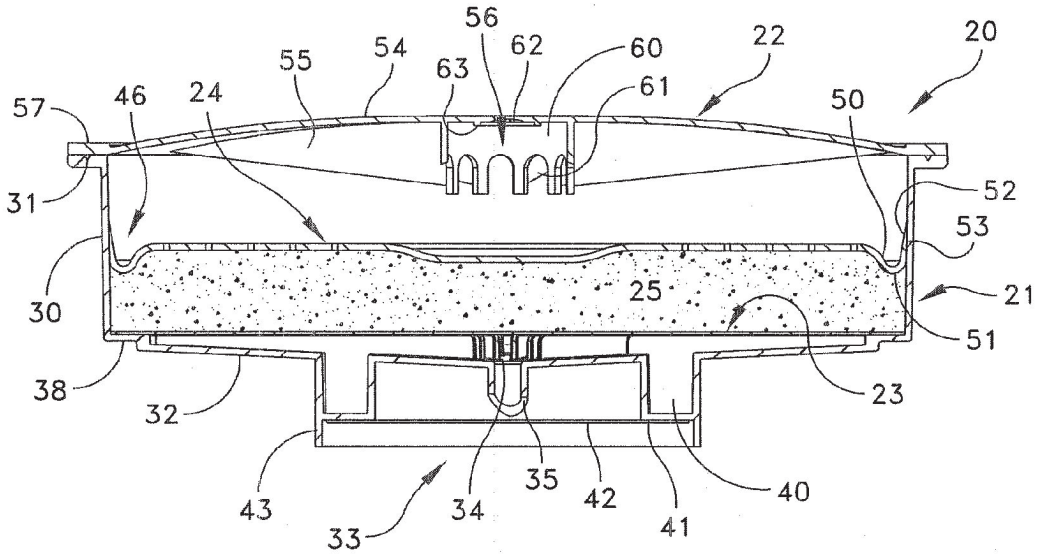

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FIG. 6

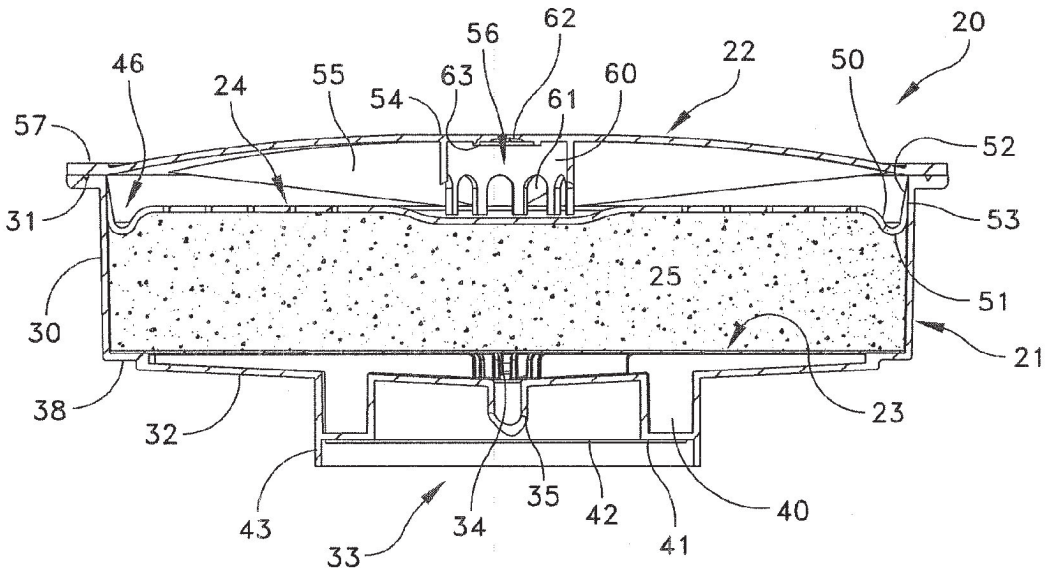

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FIG. 7

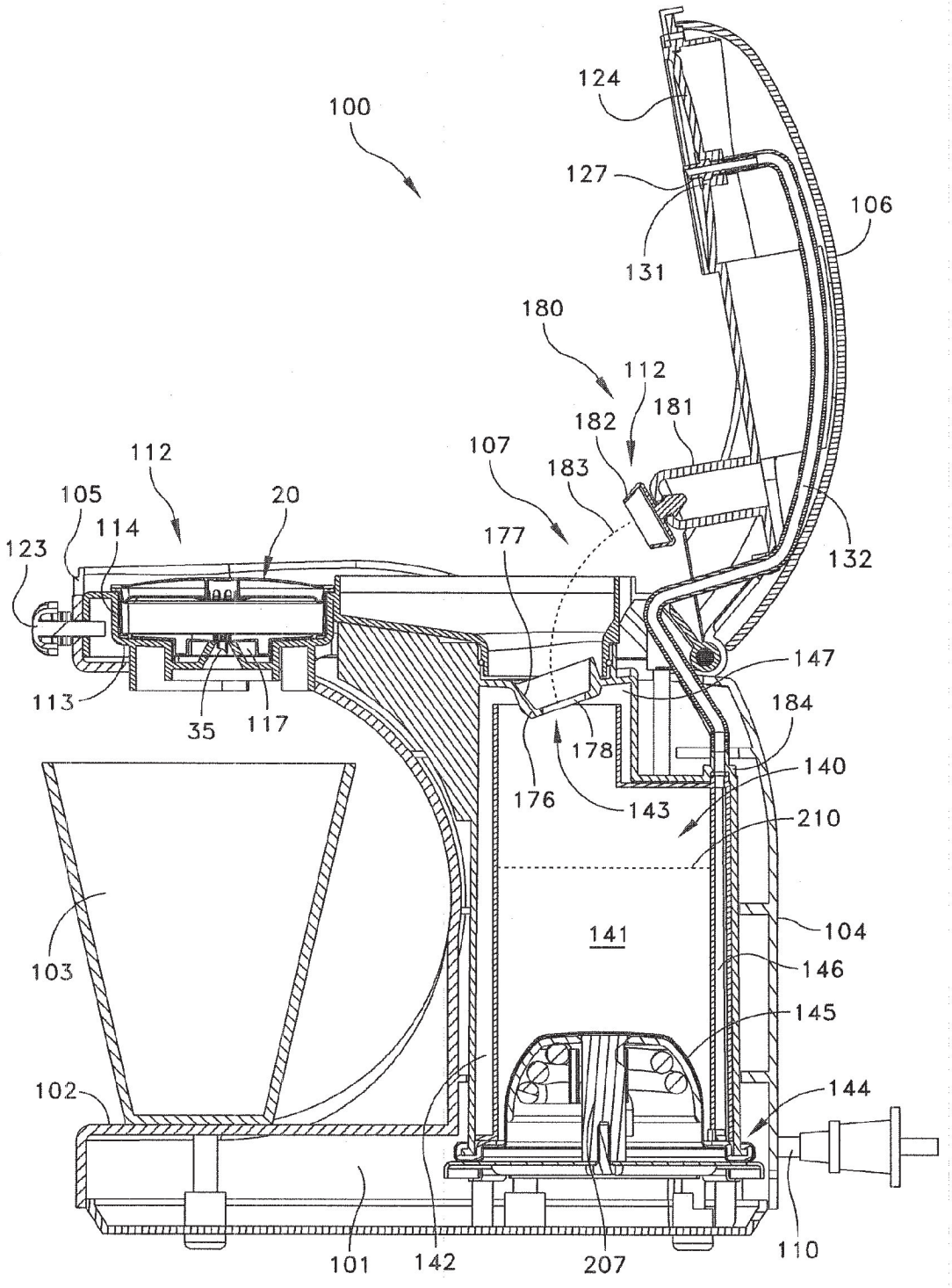

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FIG. 8

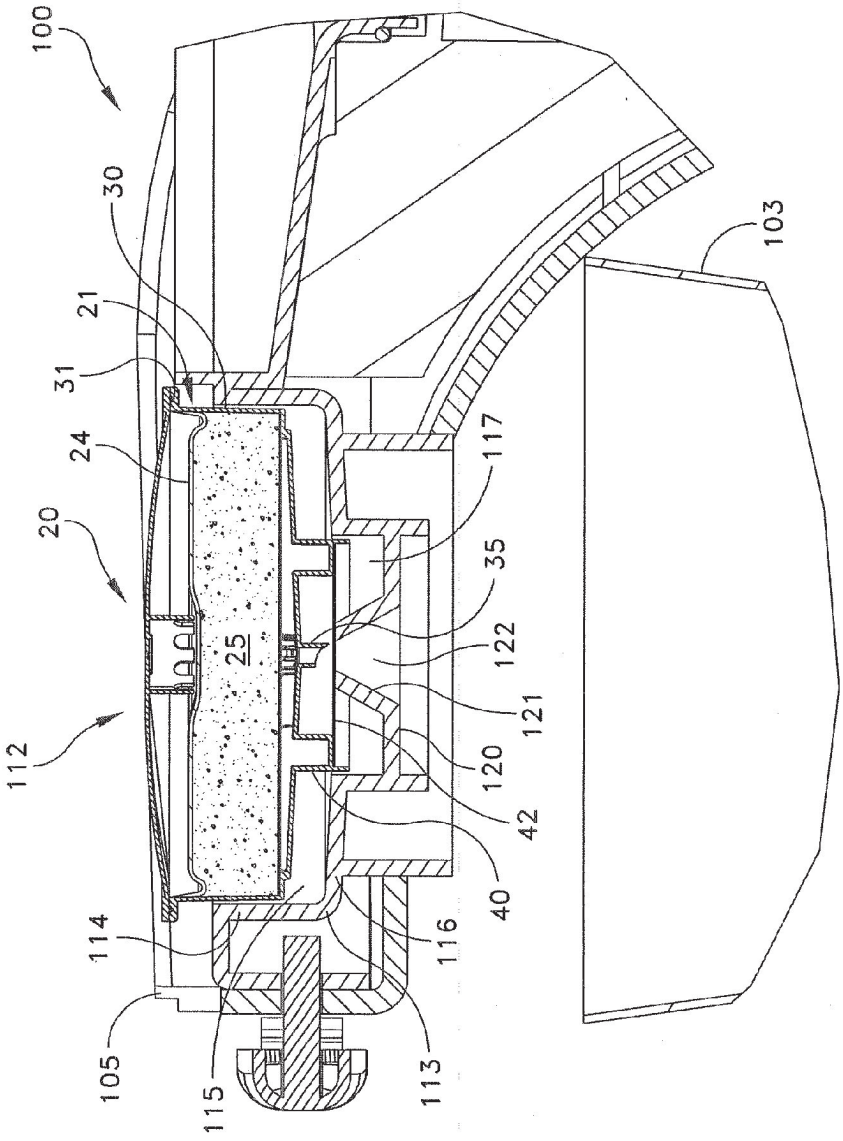

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FIG. 9

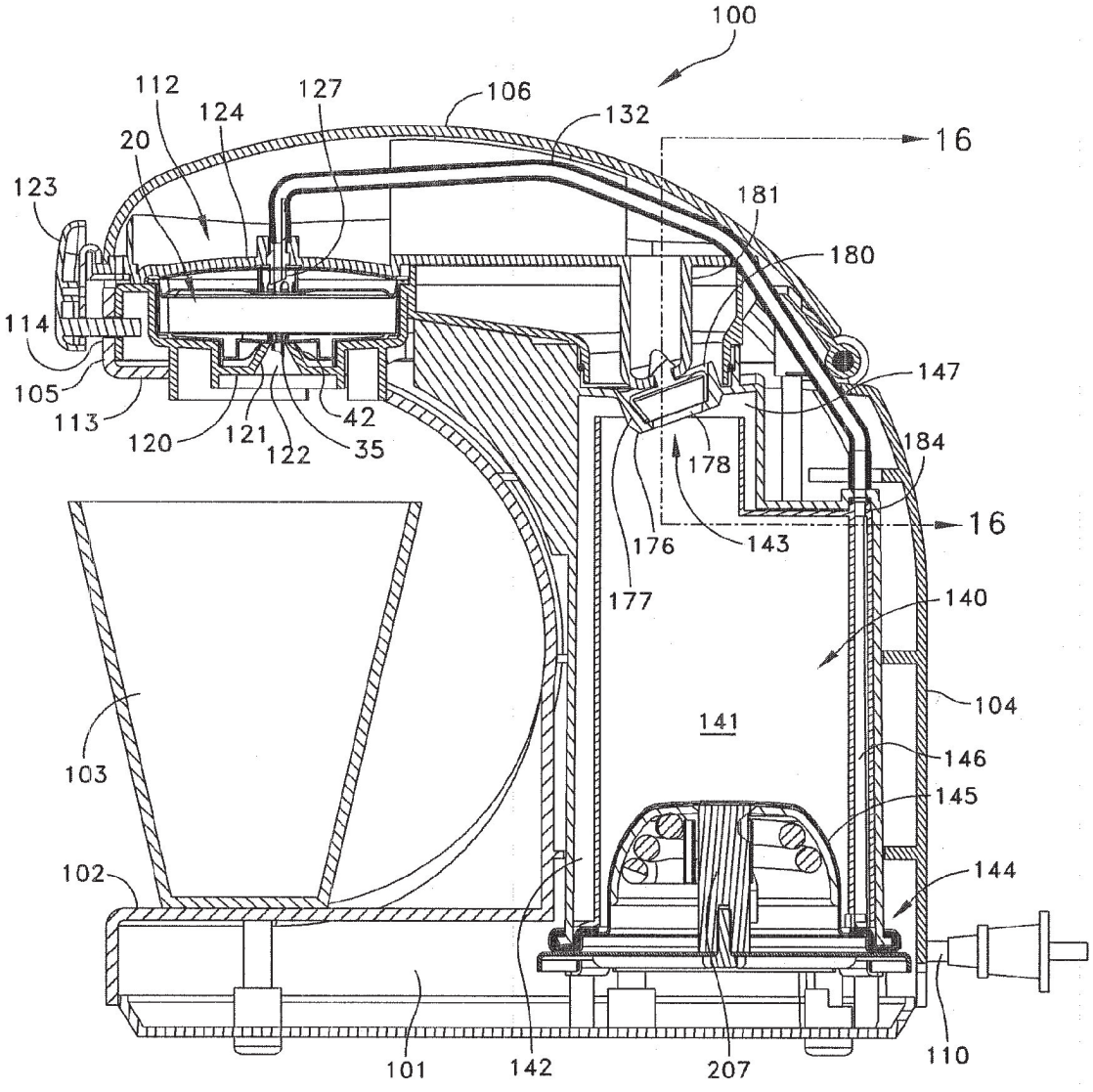

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FIG. 10

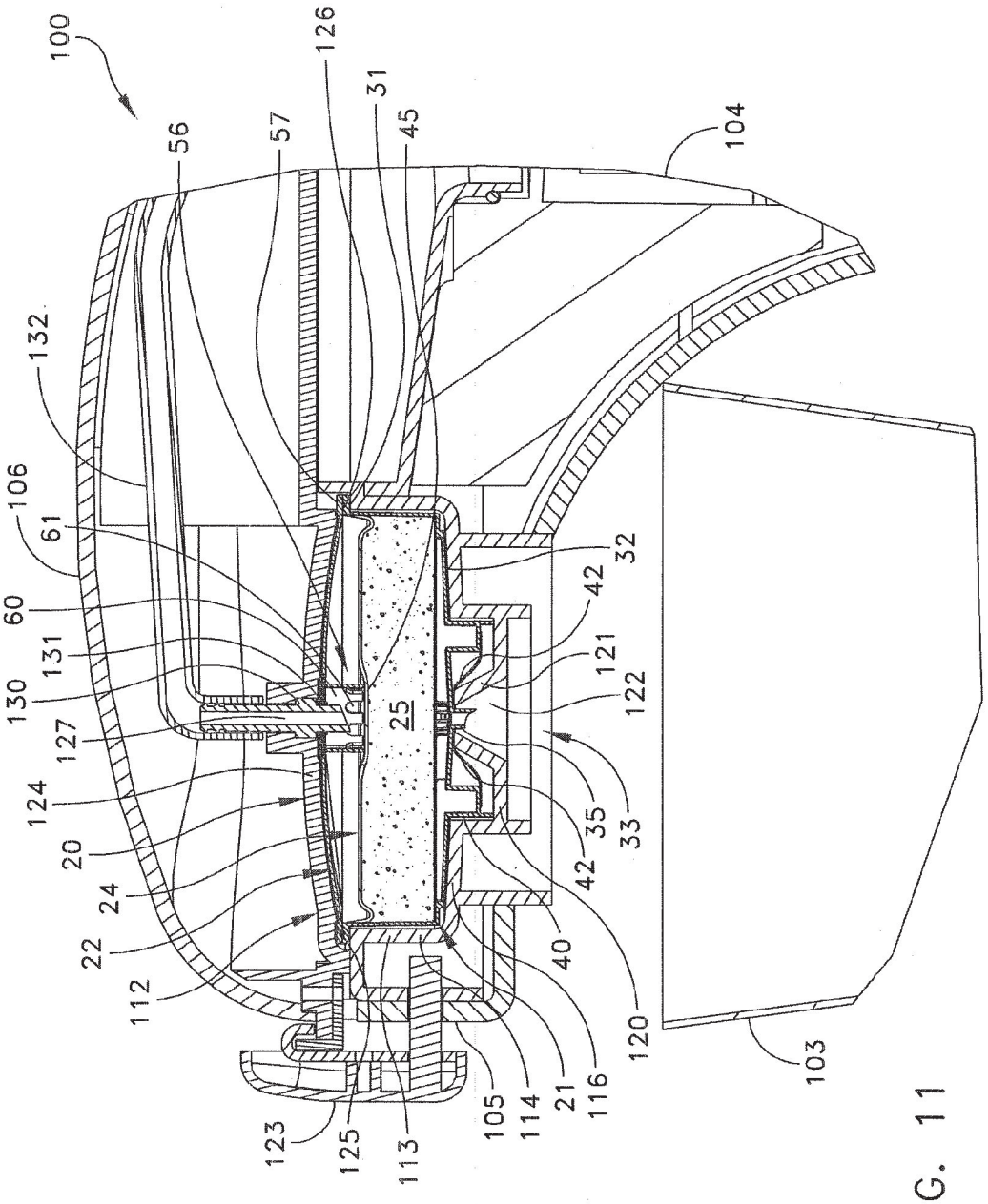

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FIG. 11

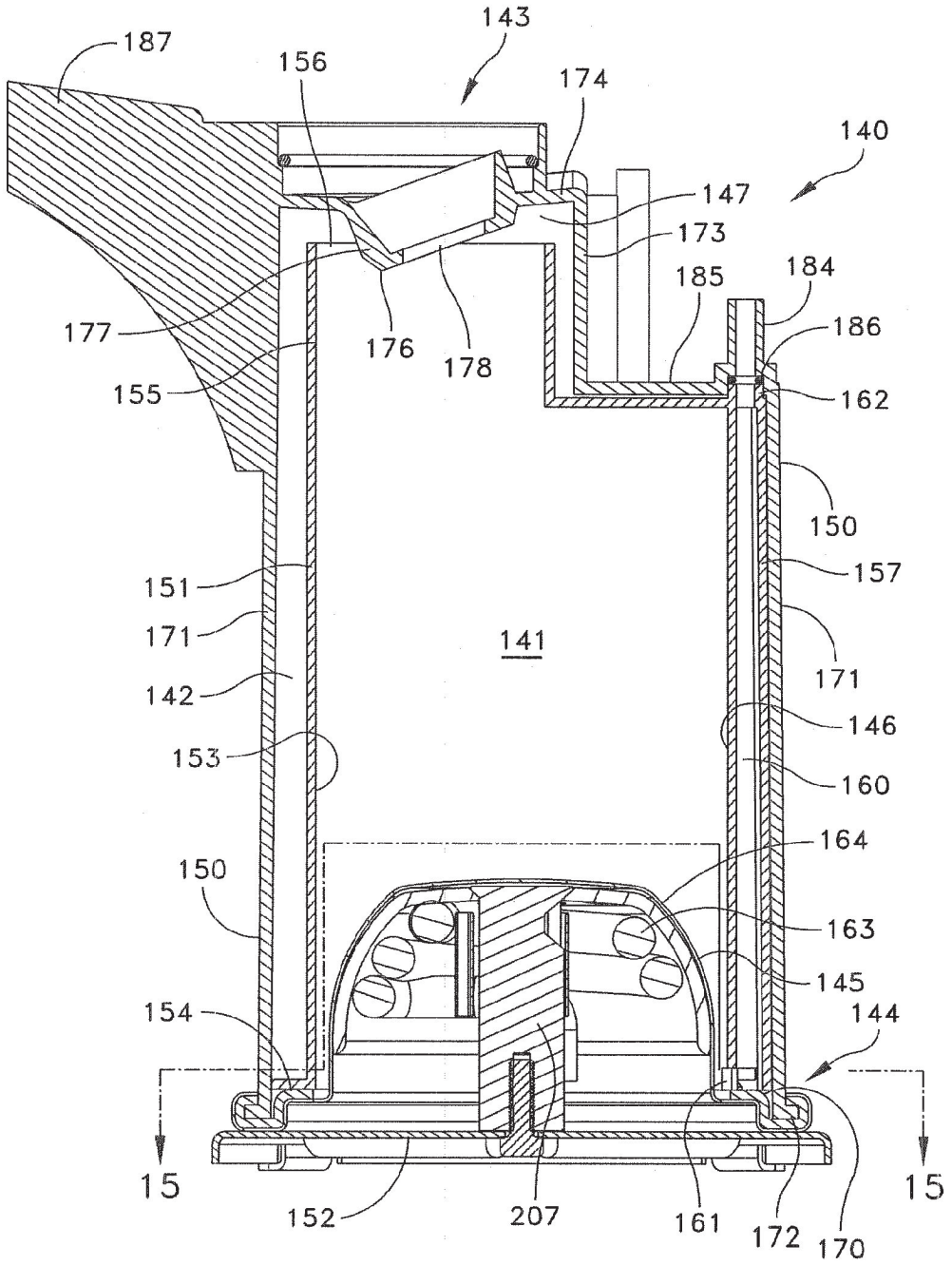

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FIG. 12

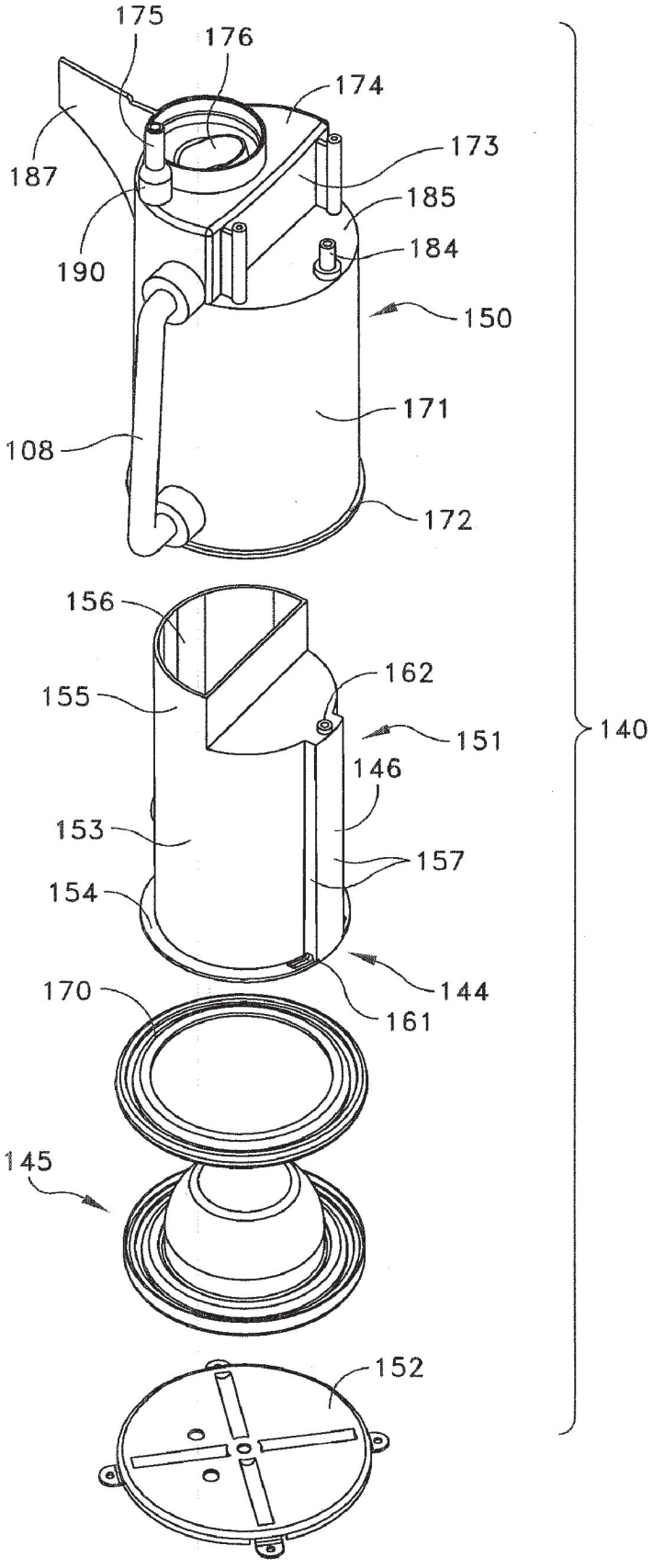

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FIG. 13

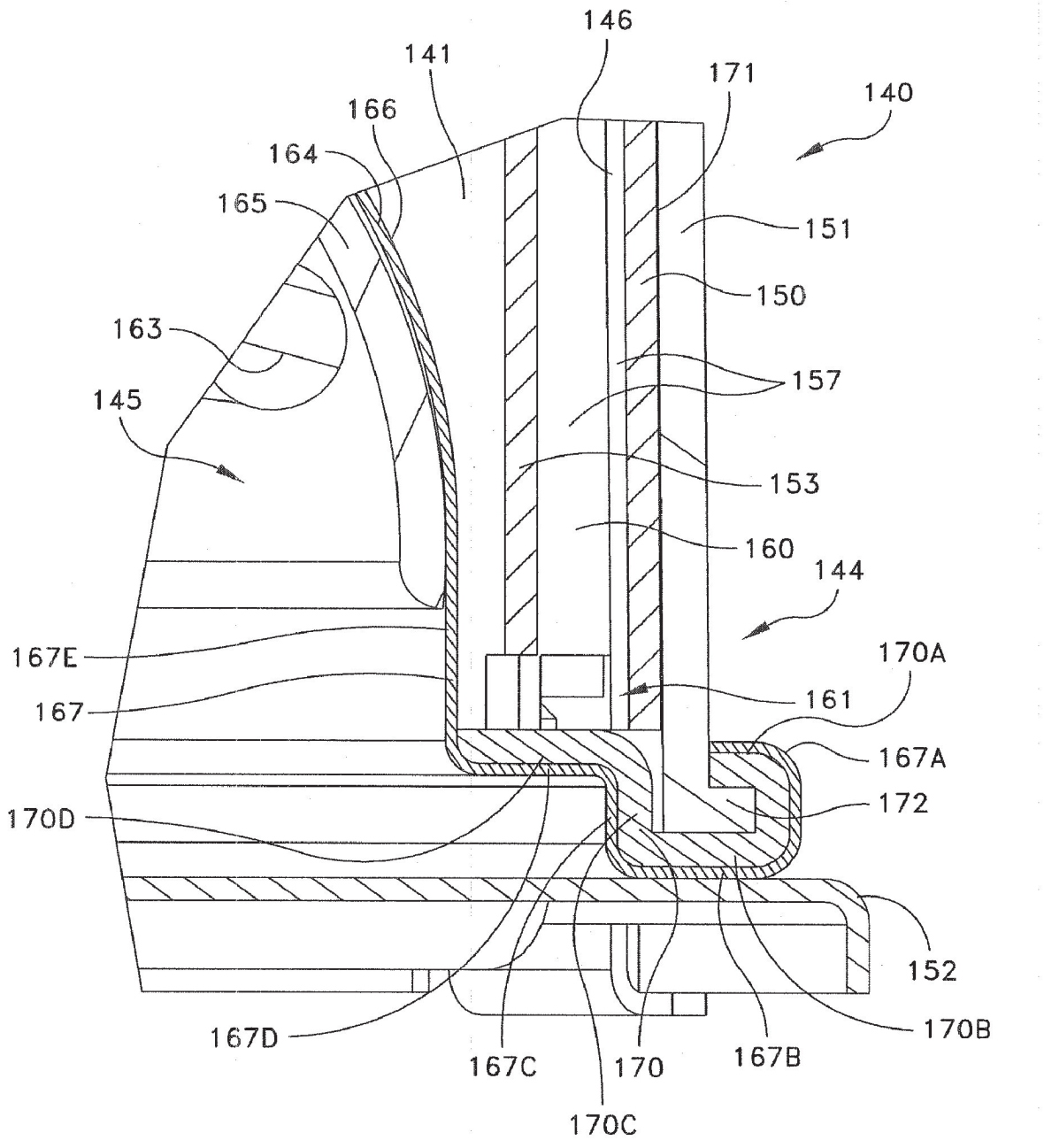

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FIG. 14

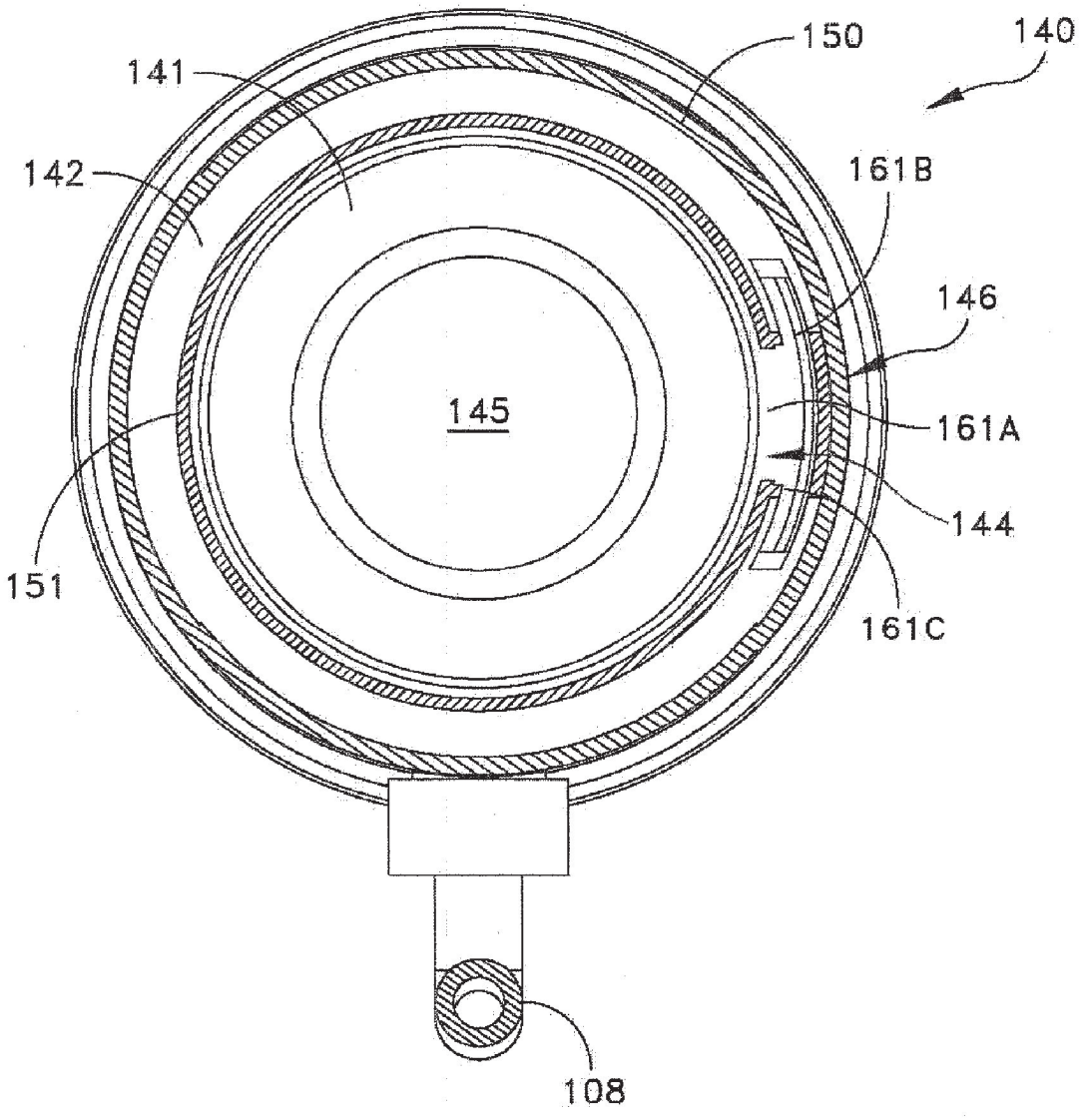


FIG. 15

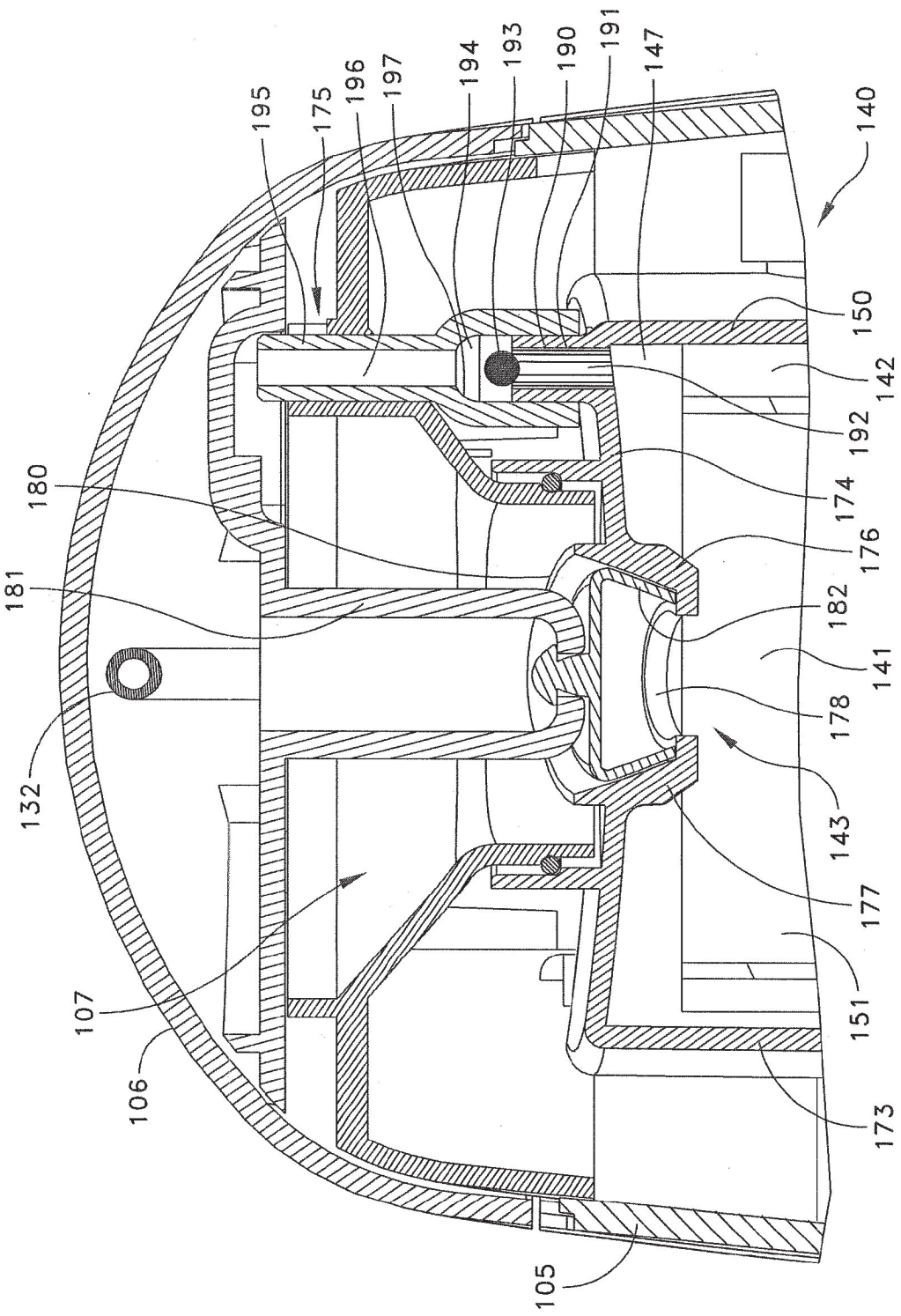

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FIG. 16

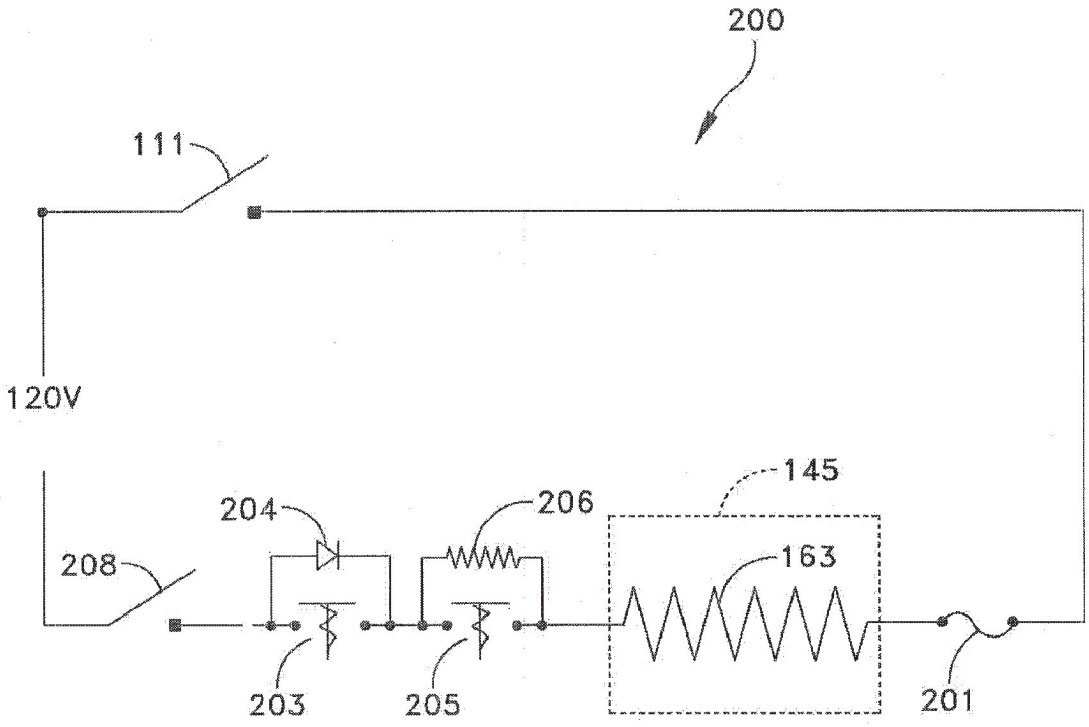


FIG. 17

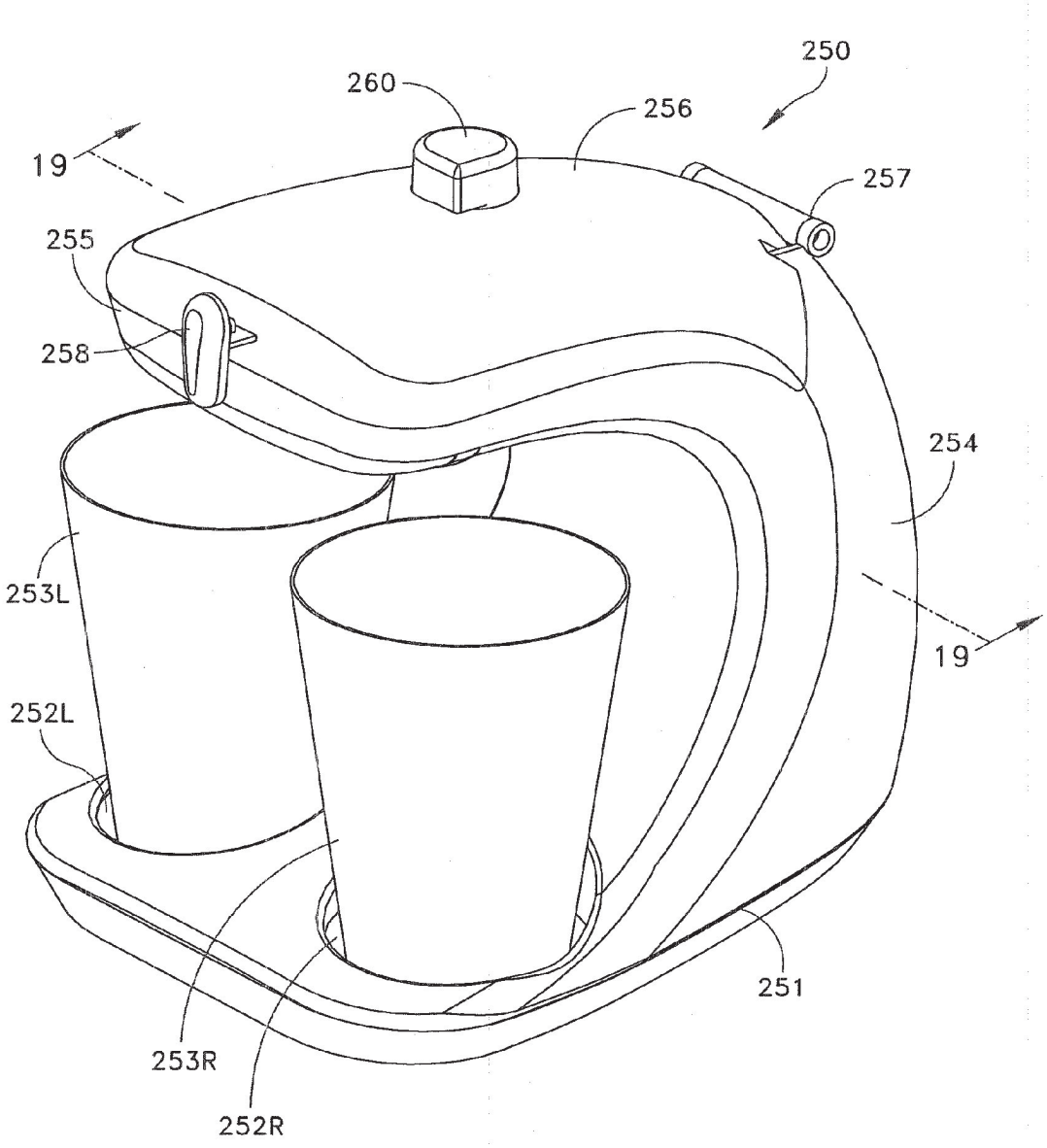


FIG. 18

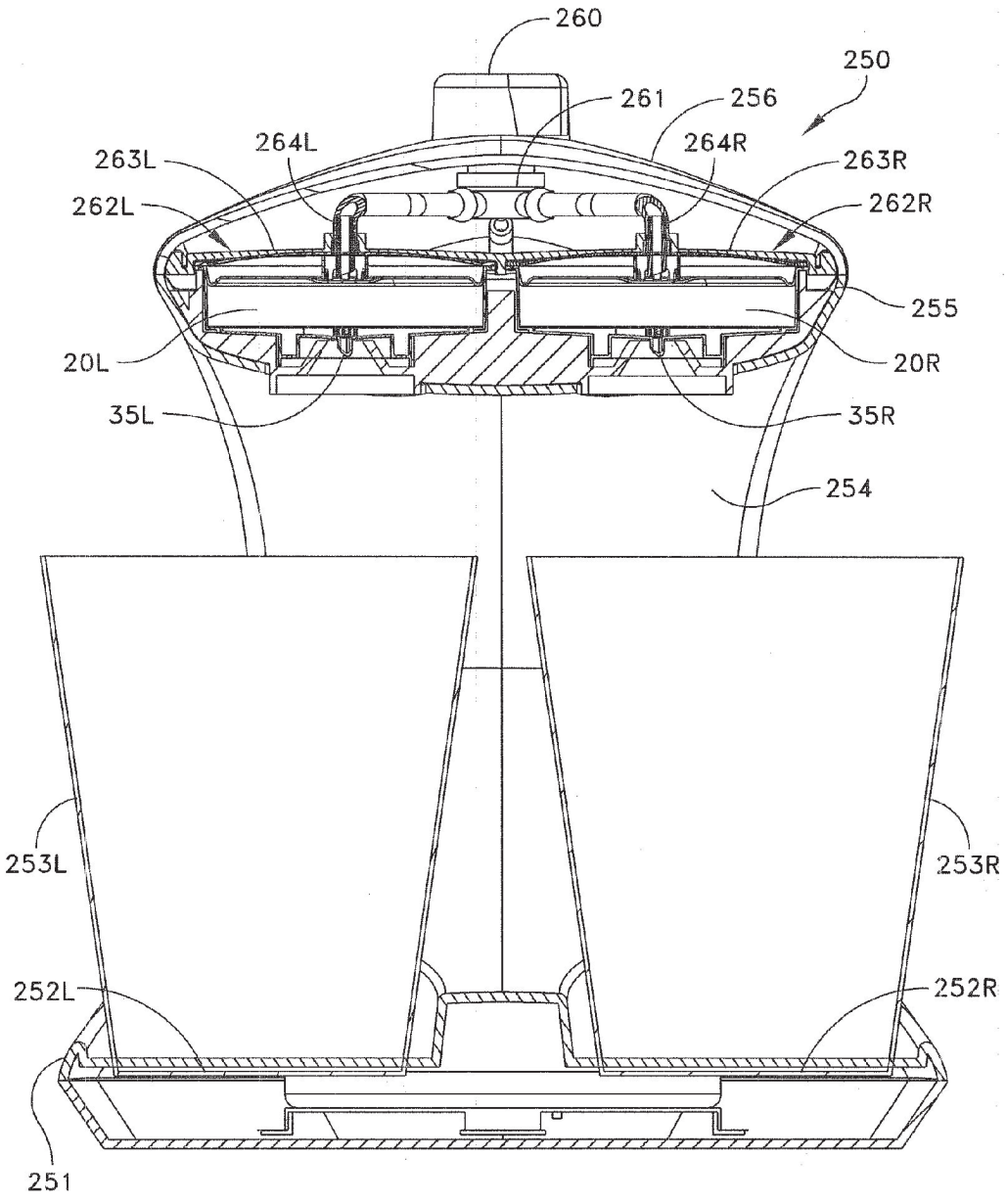

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FIG. 19

HOT BEVERAGE BREWING APPARATUS

CROSS REFERENCE TO RELATED APPLICATION

[0001] U.S. patent application Ser. No. _____ (A85-045) for an Infusible Material Capsule For Brewing A Beverage filed on the same day as this application, assigned to the same assignee as the present invention and incorporated by reference herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention generally relates to the brewing of beverages. More specifically this invention relates to apparatus for brewing a hot beverage by infusing an infusible material, such as ground coffee, with pressurized liquid, such as water, at an acceptable brewing temperature.

[0004] 2. Description of Related Art

[0005] For many years preparing a beverage, such as coffee, has involved brewing multiple servings in a pot or other container using loose coffee grounds. In some apparatus, the coffee grounds mix with hot water and are then removed from the brewed beverage as, for example, in the so-called "French press" coffee maker. Other apparatus uses a drip brewing procedure that directs hot liquid at low pressure through an open or closed basket containing the loosely ground coffee over a filter, such as a paper filter cone.

[0006] The procedures and apparatus for brewing beverages, particularly coffee, have undergone many transformations in recent years spurred by different market requirements. A convenience requirement led to prepackaged packets of ground coffee as a substitute for manually measuring coffee from bulk packages of loose, ground coffee, as in conventional drip coffee makers. A prepackaged packet comprises a permeable filter paper pouch with a pre-measured portion of loose ground coffee. An impervious package stores the packet to maintain freshness. A packet is removed from its package and placed in a basket or like receptacle. Then hot water at atmospheric pressure flows through the packet and its contents for extracting flavor and aroma from the ground coffee.

[0007] The foregoing apparatus typically brews multiple beverage servings. Now many users prefer to brew individual servings. This preference for single-serve brewing apparatus, especially for home use, led to the development of pre-packaged disposable capsules, or cartridges, with prepackaged infusible material, and related brewing apparatus. For example, U.S. Pat. No. 4,921,712 to Malmquist discloses a disposable cartridge for use in an automatic drip-type beverage brewing machine. The cartridge contains a filter member with ground coffee. A closed end of the cartridge has a plurality of holes and forms a shallow receptacle. A user removes a sealing foil from the receptacle and places the cartridge on ledges in a brewing apparatus spaced from a water delivery spout and over the receptacle. The apparatus delivers hot water at atmospheric pressure and at a controlled rate onto the top of the cartridge. Brewed beverage emerges from the bottom of the cartridge for accumulation in the receptacle. There is no requirement for sealing between the apparatus and the cartridge so long as water does not overflow the shallow receptacle.

[0008] U.S. Pat. No. 6,612,224 (2003) to Mercier et al. discloses an apparatus for brewing a beverage in which water is fed by gravity from two heated tanks. The temperature of the water in each tank can be adjusted to an optimum value for a different type of brewing. U.S. Pat. No. 6,681,960 (2004) to Garman discloses another low-pressure beverage preparation system in which a brewing chamber receives a cartridge.

[0009] Minimizing the brewing time has become another market requirement. It was determined early on that the extraction time or "brewing cycle" of such brewing apparatus could be shortened significantly if the infusible material, such as coffee beans, were ground more finely than those used in such drip-type brewing apparatus. Finer grinding exposes a larger surface area to the water. However, the coffee grounds have a higher packing fraction and volumetric density. This increases hydraulic resistance to the flow of water through the cartridge and the grounds therein. It was found that low pressure apparatus was not efficient for brewing beverages using dense or compacted infusible material.

[0010] Rather, water had to be delivered in a closed brewing chamber under an elevated pressure to be able to flow through the coffee in a short period of time. This led to a development of sealed brewing chambers formed by members that are integral to the brewing apparatus. For example, U.S. Pat. No. 4,389,925 (1983) to Paina discloses a beverage extracting and dispensing machine for use with flattened round cartridges. A cartridge contains an infusible product, such as ground coffee, and has permeable upper and lower walls traversing a substantially cylindrical side wall. In this reference a pressure plate coacts with the cartridge to provide sealing.

[0011] A myriad of other approaches have been attempted to provide a hot liquid at an elevated pressure for brewing through a cartridge or capsule. For example, U.S. Pat. No. 6,606,938 (2003) to Taylor discloses an apparatus that uses a disposable cartridge that is initially pierced and vented by a tubular outlet probe and then pierced by a tubular inlet probe. Heated liquid is directed into the cartridge through the inlet probe for combination with the beverage medium to produce the beverage. The outlet probe provides a means for extracting the beverage from the cartridge. This apparatus utilizes an air pump and sealed chamber for metering the amount of heated water to be expelled and fed to the cartridge.

[0012] U.S. Pat. No. 6,786,134 (2004) to Green discloses a coffee and tea dispenser that infuses material in a cartridge. An injection system, including a water heater and a pump, provides the water under pressure at an elevated temperature.

[0013] Similarly, U.S. Pat. No. 7,097,074 (2006) to Haliday discloses a beverage brewing apparatus which includes a cartridge holder held for infusion in the apparatus by a hot liquid under pressure. A water pump and a heater combine to provide hot water at an elevated temperature.

[0014] U.S. Patent Application Publication No. US2005/0150391 (2005) to Schifferle discloses a coffee maker in which the coffee is contained in a cartridge. Again, a pump and hot water heater provide water at a brewing temperature to be directed into a brewing chamber including the cartridge.

[0015] Any pump configurations for use in brewing apparatus should be able to provide liquid to a brewing chamber at a pressure of about 1 barg and at a flow rate in the range of 100 to 400 ml per minute. Reciprocating electromagnetic pumps can satisfy these requirements and are popular for pumping in many beverage brewing apparatuses. U.S. Pat. No. 4,389,169 (1983) to De Dionghi discloses on embodiment that includes a reciprocating piston, a field coil for driving the piston in one direction, a spring for driving the piston in the other direction and suction and delivery valves. As will be apparent and as

K-FEE SYSTEM GMBH, EX2012, page 19
NESPRESSO USA, INC. v. K-FEE SYSTEM GMBH
IPR2024-00254, U.S. PATENT 11,465,829

known, such pumps must be manufactured to close tolerances. Consequently they are expensive components to use in hot beverage brewing apparatus.

[0016] The foregoing and other drawbacks have led to the development of brewing apparatus that incorporates a sealed water boiler that heats water above its boiling point. This produces sufficient pressure to drive the liquid from the boiler through the infusible material at an increased pressure. However, at a pressure of 1 barg the boiling point of water increases from 100° C. (the boiling temperature for water at sea level and at standard barometric pressure) to about 120° C. This is well above the acknowledged acceptable brewing temperature range of 90° C. to 96° C. for coffee. As known, brewing a beverage above an acceptable range of brewing temperatures adversely impacts the quality of the brewed beverage. For example, brewed coffee can have a bitter taste and lack any aroma.

[0017] U.S. Pat. No. 3,844,206 (1974) to Weber discloses a beverage brewing apparatus with a heating chamber that receives the incoming water. A cover closes the chamber and has pressure regulating and pressure relief valves. The bottom of the heating chamber includes two electric heaters. When the water temperature reaches a proper brewing temperature, the chamber is under a vapor pressure. One of the two heaters is de-energized. Then a valve opens. Water discharges into the infusion chamber under the vapor pressure developed during heating. The infusible material, which is in a cartridge, is also subject to slight increase in pressure so water absorbed in the infusion material is driven from the chamber and into a receptacle.

[0018] In the infusion apparatus of U.S. Pat. No. 3,918,355 (1975) to Weber a first chamber contains a liquid, such as water, heated to a predetermined temperature. A second chamber contains the infusion material and is in fluid communication with the first chamber. When the temperature reaches a predetermined value, a latch releases a weight that descends through the first chamber trapping air beneath it. This weight forces hot liquid, under substantially constant pressure, from the first chamber through the passage into the second chamber. Trapped air is then forced through the material to remove any remaining excess liquid.

[0019] U.S. Pat. No. 4,147,097 (1979) to Gregg discloses a drip-type coffee maker in which cold water is fed from a reservoir to two heating chambers. One heating chamber is maintained at a temperature that is optimized for interaction with an infusible material. The other chamber maintains water at a higher temperature. The first chamber provides water to the infusible material. The infused liquid discharges into a pot or other receptacle. The second chamber discharges directly into the pot whereby the hot water from the second chamber mixes with the brewed beverage from the brewing chamber to achieve an appropriate drinking temperature.

[0020] U.S. Pat. No. 4,287,817 (1981) to Moskowitz et al. discloses another approach in which a conventional heater heats water in a container. The hot water exits from a bottom outlet of the container through valves. Steam can also be produced. Specifically, water in the container is heated to a boiling point that results in the accumulation of steam in the container so the water within the container is forced through an outlet to brew the beverage in an infuser.

[0021] Using such brewing apparatus in non-residential environments, such as in hotels or other commercial establishments, imposes still other market requirements. In a hotel environment, for example, in-room coffee apparatus must be compact, inexpensive, reliable and easy to use and must operate with minimal costs and easy to use. Such brewing apparatus must minimize the efforts of room attendants to clean and maintain the brewing apparatus, to dispose of used coffee grounds and to replenish coffee supplies in the room. In many hotels today in-room coffee apparatus includes a water heater, cups and prepackaged, pre-measured sealed packets of instant coffee. Other hotels have begun to use conventional coffee brewing machines that use capsules or cartridges to brew the coffee.

[0022] Notwithstanding the various proposals including those described in the foregoing art, commercially available units for brewing a hot beverage by infusing a material, such as compacted ground coffee, with a hot liquid, such as water, under pressure continue to incorporate both a heater and a pressure pump with the additional costs imposed by the pump and attendant electric and fluid connections and more complex control systems. Such apparatus also tends to be large and bulky. The noise generated by the pump is another deterrent to its use. What is needed is an apparatus for brewing a hot beverage by infusing a material with a hot liquid under pressure at a brewing temperature within the acceptable temperature range, that eliminates the need for a mechanical pump, that reduces manufacturing costs, that maximizes reliability, that is compact and easy for an individual to use and that minimizes the need for regularly cleaning and other maintenance.

SUMMARY

[0023] Therefore it is an object of this invention to provide an apparatus for brewing a hot beverage by infusing a material with a hot liquid under pressure that meets all the above-identified market requirements.

[0024] Another object of this invention is to provide an apparatus for brewing a hot beverage by infusing a material with a hot liquid under pressure at a brewing temperature within an acceptable brewing temperature range.

[0025] Still another object of this invention is to provide an apparatus for brewing a hot beverage by infusing a material with a hot liquid under pressure that eliminates any mechanical pump.

[0026] Yet another object of this invention is to provide an apparatus for brewing a hot beverage by infusing a material with a hot liquid under pressure that operates with simplified controls.

[0027] Yet still another object of this invention is to provide an apparatus for brewing a hot beverage by infusing a material with a hot liquid under pressure that is compact, reliable and inexpensive to manufacture.

[0028] Still yet another object of this invention is to provide an apparatus for brewing a hot beverage by infusing a material with a hot liquid under pressure that minimizes the need for regular cleaning and other maintenance.

[0029] In accordance with one aspect of this invention a pressurized hot liquid delivery system delivers pressurized hot liquid at an acceptable temperature to a utilization device. The system comprises first and second tanks that define first and second tank volumes. Liquid is poured through a sealable liquid inlet to accumulate in the first and second tanks. The first and second tanks connect to a common chamber. A liquid mixer connects to the utilization device. A port network interconnects the first and second tanks and the liquid mixer. A heater in the first tank boils the liquid therein. When the liquid inlet is sealed, liquid vapor is generated under pressure in the

K-FEE SYSTEM GMBH, EX2012, page 20
NESPRESSO USA, INC. v. K-FEE SYSTEM GMBH
IPR2024-00254, U.S. PATENT 11,465,829

common chamber thereby to force liquid from the first and second tanks through the liquid mixer to the utilization device at the acceptable temperature and under pressure.

[0030] In accordance with another aspect of this invention there is provided apparatus for brewing a hot beverage by infusing a material with a hot liquid under pressure at an acceptable brewing temperature. The apparatus comprises a tank, a heater, a water mixer and a brewing chamber. The tank forms first and second tank volumes and includes sealable inlet for directing liquid at an input temperature into the tank and an outlet for passing liquid from the tank. The heater boils the liquid in the first tank volume when the inlet is sealed to produce steam under a pressure while the liquid in the second tank volume remains substantially at the input temperature. The steam pressure is applied substantially equally to the liquid in each of the first and second tank volumes causing liquid from the tank volumes to flow through the outlet. The water mixer mixes the liquid flowing from the outlet to provide pressurized hot liquid substantially at the acceptable brewing temperature. The brewing chamber brews the beverage with the pressurized hot liquid from the mixer by directing the pressurized hot liquid through the material contained in the brewing chamber to be dispensed at an outlet thereof as the brewed beverage.

[0031] In accordance with still another aspect of this invention there is provided apparatus for dispensing a hot beverage into a beverage receptacle after infusing a material in a capsule having a cover and a sealed outlet. A housing defines a plurality of stations for performing different functions. A lid hinged from the housing moves between opened and closed positions. A platform station supports the beverage receptacle. The apparatus includes a pressurized hot water dispensing station that produces water at an appropriate brewing temperature. A capsule receiving station holds the capsule during brewing and includes a well that circumscribes the capsule, first and second supports and an infuser. The first support engages the sealed outlet after the capsule is inserted into the well when the lid is open and for rupturing the sealed outlet when the lid closes. The second support engages the capsule in the well when the lid is closed. The infuser attaches to the lid and connects to the dispensing station for infusing the material contained the capsule whereby the apparatus dispenses the hot beverage into a receptacle at the platform station.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] The appended claims particularly point out and distinctly claim the subject matter of this invention. The various objects, advantages and novel features of this invention will be more fully apparent from a reading of the following detailed description in conjunction with the accompanying drawings in which like reference numerals refer to like parts, and in which:

[0033] FIG. **1** is a perspective view of one embodiment of a beverage brewing apparatus constructed in accordance with this invention;

[0034] FIG. **2** is a perspective view of the beverage brewing apparatus of FIG. **1** with its lid opened;

[0035] FIG. **3** is a perspective view of a capsule constructed in accordance with this invention;

[0036] FIG. **4** is another perspective view of the capsule in FIG. **3** with a portion broken away;

[0037] FIG. **5** is an exploded view showing the components of the capsule in FIG. **3** in perspective;

[0038] FIG. **6** is a cross-sectional view taken along lines **6-6** in FIG. **3** of an assembled capsule containing a small amount of infusible material;

[0039] FIG. **7** is a cross-sectional view taken along lines **6-6** in FIG. **3** of an assembled capsule containing a maximum amount of infusible material;

[0040] FIG. **8** is a cross sectional view of the beverage brewing apparatus taken along lines **8-8** in FIG. **1** with an open lid;

[0041] FIG. **9** is an enlarged sectional view of a portion of the beverage brewing apparatus of FIG. **8**;

[0042] FIG. **10** is a cross sectional view of the beverage brewing apparatus corresponding to the view in FIG. **8** with a closed lid;

[0043] FIG. **11** is an enlarged sectional view of a portion of the beverage brewing apparatus of FIG. **10**;

[0044] FIG. **12** is a cross sectional view of a pressurized hot water delivery system included in the beverage brewing apparatus shown in FIG. **8**;

[0045] FIG. **13** is an exploded view of a portion of the pressurized hot water delivery system shown in FIG. **12**;

[0046] FIG. **14** is enlarged cross sectional view of a portion of the system shown in FIG. **12**;

[0047] FIG. **15** is a cross sectional view taken along lines **15-15** of FIG. **12**;

[0048] FIG. **16** is an enlarged cross sectional view of a portion of the beverage brewing apparatus taken along lines **16-16** in FIG. **10**.

[0049] FIG. **17** is a schematic of a control system for the beverage brewing apparatus shown in FIG. **1**;

[0050] FIG. **18** is a perspective view of an alternate embodiment of beverage brewing apparatus constructed in accordance with this invention; and

[0051] FIG. **19** is a sectional view taken along lines **19-19** in FIG. **18**.

DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0052] The specifically disclosed embodiment of a hot beverage brewing system includes a capsule and portions of a brewing apparatus that are also described in greater detail in co-pending U.S. patent application Ser. No. _____ (Docket No. A84-045). This description uses the same reference numerals to identify the same elements as appear in that co-pending application. The constructions of both are somewhat interdependent; that is, a modification to the capsule could require a corresponding modification to the brewing apparatus. Consequently the following description initially discloses the construction and operation of the hot beverage brewing system from the user's perspective. Next the description reviews (1) the important construction and operation features of the capsule and (2) a capsule receiving station, both of which are disclosed in greater detail in the co-pending application. Then the description discusses the construction and operation of a pressurized hot water delivery system that is particularly adapted for implementing this invention.

The Hot Beverage Brewing System

[0053] FIGS. **1** and **2** are two different views of a hot beverage brewing apparatus **100** that infuses a material with a hot liquid supplied at a brewing temperature within an acceptable temperature range and under pressure. For purposes of this description, the depicted apparatus brews coffee by infus-

K-FEE SYSTEM GMBH, EX2012, page 21
NESPRESSO USA, INC. v. K-FEE SYSTEM GMBH
IPR2024-00254, U.S. PATENT 11,465,829

ing packed ground coffee in a capsule **20** (FIG. **2**) with water at an acceptable brewing temperature in the range from 90° C. to 96° C. and at a pressure of about 1 barg to provide optimum brewing quality and brewing time.

[0054] From the user's perspective the apparatus in FIGS. **1** and **2** has a base housing **101** with a platform station **102** for receiving a mug, cup or other type of beverage receptacle **103** (FIG. **2**). A vertical housing **104** rises from the base structure **101** and supports an upper housing **105** that cantilevers over the platform station **102**. The vertical housing **104** carries a hinged lid **106** and houses a pressurized hot water delivery system.

[0055] With particular reference to FIG. **2**, the user pours a required quantity of water into a water filling station **107** that is exposed when the lid **106** is open. Typically the user will fill the receptacle **103** with cold water and then pour the cold water into the water filling station **107**. A water level indicator **108** allows the user to determine the quantity of water in the apparatus. The apparatus **100** also includes a power cord **110** and a switch **111** to start a self-terminating brewing cycle. As shown in FIG. **2** the upper housing **105** also has a capsule receiver station **112** for a capsule **20**.

Capsule **20**

[0056] The specific embodiment of the capsule **20** shown in FIGS. **3** through **7** is an integral structure comprising several components. Viewed externally in FIGS. **3** and **4**, the capsule **20** includes a capsule base **21** for containing the infusible material and a capsule cover **22**. Viewed internally, in FIGS. **5** though **7**, the capsule **20** includes a layer of filter paper or a filter **23** and a water distribution plate **24**. Infusible material, such as the ground coffee **25** shown in FIGS. **6** and **7**, is contained in a cavity intermediate the water distribution plate **24** and the filter **23** and bounded by a side wall **30** of the capsule base **21**.

[0057] More specifically and still referring to FIGS. **3** through **7**, the capsule base **21** has a cup shape with a closed bottom and an open top and includes the side wall **30**. A radially outwardly extending flange **31** from the side wall **30** at the periphery of the open top provides a planar annular support surface for the cover **22**. As shown in FIGS. **5** through **7**, a floor **32** closes the bottom of the capsule base **21** and is slightly concave in shape. A central dispensing structure **33** directs the brewed beverage through a central aperture **34** and a dispensing spout **35** to the cup or other beverage receptacle **103** shown in FIG. **2**. In FIGS. **5** through **7**, the dispensing spout **35** extends externally, downwardly from the floor **32** to a free sharpened end.

[0058] Referring to FIG. **5**, the floor **32** includes integral, radially extending, angularly spaced interior ribs **36** and **37**. In combination with the concavity of the floor **32**, the ribs **36** and **37** form converging, sloping channels from the side wall **30** down to the aperture **34** thereby to channel brewed beverage through the aperture **34** and the dispensing spout **35**. A circular ledge **38** at the intersection of the side wall **30** and the floor **32** improves capsule rigidity. The ledge serves as a base to which the filter periphery can be sealed thereby to fix its position in the capsule base **21**.

[0059] Referring specifically to FIGS. **4** through **7**, a rim or collar **40** extends downwardly from the exterior of the floor **32** thereby to form a standoff that is concentric with the spout **35** and spaced proximate thereto. The collar **40** also extends for a distance that is at least the distance the spout **35** extends from the floor **32**. The collar **40** thereby surrounds and protects the dispensing spout **35** during handling and storage.

[0060] A free end **41** of the collar **40** forms an annular planar support surface **41** for a thin gas impermeable sealing foil **42**. The foil **42** seals the spout **35** to assist in maintaining the freshness of the infusible material **25**. The foil **42** also prevents an individual from contacting the sharpened end of the spout **35**. An adherent material, or other means, fixes the foil **42** to the free end **41**. In this embodiment, an outer peripheral cylindrical extension of the collar **40** forms a protective barrier or fence **43**. The fence **43** prevents any accidental puncture of the foil **42** by being pushed against the free end of the spout **35** prior to its intentional rupture during the brewing process as will be described later.

[0061] Referring particularly to FIG. **5**, the water distribution plate **24** is a thin plate with a dimpled center portion **45** and a peripheral positioning structure **46**. A plurality of spaced apertures **47** extend through the plate in an annular area **48** between the center portion **45** and the positioning structure **46**. Each aperture **47** allows the passage of a brewing liquid, such as water, but blocks the passage of coffee grounds. The collective or total area for all the apertures **47** allows the passage of the volume of liquid being supplied under pressure above the water distribution plate **24** with only a minimal pressure drop.

[0062] The positioning structure **46** has a construction that enables a capsule **20** of a given size to accommodate a range of quantities of infusible material. As most clearly shown in FIGS. **6** and **7**, the positioning structure **46** has a generally J-shape and slides over the interior surface of the side wall **30** as the water distribution plate **24** is inserted into the capsule **20** against a quantity of infusible material, such as coffee grounds. A predetermined force applied to the plate **24** compacts the infusible material to a specified density. When the force is released, the positioning structure **46**, with its downwardly extending leg **50**, reverse bend **51** and tail **52** with a preferably feathered outer surface **53**, blocks any reverse displacement. Thus, this positioning structure **46** is not dependent upon being locked at a mechanically predetermined position within the capsule base **21**. In one embodiment, the capsule base **21** can accommodate up to 18 grams (0.6 ounces) of coffee. FIGS. **6** and **7** depict different configurations of a single version of a capsule with approximately 9 grams and 18 grams of ground coffee respectively.

[0063] Now referring to FIGS. **5** through **7**, the cover **22** has a dome-like thin circular body **54** with a plurality of angularly spaced, radially extending, tapered ribs **55** extending from a central structure **56** to a peripheral flange **57**. The ribs **55** provide structural integrity. A peripheral flange **57** for the cover **22** and the flange **31** on the base **21** are joined to form an integral pressure tight assembly by ultrasonic welding or other techniques.

[0064] As described later, a water supply probe pierces the cover **22** to deliver hot liquid under pressure to the capsule **20**. The central structure **56** includes a cylindrical body **60** that depends from the body **54** and terminates with a plurality of radially facing, arched passages **61**. As shown in FIGS. **3**, **6** and **7**, a breakout **62** of the cover **22** is aligned with the cylindrical body **60** to facilitate piercing. As shown in FIGS. **6** and **7**, an integral cylindrical barrier **63** surrounds the breakout **62** to block any propagation of the effects of piercing thereby to preclude any impact on the integrity of the cover **22**.

Capsule Receiving Station **112**

[0065] Referring again to FIG. **2**, when the lid **106** of the brewing apparatus **100** is open, a user places a capsule, like

K-FEE SYSTEM GMBH, EX2012, page 22
NESPRESSO USA, INC. v. K-FEE SYSTEM GMBH
IPR2024-00254, U.S. PATENT 11,465,829

capsule **20**, into the capsule receiver station **112** located in the upper housing **105** also shown in FIGS. **8** and **9**. Referring specifically to FIGS. **8** and **9**, the capsule receiver station **112** includes a cup-shaped receiver **113** with a cylindrical side wall **114**. As shown most clearly in FIG. **8**, the cup-shaped receiver **113** forms a well **115** that closely fits the capsule side wall **30**. A floor **116** has a central opening **117** formed by an annular depending channel **120** with an inner frustoconical wall **121** that forms an inverted funnel-like opening **122**. At the top of the frustoconical wall **121**, also shown in FIG. **11**, the opening **117** has a diameter that is larger than the diameter of the spout **35**. The outer diameter at the base of the wall **121** is less than the inner diameter of the collar **40**. As shown in FIG. **9**, when a user places a capsule **20** in the capsule receiver station **112**, the upper surface of the frustoconical wall **121** initially supports the capsule **20** at the foil **42**. So the capsule **20** remains sealed resting in the capsule receiver station **112**.

[0066] Next, and referring to FIGS. **10** and **11**, the user closes the lid **106** and uses a latch **123** to fix the lid **106** in a latched position. The lid **106** includes a cover member **124** with a smooth inner surface and an annular peripheral clamping surface **125** shown in FIG. **11** and aligns with a free edge **126** of the sidewall **114** for the receiver member **113**. The lid **106** also supports a water delivery probe **127** with a central body portion **130** and a seal, a flat annular seal **131** in this embodiment. The water delivery tube attaches to a hot water delivery tube **132** from a pressurized hot water delivery system that delivers hot water under pressure to the probe **127**.

[0067] Still referring to FIGS. **9** and **10**, as the user closes and latches lid **106**, several actions occur essentially simultaneously. For example, the water delivery probe **127** penetrates the cover **22** through the breakout **62**, as shown in FIG. **3**. When the lid **106** is latched in position as shown in FIGS. **9** and **10**, the flat seal **131** seals the cover **22** to the cover member **124**.

[0068] As the cover member **124** exerts a downward force on the cover **22**, the capsule **20** displaces downward into the capsule receiving station **112**. This causes the frustoconical wall **121** to rupture the foil **42** over the sharpened spout **35** and to expose the open spout **35** in the central opening **122**. This downward motion continues until the capsule base floor **32** seats on the floor **116**. The collar **40** then lies positioned in the annular channel member **120**.

[0069] As the lid **106** latches, the capsule **20** is firmly held inside the cavity defined by the receiver member **113** and the cover member **124**, with the center of its cover **22** proximate the flat annular seal **131**. There is a closed path for liquid from the delivery tube **132**, through the probe **127** and the capsule **20** to the spout **35**. Both the hot water and brewed beverage are confined to the interior of the capsule **20**. The brewed beverage does not contact any portion of the apparatus **100**.

[0070] As will now be apparent, the combination of the disclosed capsule **20**, capsule receiving station **112** and lid **106** enables a brewing apparatus, such as the brewing apparatus **100**, to achieve some of the objectives of this invention. Specifically, no brewed beverage or coffee grounds contact any part of the apparatus. Therefore, only minimal maintenance including light cleaning is required between uses. The ability to merely add water, place the capsule, clamp a lid and turn on a switch facilitates ease of use.

The Pressurized Hot Liquid Delivery System

[0071] As will be apparent, any number of a variety of known combinations of boilers and pumps could be used to supply pressurized hot water to the water delivery probe **127** through the delivery tube **132** in FIG. **11**. However, in accordance with this invention, a pressurized hot liquid delivery system provides liquid at an acceptable brewing temperature without the need for a mechanical pump. FIGS. **8** and **10** and particularly FIGS. **12** and **13** depict a pressurized hot water delivery system **140** that includes a first, or inner, tank volume **141** and a second, or outer, tank volume **142**. A tank inlet **143** directs cold tap water, or the like, at an inlet temperature into the system **140**. As one function, a port network **144** allows the cold tap water to pass between the first and second tank volumes **141** and **142** to maintain the same water level in each tank volume.

[0072] A heater **145**, located at the bottom of the first tank volume **141**, boils water in the first tank volume **141**. When the inlet **143** is sealed this produces steam under pressure. During this time water in the second tank volume **142** remains substantially at the input temperature. The first and second tank volumes **141** and **142** open to a common chamber **147** that provides hydraulic communication above the water level so the pressure above the water level acts equally on the surfaces of the water in both the tank volumes **141** and **142**.

[0073] When the inlet **143** is sealed, the pressure rises as the water reaches its boiling point and the flow through the capsule creates a back pressure. It was found that the combination of a delivery rate of about 400 milliliter of water per minute and of a typical capsule filled with about 14 grams of finely ground coffee (400-500 mesh) creates a hydraulic resistance equal to about 1 bar over atmospheric pressure. At this pressure the boiling point of water is about 120° C. The water in the second tank volume is at the original input temperature, typically about 20° C. The relative volumes of the tank volumes **141** and **142** are selected so that when water from the tank volumes **141** and **142** mixes, it produces water in a water mixer **146** at an acceptable brewing temperature in the range 90° to 96° C. Stated differently, the ratio of the water in the first and second tank volumes **141** and **142** corresponds to the ratio of the temperatures of the water in the first tank volume **141** and in the second tank volume **142**.

[0074] Specifically, the relationship between the temperatures of the water in the tank volumes **141** and **142** and the temperature of the delivered water temperature is:

$$(PT_1)+[(1-P)T_2]=100T_3$$

where T_1 and T_2 are the temperatures of the water in the tank volumes **141** and **142**, respectively, where T_3 is the desired water delivery, or acceptable brewing, temperature and where P represents the percentage of the water to be contained in the tank volume **141**. Assume, for example, that T_1 and T_2 have values of 120° C. and 20° C., respectively and that the desired water delivery temperature T_3 is 92° C. This result is that P=72 percent. That is, the tank volumes **141** and **142** should be sized so that 72% of any cold water in the tank volumes is heated in the first tank volume **141** while the remaining 28% remains essentially unheated in the second tank volume **142**. As the pressure on water surface in the two tank volumes is equal, the pressure causes the water to discharge through the port network **144** to combine in the water mixer **146** in a corresponding ratio. From the water mixer **146**, the pressurized hot water at the acceptable brewing temperature transfers through the delivery tube **132** to the water delivery probe **127** as shown in FIG. **10**.

[0075] As known, the temperature of tap water can vary. Further some heat will transfer to the water in the tank volume

142 during boiling. However, these variations produce only a minimal effect on the temperature of delivered water. For example, in the foregoing example, a shift of 10° C. in the water temperature in the tank volume 142 from the nominal temperature only shifts the temperature of the mixed water by 2.8° C.

[0076] Referring particularly to FIGS. 12 through 15, the delivery system 140 includes an outer tank 150 and an inner tank 151 that is spaced from the outer tank 150. As shown in FIGS. 12 through 14, the inner tank 151 overlies the heater 145 that attaches to a bottom plate 152 to form an integral assembly. Now referring to FIGS. 12 and 13, the inner tank 151 includes a cylindrical wall portion 153 that extends from a bottom flange 154. A semi-cylindrical extension 155 extends above the cylindrical wall portion 153 and forms an open top 156. The water mixer 146 is formed integrally with the cylindrical wall portion 153 by walls 157 that form a channel 160 from ports 161 at the bottom of the tanks 150 and 151 to an exit port in the form of a nipple 162 that extends to the exterior of the inner tank 151.

[0077] As most clearly shown in FIG. 15, the port network 144 comprises three ports at the base of the water mixer 146 that establish flow paths with the first and second tank volumes 141 and 142 and the water mixer 146. In the port network 144, a first port 161A provides a passage between the water mixer 146 and the inner tank volume 141. Ports 161B and 161C provide passages to the outer tank volume 142 on opposite sides of the water mixer 146 and lie in the second volume 142 between the tanks 150 and 151. The cross-section areas of the individual ports are not critical because the pressure drop through them is small in comparison with the hydraulic resistance of the capsule. In a preferred embodiment, the ratio of the cross sectional area of the port 161A to the total areas of the ports 161B and 161C is the same as the ratio of the volumes 141 to 142 described above so the velocities of liquid through the ports 161A, 161B and 161C are substantially equal.

[0078] Referring now to FIG. 14, the heater 145 is electrically powered and includes a resistor heating element 163 under a laminated domed housing 164 comprising an inner aluminum shell 165 and an outer stainless steel cover 166. Aluminum facilitates the even transfer of heat from the heating element 163. Stainless steel minimizes the buildup of scale and other debris on the surface but, due to the thinness of the cover 166, provides minimum barrier to heat transfer. Consequently, there is an efficient transfer of heat from the heating element 163 to water in the inner tank volume 141. The stainless steel layer 166 extends downward beyond the aluminum shell 165 to form a skirt 167 that, with a seal 170, seals the bottom flange 154 of the cylindrical portion 153 to the extension of the skirt 167.

[0079] Now referring to FIGS. 12 and 14, the outer tank 150 includes a cylindrical body portion 171 with a bottom flange 172. As shown more clearly in FIG. 14, portions 170A and 170B of the seal wrap around the flange 172. The portion 170B lies under the flange 172. A vertical transition 170C connects the portion 170B to a horizontal end portion 170D that closes the bottom of the tank volumes 141 and 142, the port network 144 and the water mixer 146, to prevent hot water from volume 141 from mixing prematurely with cold water in volume 142.

[0080] Portions 167A through 167D of the skirt 167 overlie the seal 170. The portions 167A and 167B can be crimped to affix the seal portions 170A and 170B to the flange 172. Thus, the seal 170 and skirt 167 seal the tank volumes 141 and 142 along with the channel 160 in the water mixer 146. Another skirt portion 167E offsets the seal 170 from the heating element 163 and aluminum shell 165. As the cross-sectional area of the skirt portion 167E is thin and the length is relatively long, portion 167E minimizes any heat transfer to the seal 170 and the tanks 150 and 151 thereby thermally isolating the hot portions of heating element 145 from other structures, so they remain cool during normal operations. Thus, the pressurized hot water delivery system 140 is a sealed subassembly to which water can be added through the inlet 143.

[0081] Now referring to FIGS. 12 and 13, the outer tank 150 also includes a closed top 174 and may include a vent 175, described later. The closed top 174 also includes a canted cup-shaped receiver 176 with a tapered side wall 177 and an opening 178 therethrough as part of the sealable inlet 143. The receiver 176 aligns with a corresponding sealing structure 180 as shown in FIGS. 8, 10 and 16. As more clearly shown in FIGS. 8 and 16, the sealing structure 180 extends from a support 181 extending from the lid 106 and carrying a cup-shaped member 182 with an inwardly tapered wall. When the lid 106 closes, as shown in FIG. 16, along a path 183, shown in FIG. 8, the tapered walls 177 and 182 interface to seal the inlet 143. As pressure builds inside the tank volumes 141 and 142 and the common chamber 147, it reinforces the sealing pressure exerted by the wall 182 against the wall 177.

[0082] In this embodiment the sealing structure 180 is also canted with respect to the general plane of the lid 106. The degrees of cant in each of the sealing members 180 and the inlet 143 are selected so that as the lid 106 closes and the sealing member 180 travels along the path 183 to mate properly with the receiver 176.

[0083] As particularly shown in FIGS. 12 and 13, the semi-cylindrical sections 155 and 173 are sized to interengage and provide proper alignment between the outer tank 150 and inner tank 151 with the proper spacing between the cylindrical walls 153 and 171. This alignment also assures that the nipple 162 aligns with another nipple 184 extending through a closed top surface 185 of the outer tank 150. As particularly shown in FIG. 12, an O-ring seal 186 positioned on top of the nipple 162 provides an integral seal so the nipple 184 constitutes an extension of the water mixer 146 and connects to the delivery tube 132 as shown in FIG. 8. Still referring to FIGS. 12 and 13, a wing 187 extends radially from the outer tank 150 diametrically opposite the nipple 184. This wing 187 provides proper support for the upper housing 105 within the vertical housing 104.

[0084] The vent 175 in FIG. 13 is most clearly shown in FIG. 16. It includes a base 190 extending from the top portion 174 of the outer tank 150. The base 190 forms a passage 191 with a plurality of axially extending ribs 192 angularly spaced about the interior of the passage 190. A spherical operator 193 normally rests on the top of the ribs 192 in an intermediate chamber 194 formed by the base 190 and a chimney 195 with a passage 196. At the entrance of the passage 196 the chimney 195 has an internal spherical valve seat 197.

[0085] When the spherical operator 193 is in its lower position shown in FIG. 16, gas can escape through the passage 190 and 196 by way of channels between the ribs 192. Such discharge would occur for example, while a user adds water through the open inlet 143. It would also occur during the heat up period, during which air above the water expands, and during the initial portion of a boiling cycle as the water in the

K-FEE SYSTEM GMBH, EX2012, page 24
NESPRESSO USA, INC. v. K-FEE SYSTEM GMBH
IPR2024-00254, U.S. PATENT 11,465,829

inner tank volume **141** begins to generate steam vapor. As the top of the chimney **195** exits in the receiving station **107**, any steam condensation collects in the receiving station **107**. As steam is generated at a higher rate, the steam velocity through the vent **175** increases. At some velocity, the spherical operator **193** rises against the seat **197** to close the vent **175**. When this occurs, the steam pressure in the common chamber **147** continues to block any flow of steam through the vent **175**. As the steam pressure begins to build further, water in the tank volumes **141** and **142** discharges through the port network **144** to mix in the channel **160** and to be transported to the delivery probe **127** in FIGS. **10** and **11**, as previously described.

Control System

[0086] FIG. **17** depicts a simple and inexpensive control circuit **200** for incorporation in this brewing apparatus. The power cord **110**, shown in FIG. **1** for example, connects the control circuit **200** to a power source. The switch **111** is in a series circuit with a fuse **201**, the resistive heating element **163** in the heater **145**, a first normally closed thermostatic switch **203** in parallel with a diode **204** and a second normally closed thermostatic switch **205** in parallel with a high resistance auxiliary heater **206**. Both thermostatic switches mount to a plate **207** shown in FIG. **12**. A lid closure switch **208** conducts when the lid **106** is closed and latched. The exact placements and connections of the elements of this control circuit **200** are not shown but will be obvious to those of ordinary skill in the art.

[0087] Each thermostatic switch shifts to an open circuit state when the temperature of the post **207** reaches a particular set point. The set point for the thermostatic switch **203** corresponds to a water temperature of about 100° C. Thus, when the heater **145** in FIG. **12** raises the water temperature in the tank volume **141** to 100° C., the switch **203** opens and cuts the power in half due to the introduction of the diode as a half-wave rectifier in series with the resistive heating element **163**. This feature allows rapid heating of the water to its boiling point at atmospheric pressure and then reduced heat generation to slow down the rate of steam generation to achieve a desired delivery rate of hot water to the brewing station.

[0088] As the water discharges from the tank volume **141**, the water level eventually falls below the top of the heater **145** in FIG. **10**. The post temperature then rises to a second set point that is higher than the first set point, for example, a post temperature of 130° C. The thermostatic switch **205** then terminates the brewing cycle by essentially deenergizing the resistive heating element **163**. When the thermostatic switch **205** opens, the auxiliary heater **204** energizes to maintain the thermostatic switch **205** at a temperature above its closing point and to maintain its non-conducting state. This prevents cycling on and off while the switch **111** is still in its closed position. When, however, the user turns off the power switch **111** or opens lid closure switch **208** by lifting the lid **106**, the auxiliary heater **204** is deenergized so the thermostatic switch **205** cools and closes to be ready for the next brew cycle.

Operation

[0089] Now referring to the operation of a brewing apparatus **100** using a capsule **20** and initially referring to FIG. **2**, a user places a capsule **20** into the capsule receiving station **112** and pours cold tap water into the water inlet station **107** as previously described. During this process air escapes through the vent **175**. Water fills the tank volumes **141** and **142** of FIG. **8** and the mixing tube **146** to a common level because the volumes **141** and **142** and the mixing tube **146** are open to the atmosphere through various paths. In FIG. **8** a dashed line **210** indicates a typical water level in the tank assembly.

[0090] Next the user closes and latches the lid **106** in the position shown in FIG. **10**. As previously described, the water delivery probe **127** now penetrates the top cover of the capsule **20**. The inner wall **121** has ruptured the seal **42** and exposed the spout **35**. The switch **208** of FIG. **17** has closed. The cover member **124** along with the flat seal **131** has formed a sealed structure so there is a closed delivery water path from the tank volumes **141** and **142** to the interior of the capsule **20**.

[0091] Next the user activates the switch **111** whereupon the heater **145** is fully energized to promote rapid heating. During this process the dome shape of the heater **145** produces thermal currents that deliver the hot water throughout the tank volume **141** to promote a uniform temperature in the water. The vent **175** relieves any pressure increase because the spherical operator **193** is at its lower position.

[0092] About the time the water in the tank volume **141** begins to boil, the thermostatic switch **203** opens and reduces the power to the heater **145** by 50%. Eventually the steam escaping through the vent **175** moves the spherical operator **194** into the spherical seat **197** thereby fully sealing pressurized hot water delivery system **140**.

[0093] The vapor pressure builds up in the common chamber **147** to about 1 barg, with a corresponding boiling point of about 120° C. Steam pressure on water in the tank volumes **141** and **142** of about 1 barg overcomes the hydraulic resistance of the coffee grounds in the capsule **20** and produces a predetermined flow rate of about 400 milliliter per minute. Consequently the water emerges from the ports **161**A, **161**B and **161**C to pass through the water mixer **146**, the delivery tube **132** and probe **127** to infuse the coffee grounds in the capsule **20**. Brewed beverage dispenses from the spout **35** into the beverage receptacle.

[0094] When nearly all the water has been discharged from the tank volume **141** and has exposed the heater **145**, switch **205** opens and effectively terminates any heating by the heater **145**. This ends the brewing cycle, so that the user can remove the receptacle **103** with the brewed beverage

Brewing System for Two Servings

[0095] FIGS. **18** and **19** present a variation on the brewing apparatus **100** shown in FIGS. **1** and **2** that can fill one or two receptacles with a beverage by infusing a material with pressurized hot water from a single source, such as the pressurized hot water delivery system **140** of FIGS. **12** and **13**. In this particular embodiment the apparatus **250** includes a base housing **251** with left and right platform stations **252**L and **252**R, respectively. As shown, the platform stations are adapted to carry beverage receptacles **253**L and **253**R, respectively. An upstanding housing **254** houses a pressurized hot water delivery system that includes a delivery tube like the delivery tube **132** in FIGS. **8** and **10**. An upper housing **255** cantilevers over the platform stations **252**L and **252**R and includes a lid **256** rotatable between the closed position shown in FIGS. **18** and **19** and an open position about a hinge **257**. A latch **258** locks the lid **256** in a closed position.

[0096] In this particular embodiment a selector knob **260** mounts on the lid **256** and controls a three position valve **261** that has a right position as shown in FIG. **18**, a center position and a left position. The knob **260** and valve **261** control the

K-FEE SYSTEM GMBH, EX2012, page 25
NESPRESSO USA, INC. v. K-FEE SYSTEM GMBH
IPR2024-00254, U.S. PATENT 11,465,829

flow of pressurized hot water from the delivery tube to one of two capsule receiving stations **262**L and **262**R each being shown as containing a capsule **20**L and **20**R respectively in FIG. **19**. Each of the capsule receiving stations **262**L and **262**R has a construction that is similar to the capsule receiving station **112** shown in FIGS. **8** and **9**. Covers **263**L and **263**R mounted in the lid **256** overlie the capsule receiving stations **262**L and **262**R, respectively. Each of the covers **263**L and **263**R carries a water delivery probe **264**L and **264**R, respectively, that connects to two valve outlets.

[0097] The position of the knob **260** controls whether pressurized hot water is directed to one of the capsule receiving stations **262**L or **262**R or both. That is, when the control knob **260** is oriented as shown in FIG. **18**, the valve **261** diverts all hot water to the water delivery probe **264**R so beverage only discharges into the receptacle **253**R. When the control knob **260** is at the other end position, the valve **261** diverts all hot water to the water delivery probe **264**L so beverage only discharges into the receptacle **253**L. When the knob **260** is in its center position, the valve **261** sends water to both the water delivery probes **264**L and **264**R so beverage discharges simultaneously into both the receptacles **263**L and **263**R respectively.

[0098] As will be apparent, this apparatus shown in FIGS. **18** and **19** can be readily adapted for filling either one cup or two cups simultaneously. Further, the brewed beverage from each capsule can be different as for example caffeinated coffee from capsule **20**L and decaffeinated coffee from the capsule **20**R. In each case during operation beverage will emerge from the spouts **35**L and **35**R of the capsules **20**L and **20**R without contacting the apparatus **250**.

[0099] As can now be appreciated, brewing apparatus constructed in accordance with the various aspects of this invention satisfies all the objectives of this invention. Specifically, the brewing apparatus meets all the market requirements for brewing apparatus that provides individual servings. The brewing apparatus infuses a material with hot liquid under pressure at a brewing temperature within an acceptable brewing temperature range. Brewing is accomplished by a hot liquid under pressure without the need for any mechanical pump. Controls for operating the brewing apparatus are very simple. Specific embodiments of this invention can be compact, reliable to operate and inexpensive to manufacture. Further, the implementations of this invention provide a hot beverage brewing apparatus that minimizes the need for regular cleaning and other maintenance.

[0100] This invention has been disclosed in terms of certain embodiments and variations on those embodiments. It will be apparent that many modifications can be made to the disclosed apparatus without departing from the invention. For example, FIGS. **1** and **2** disclose apparatus with a specific configuration. The various components of this invention could be placed in a housing that has an entirely different configuration. This specific implementation of the pressurized hot water delivery system shown in FIGS. **12** and **13** can be modified. For example, it is possible to provide the same operation using separated tanks provided a method of maintaining equal pressure on the liquid in both tanks is provided. A specific heater assembly **145** that is particularly advantageous in such apparatus is shown. Other heating apparatus might be substituted. FIG. **17** discloses a simple control system. In other implementations a similar or more complicated control system might be used to incorporate other features. The pressurized hot water delivery system includes a vent. Different vent structures might be substituted. The system might be constructed without any vent structure. Pressure relief valves might also be used to control or limit steam pressure during brewing. Further, modifications that will adapt the apparatus, particularly the hot water delivery system, to dispense other liquids will be apparent to those of ordinary skill in the art.

[0101] Brewing apparatus might also be constructed using some, but not all of the features described above with the attainment of only some of the objectives and advantages of this invention. Changes may be made to the specifically disclosed capsule receiving station in order to accommodate different capsule constructions. Any of such variations or modifications may be made while still obtaining some or all of the objectives of this invention. Therefore, it is the intent of the appended claims to cover all such variations and modifications as come within the true spirit and scope of this invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A system that delivers pressurized hot liquid at an acceptable temperature to a utilization device comprising:

A) first and second tanks that define first and second tank volumes in hydraulic communication above the liquid level in said tank volumes,

B) a sealable inlet through which liquid is admitted to said first and second tanks,

C) a liquid mixer that connects to the utilization device,

D) a port network interconnecting said first and second tanks and said liquid mixer,

E) a heater in said first tank to boil the liquid therein when said liquid inlet is sealed whereby steam is generated under pressure above the liquid level in said tank volumes thereby to discharge liquid from said first and second tanks through said liquid mixer at the acceptable temperature and under pressure.

2. A pressurized hot liquid delivery system as recited in claim **1** wherein said first tank defines a first tank volume and is substantially concentric with and spaced from said second tank thereby to define a second tank volume between said first and second tanks.

3. A pressurized hot liquid delivery system as recited in claim **2** wherein said port network include ports to said first and second tank volumes and to said liquid mixer.

4. A pressurized hot liquid delivery system as recited in claim **2** wherein said heater is electrically powered and includes:

i) a sensor responsive to the liquid temperature in said first tank volume, and

ii) a controller responsive to said sensor that adjusts the power to said heater thereby to control the rate at which said heater produces liquid vapor and the delivery rate of the liquid to the utilization device.

5. A pressurized hot liquid delivery system as recited in claim **1** wherein the ratio of the liquid in said first and second tank volumes corresponds to the ratio of the temperatures of the boiling liquid in said first tank volume and of the liquid in said second tank volume required to produce the pressurized hot liquid at an acceptable temperature.

6. A pressurized hot liquid delivery system as recited in claim **5** wherein the ratio of the quantity of liquid in said first and second tank volumes is:

$$(T_1P)+(T_2(1-P)=100T_3$$

K-FEE SYSTEM GMBH, EX2012, page 26
NESPRESSO USA, INC. v. K-FEE SYSTEM GMBH
IPR2024-00254, U.S. PATENT 11,465,829

where T_1 and T_2 are the temperatures of the liquid in said first and second tank volumes, respectively, where T_3 is acceptable temperature and where P is the percentage of the liquid to be contained in said first tank volume.

7. A pressurized hot liquid delivery system as recited in claim **5** wherein said ports from said first and second tanks have cross sectional areas that are in the same ratio as the ratio of the stored volumes of liquid.

8. A pressurized hot liquid delivery system as recited in claim **1** wherein said tank means additionally includes a vent from said tank volumes above the liquid level therein, said vent selectively controlling the pressure in said first and second tanks.

9. A pressurized hot liquid delivery system as recited in claim **8** wherein said vent includes:

a) a passage extending from said tank volumes to the exterior of said first and second tanks, and

b) a valve operator that blocks said passage after the liquid in said first tank volume boils.

10. A pressurized hot liquid delivery system as recited in claim **1** wherein the utilization device comprises a beverage brewing apparatus that includes infusible material in a brewing chamber, wherein said brewing apparatus includes a lid that moves between open and close positions, said lid, in the open position, exposing said liquid inlet to allow liquid to be poured therethrough and wherein said lid includes a sealing member that seals said liquid inlet when said lid is in the closed position.

11. Apparatus for brewing a hot beverage by infusing a material with hot water under pressure at an acceptable brewing temperature, said apparatus including:

A) tank means for forming first and second tank volumes, said tank means including sealable inlet means for directing water at an input temperature into said tank means and means for providing hydraulic communication between said tank volumes above the water therein,

B) mixing means for mixing water,

C) port network means for enabling flow among said first and second tank volumes and said mixing means,

D) heater means for boiling the water in said first tank volume when said inlet means is sealed to produce steam under a pressure while the water in said second tank volume remains substantially at the input temperature, said pressure discharging water from each of said tank volumes through said port network means and into said mixing means whereby the water in said mixing means produces water at the acceptable brewing temperature, and

E) brewing chamber means for brewing the beverage with the pressurized hot water from said mixing means by directing the pressurized hot water through the material contained therein to be dispensed at an outlet thereof as the brewed beverage.

12. Hot beverage brewing apparatus as recited in claim **11** wherein said hydraulic communication means interconnects said first and second tank volumes above the water contained therein whereby the pressure on the water in said first and second tank volumes is equal.

13. Hot beverage brewing apparatus as recited in claim **12** wherein said tank means includes means for locating said first tank volume within said second tank volume.

14. Hot beverage brewing apparatus as recited in claim **13** wherein said port network means includes first and second passage means for establishing flow paths with said first and second tank volumes and said mixing means.

15. Hot beverage brewing apparatus as recited in claim **14** wherein said heater means is electrically powered and includes:

i) sensing means for indicating the temperature in said first tank volume, and

ii) control means for adjusting the power to said heater means thereby to control the rate at which said heater means produces liquid vapor and the delivery rate of the water into the infusible material.

16. Hot beverage brewing apparatus as recited in claim **11** wherein the ratio of the water in said first and second tank volumes corresponds to the ratio of the temperatures of the boiling water in said first tank volume and the water in the second water volume required to produce the pressurized hot water at the acceptable brewing temperature.

17. Hot beverage brewing apparatus as recited in claim **16** wherein the ratio of the quantity of water in said first and second tank volumes is:

$$(T_1P)+(T_2(1-P)=100T_3$$

where T_1 and T_2 are the temperatures of the water in said first and second tank volumes, respectively, where T_3 is acceptable temperature and where P is the percentage of the water to be contained in said first tank volume.

18. Hot beverage brewing apparatus as recited in claim **16** wherein said port network means includes first and second passage means for establishing flow paths with said first and second tank volumes and said mixing means wherein the cross-sectional areas of said passage means are in the same ratio as the ratio of the stored volumes of water.

19. Hot beverage brewing apparatus as recited in claim **11** wherein said apparatus includes housing means for containing said tank means, said heater means, said mixing means and said brewing chamber means and lid means attached to said housing means for moving between open and closed positions, said lid means and said inlet means including complementary sealing means for sealing said inlet means when said lid means is in the closed position and said lid means, when open, exposing said inlet means to receive water and direct the water to said tank volumes.

20. Hot beverage brewing apparatus as recited in claim **19** wherein said tank means additionally includes means for venting said tank volumes and means for blocking said venting means after the water in said first tank volume begins to boil.

21. Hot beverage brewing apparatus as recited in claim **11** wherein tank means includes vent means for selectively controlling the relative pressure in said tank means during brewing.

22. Hot beverage brewing apparatus as recited in claim **21** wherein said vent means includes:

a) passage means for venting said tank volumes, and

b) means for blocking said passage means after the water in said first tank volume boils.

23. Hot beverage brewing apparatus as recited in claim **11** including housing means for said brewing chamber means, said apparatus including means for distributing the pressurized hot water through the infusible material and said mixing means includes means for conveying the pressurized hot water to said distributing means from said mixing means.

24. Hot beverage brewing apparatus as recited in claim **23** including lid means attached to said housing means for mov-

K-FEE SYSTEM GMBH, EX2012, page 27
NESPRESSO USA, INC. v. K-FEE SYSTEM GMBH
IPR2024-00254, U.S. PATENT 11,465,829

ing to opened and closed positions, said lid means supporting said means for conveying the pressurized hot water from said mixing means to said distributing means

25. Hot beverage apparatus as recited in claim **23** wherein the infusible material is contained in a sealed capsule and said means for conveying the pressurized hot water terminates in a water probe means for penetrating the capsule as said lid means closes thereby to distribute the pressurized hot water through the infusible material.

26. Hot beverage brewing apparatus as recited in claim **25** wherein the capsule includes a collar and seal forming a sealed structure about an output spout that delivers brewed beverage from the capsule, said brewing chamber having means for receiving the capsule and means for causing the capsule seal to rupture thereby to expose the output spout as said lid means closes.

27. Hot beverage brewing apparatus as recited in claim **11** wherein said heater means is electrically powered and includes:

i) sensing means for indicating the temperature of the water in said first tank volume, and

ii) control means responsive to said sensing means for reducing the power to said heater means thereby to reduce the rate at which said heater means produces steam and the delivery rate of the water into the infusible material.

28. Apparatus for dispensing a hot beverage into a beverage receptacle after infusing a material in a capsule having a cover and a sealed outlet, said apparatus comprising:

A) housing means for defining a plurality of station means for performing different functions,

B) lid means hinged from said housing means for moving between opened and closed positions,

C) platform station means for supporting the beverage receptacle,

D) pressurized hot water dispensing station means for producing water at an appropriate brewing temperature, and

E) capsule receiving station means for holding the capsule during brewing, said capsule receiving station means including:

i) well means for circumscribing the capsule,

ii) first support means for engaging the sealed outlet after the capsule is inserted into said well means when said lid means is open and for rupturing the sealed outlet when said lid means closes,

iii) second support means for supporting the capsule in said well means when said lid means is closed, and

iv) infusing means attached to said lid means and connected to said dispensing station means for infusing the material contained the capsule whereby said apparatus dispenses the hot beverage into a receptacle on said platform station means.

29. Hot beverage dispensing apparatus as recited in claim **28** wherein the capsule sealed outlet includes an axially extending spout, a support surrounding the spout and a seal attached to said support, said first support means including means for forming a central passage through which brewed beverage passes aligned with the spout in said capsule receiving station means.

30. Hot beverage dispensing apparatus as recited in claim **28** wherein said lid means includes cover means for overlying said well means in a sealed relationship therewith when said lid means closes.

31. Hot beverage dispensing apparatus as recited in claim **30** wherein said infusing means attaches to said cover means.

32. Hot beverage dispensing apparatus as recited in claim **28** wherein said infusing means includes water delivery probe means for penetrating the capsule when said lid means closes and tubing means for connecting said water delivery probe means to said pressurized hot water dispensing station means.

33. Hot beverage dispensing apparatus as recited in claim **28** wherein said pressurized hot water dispensing station includes:

i) tank means for forming first and second tank volumes, said tank means including a sealable inlet means for directing water at an input temperature into said tank means,

ii) mixing means for mixing water,

iii) port network means for enabling flow among said first and second tank volumes and said mixing means,

iv) heater means for boiling the water in said first tank volume when said inlet means is sealed to produce steam under a pressure while the water in said second tank volume remains substantially at the input temperature, said pressure discharging water from each of said tank volumes through said port network means and into said mixing means whereby the water in said mixing means produces water at the acceptable brewing temperature, and

v) means for transporting the water from said mixing means to said infusing means.

34. Hot beverage brewing apparatus as recited in claim **33** including means for interconnecting said first and second tank volumes above water contained therein whereby the pressure on the water in said first and second tank volumes is substantially equal.

35. Hot beverage brewing apparatus as recited in claim **33** wherein said tank means includes means for locating said first tank volume within said second tank volume.

36. Hot beverage brewing apparatus as recited in claim **35** wherein said outlet means includes first and second passage means for establishing flow paths with said first and second tank volumes and said mixing means.

37. Hot beverage brewing apparatus as recited in claim **33** wherein the ratio of the water in said first and second tank volumes corresponds to the temperature ratio between the boiling water in said first tank volume and the water in the second water volume required to produce the pressurized hot water at the acceptable brewing temperature.

38. Hot beverage brewing apparatus as recited in claim **37** wherein the ratio of the quantity of water in said first and second tank volumes is:

$$(T_1P)+(T_2(1-P)=100T_3$$

where T_1 and T_2 are the temperatures of the water in said first and second tank volumes, respectively, where T_3 is acceptable temperature and where P is the percentage of the water to be contained in said first tank volume.

39. Hot beverage brewing apparatus as recited in claim **37** wherein said outlet means includes first and second passage means for establishing flow paths with said first and second tank volumes and said mixing means wherein the cross-sectional passage sizes are in the same ratio as the ratio of the stored volumes of water.

40. Hot beverage brewing apparatus as recited in claim **33** wherein said lid means and said inlet means include complementary sealing means for sealing said inlet means when said

K-FEE SYSTEM GMBH, EX2012, page 28
NESPRESSO USA, INC. v. K-FEE SYSTEM GMBH
IPR2024-00254, U.S. PATENT 11,465,829

lid means is in the closed position and said lid means, when open, exposing said inlet means to receive water and direct the water to said tank volumes.

41. Hot beverage brewing apparatus as recited in claim **33** wherein said tank means additionally includes means for venting said tank volumes and means for blocking said venting means after the water in said first tank volume begins to boil.

42. Hot beverage brewing apparatus as recited in claim **33** wherein tank means includes vent means for selectively controlling the relative pressure in said tank means during brewing.

43. Hot beverage brewing apparatus as recited in claim **41** wherein said vent means includes:

a) means for venting said tank volumes, and

b) means for blocking said venting means after the water in said first tank volume boils.

44. Hot beverage brewing apparatus as recited in claim **33** wherein said heater means is electrically powered and includes:

a) sensing means for indicating the water temperature of the water in said first tank volume, and

b) control means for adjusting the power to said heater means thereby to reduce the rate at which said heater means produces steam and the delivery rate of the water into the infusible material.

45. Hot beverage brewing apparatus as recited in claim **28** including second platform station means, second capsule receiving station means and second infusing means and valve means interconnecting said pressurized hot water dispensing station means with each of said infusing means for selectively directing pressurized hot water to one or both of said infusing means.

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