



- (51) **International Patent Classification:**
A47J 27/21 (2006.01)

(21) **International Application Number:**
PCT/GB2010/050135

(22) **International Filing Date:**
28 January 2010 (28.01.2010)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**
0902726.9 18 February 2009 (18.02.2009) GB
0911296.2 30 June 2009 (30.06.2009) GB

(71) **Applicant** (*for all designated States except US*): **OTTER CONTROLS LIMITED** [GB/GB]; Tongue Lane Industrial Estate, Dew Pond Lane, Fairfield, Buxton Derbyshire SK17 7LF (GB).

(72) **Inventors; and**

(75) **Inventors/Applicants** (*for US only*): **COLLINSON, Michael** [GB/GB]; 10 Hillcrest Road, Offerton, Stockport Cheshire SK2 5QL (GB). **WRIGHT, Peter, Hallam** [GB/GB]; 167 Endon Road, Norton Green, Stoke-on-Trent Staffordshire ST6 8NW (GB). **HADFIELD, Robert, Henry** [GB/GB]; 29 Leigh Avenue, Marple, Cheshire SK6 6DF (GB).

(74) **Agent: CROSS, James;** RGC Jenkins & Co., 26 Caxton Street, London Greater London SW1H 0RJ (GB).

(81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

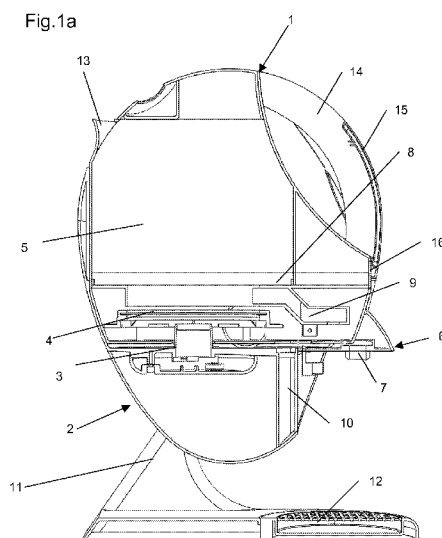
(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

Published:

— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: LIQUID HEATING APPLIANCES



(57) Abstract: A liquid heating appliance comprises one or more of: a cordless heating vessel connectable to a base having an integrated liquid dispenser; a kettle with an integrated dispenser that dispenses under gravity; a heating chamber that dispenses under steam pressure or through a spout; an integrated cordless kettle and flow-through heater; and an expandable reservoir.

Liquid Heating Appliances

Field of the Invention

[0001] The present invention relates to liquid heating appliances, and particularly but not exclusively to water heaters and dispensers.

5 Background of the Invention

[0002] In known electrically heated kettles, the kettle body includes a water reservoir and an electric heating element for heating water in the reservoir. Heated water is dispensed from the reservoir by lifting the kettle body and pouring water out of the reservoir through a spout.

[0003] Drip coffee makers rely on a separate reservoir to supply water to an in line heater.

10 The water supply line incorporates a non-return valve so that when the water boils the pressure discharges the heated water into an adjacent funnel which includes coffee grounds. The unit continues to cycle until the all the water has been heated. The brewed coffee then filters into a carafe. Alternatively the water can be dispensed immediately into the carafe. The in line heater has a dual function, also acting as a keep warm heater for the carafe.

15 [0004] GB-A-2174293 describes a tea/coffee making unit comprises a lower base section providing a pressure chamber containing an electrical heating element for boiling water in the chamber which has a filling opening sealed by a removable filler cap. An upper tea- or coffee-making jug section rests on top of the base section and provides a brewing chamber in which the tea or coffee is made. The jug has a detachable lid and a water transfer tube leads
20 from a lower level in the chamber to discharge into the jug when boiling water is displaced along the tube from the chamber by steam pressure. The base section has an integral side handle by which the unit can be lifted and carried as a whole, whereas the jug can be lifted by its own handle for pouring out the hot water or brewed tea or coffee. The unit switches off on dry boil and the on-off mechanism interfaces with an Otter Z3 dry boil control which
25 effectively acts as an on off switch; this switch mechanism includes an interface between the water collector and the switch which ensures the water collector is in place before the appliance can be switched on.

[0005] EP 0988820 discloses a unit incorporating a pressurised heating chamber that evacuates the heated water into an adjacent vessel. The supply tube between the reservoir
30 and the heating chamber incorporates a non-return valve and the heating chamber is automatically refilled following the discharge of the heated water.

[0006] In a known on-demand hot water dispenser, such as the Tefal 'Quick & Hot' water heater, cold water is stored in a reservoir and is heated on demand as the water is dispensed,

by means of a pumped flow-through heater. This provides a convenient method of dispensing small quantities of hot water quickly, but does not replace all of the applications of a kettle, such as heating up a large quantity of hot water for pouring into a pan.

5 [0007] Another type of hot water heater is an 'airpot', which is commonly used in countries where water needs to be sterilised by boiling for an extended time, and where the water needs to be kept close to boiling after sterilisation, for example for making tea. Airpots typically include a pump for dispensing hot water from the reservoir.

10 [0008] WO 2008/139173 discloses a liquid heating vessel that incorporates a liquid storage reservoir in which a user actuable dispenser is employed to dispense predetermined volumes of liquid into the heating chamber in response to a user actuation. This application also discloses the use of a pump as the dispensing means.

[0009] Patent publication JP-A-57153152 discloses an inductively heated airpot having a reservoir from which hot water is pumped, and an inductive heating base on which the reservoir is disposed. The reservoir has a handle and a 'pouring port' with a lid.

15 [0010] GB-A-2438244 discloses a thermal control that provides the user with two temperature options - a boiling setting, where the liquid is heated to boiling point, and a sub-boiling setting, where the liquid is heated only to a predetermined temperature below boiling. This function is known in the art as 'Bitemp' (i.e. bi-temperature). With one switch actuator, the user can choose either temperature setting and then manually switch off ahead of the
20 temperature being reached if required.

[0011] It would be desirable to create a single appliance that combines the functions of a kettle and a hot water dispenser. An example of such an appliance is disclosed in GB-A-2375284, which discloses a cordless kettle with a pump dispenser, for users who cannot safely lift the kettle. However, there are a number of problems with this appliance.

25 [0012] One problem is that a pump is required for dispensing; the pump may become clogged by scale deposits, and adds to the cost of the appliance. Another problem is that the appliance is not particularly suitable for quickly heating and dispensing small quantities of water at near boiling temperature; the kettle could be filled with only a small quantity of water so that this is heated quickly to boiling, but the kettle would need to be refilled
30 frequently, which is not possible for a user who cannot safely lift the kettle.

[0013] Patent publications JP-A-2001070158 and JP-A-2004275211 disclose airpots with a partition within the reservoir, allowing a small quantity of water within the compartment to heat up quickly.

[0014] The Breville Hot Cup™ hot water dispenser comprises a boiling chamber that is filled with a fixed volume of water from a reservoir; the contents of the boiling chamber are then heated to boiling and dispensed in response to a user actuation. However, this appliance is not convenient for heating larger quantities of water, so that users would also need to purchase a conventional kettle.

Statement of the Invention

[0015] According to one aspect of the present invention, there is provided a liquid heating appliance comprising a liquid heating reservoir detachably mounted on a base, wherein liquid is dispensable from the reservoir both by lifting the reservoir from the base and pouring liquid from the reservoir, and by means of a dispenser for dispensing liquid from the reservoir when mounted on the base. The dispenser may be integrated with the base or the reservoir. The dispenser may operate by gravity alone, without a pump.

[0016] According to another aspect of the invention, there is provided a liquid heating appliance comprising first and second heating chambers, a user-actuable valve for selectively interconnecting the first and second chambers, and means for heating liquid within the first heating chamber such that liquid within the second chamber is also heated when the valve is open. There may be provided a unitary steam sensor arranged to detect steam from both the first heating chamber and the second heating chamber. There may be provided an outlet connected to the first chamber, such that liquid is dispensed through said outlet by steam pressure when the valve is closed. The outlet may be closed when the valve is open. At least part of the first chamber may be arranged to one side of, or below the second chamber.

[0017] According to another aspect of the invention, there is provided a liquid heating appliance comprising a liquid reservoir arranged to supply liquid to a heating chamber by means of a valve, the heating chamber being arranged to dispense liquid under steam pressure, wherein the valve is actuable by a user, preferably to supply a variable volume of liquid into the heating chamber.

[0018] According to another aspect of the invention, there is provided a liquid heating appliance comprising a flow-through heater removably connectable to the liquid reservoir so as to recirculate heated liquid to the liquid reservoir.

[0019] According to another aspect of the invention, there is provided a liquid heating appliance comprising a liquid reservoir and a heater arranged to heat water removed from the reservoir, and a cordless liquid heating vessel having a cordless base integrated with the liquid reservoir.

[0020] According to another aspect of the invention, there is provided a liquid heating appliance comprising a liquid reservoir and a liquid heating chamber arranged to heat liquid removed from the reservoir and to dispense heated liquid through an outlet by steam pressure, wherein the floor of the liquid chamber slopes to one side relative to the horizontal.

5 There may be a dry boil detector arranged to reduce or terminate heating of the liquid when a portion of the floor above the lower side is no longer immersed. The outlet may comprise a passage having an inlet towards the lower side of the floor, such that the inlet remains submerged after heating is reduced or terminated.

[0021] According to another aspect of the invention, there is provided a liquid heating vessel
10 having a handle at one side thereof and a pivotally openable lid, wherein the axis of opening of the lid is displaced away from an end of the lid closest to the handle, and may be approximately central or disposed towards a spout.

[0022] According to another aspect of the invention, there is provided a liquid heating appliance comprising a reservoir arranged to dispense liquid into a heating chamber by
15 means of a user actuable valve, wherein the valve is arranged to empty the reservoir to a level determined by the actuation thereof.

[0023] According to another aspect of the invention there is provided a liquid heating appliance comprising a reservoir, a heating chamber, and a dispensing part interconnected by a three position valve, wherein in the first position the valve is arranged to transfer liquid
20 from the reservoir into the heating chamber, in the second position the valve is closed and in the third position the valve transfers heated liquid from the heating chamber to the dispensing part. The heating chamber may be energised when the valve is in the first position. The valve may be moved manually or automatically from the first to the second position when the required volume of liquid is in the heating chamber. The valve may be
25 moved manually or automatically from the second position to the third position when the liquid in the heating chamber has reached the desired temperature.

[0024] According to another aspect of the invention, there is provided a liquid heating appliance comprising a reservoir arranged to dispense liquid into a heating chamber, wherein the reservoir has a variable volume determined by the level of liquid contained therein. The
30 reservoir may be biased towards a minimum volume and expanded away from the bias by the liquid contained therein. The reservoir may be arranged to dispense liquid into a heating chamber, wherein the reservoir has a variable volume determined by the level of liquid contained in the heating chamber. The reservoir may include a buoyant portion arranged to float within the heating chamber.

[0025] According to another aspect of the invention there is provided a liquid heating appliance comprising a reservoir, a heating chamber and a pump arranged to pump additional liquid from the reservoir to the heating chamber after the liquid in the heating chamber has reached a predetermined temperature and prior to dispensing. The quantity of the additional liquid may be determined so that the liquid within the heating chamber remains at or around the predetermined temperature, due to residual heating by a heating element. Alternatively, the quantity of the additional liquid may be determined so as to reduce the temperature of the liquid in the heating chamber to a second predetermined temperature.

[0026] According to another aspect of the invention, there is provided an electrical liquid heating appliance comprising first and second heating loads supplied by discrete power supplies and controlled by a common control, such as a thermal sensor, a user actuatable switch or an overheat protector.

[0027] Liquid heating appliances according to the invention may comprise one or more of: a cordless heating vessel connectable to a base having an integrated liquid dispenser; a kettle with an integrated dispenser that dispenses under gravity; a heating chamber that dispenses under steam pressure or through a spout; an integrated cordless kettle and flow-through heater; and an expandable reservoir.

[0028] According to another aspect of the invention there is provided a liquid heating appliance in which a user-actuatable component, such as a switch actuator, includes an anti bacterial agent.

[0029] According to another aspect of the invention there is provided a liquid heating appliance comprising a heating chamber and a reservoir arranged to dispense liquid into the heating chamber, wherein the reservoir is arranged as a heat sink for an electronic component of the liquid heating appliance.

[0030] According to another aspect of the invention there is provided a liquid heating appliance comprising a reservoir, a heating chamber and a pump arranged to circulate the water as it is being heated. The user may choose to heat a predetermined quantity of water in the heating chamber or may heat the combined contents of the heating chamber and the reservoir. The liquid can be dispensed at any time during the heating process. The circulation of the water can be thermostatically controlled.

Brief Description of the Drawings

[0031] There now follows, by way of example only, a detailed description of preferred embodiments of the present invention, with reference to the figures identified below.

5 Figure 1a is a schematic cross-section of a liquid heating appliance in a first embodiment.

Figure 1b is a perspective view of the first embodiment, from the front and side.

Figure 1c is a front view of the first embodiment.

Figure 1d is a perspective view of the first embodiment from the front and side, with a kettle body separated from a base.

10 Figure 1e is a perspective view from above and to one side of the first embodiment, with the kettle body separated from the base.

Figure 1f shows a perspective view of the first embodiment, with legs in an extended position.

15 Figure 1g shows two perspective views of the first embodiment, with a support tray in deployed and stowed positions respectively.

Figure 2a is a schematic cross-section of a kettle body in an appliance according to a second embodiment.

Figure 2b is a detailed cross-section of a part of the kettle body of the second embodiment, with a self-closing valve in an open position.

20 Figure 2c is a perspective underside view of a partition with steam tube and user actuatable valve in the second embodiment, with the valve in a fully open position.

Figure 2d is a perspective underside view of a partition with steam tube and user actuatable valve in the second embodiment, with the valve in a fully closed position.

25 Figure 3 is a schematic cross-section of a kettle body in an appliance according to a third embodiment.

Figure 4 is a schematic diagram of a liquid heating appliance in a fourth embodiment of the invention.

Figure 5 is a schematic diagram of a liquid heating appliance in a fifth embodiment of the invention.

30 Figure 6 is a schematic diagram of a liquid heating appliance in a sixth embodiment of the invention.

Figure 7 is a schematic diagram of a liquid heating appliance in a seventh embodiment of the invention.

Figure 8 is a schematic diagram of a liquid heating appliance in an eighth embodiment of the invention.

Figure 9 is a schematic diagram of a liquid heating appliance in a ninth embodiment of the invention.

5 Figure 10 is a perspective view of a kettle including a lid suitable for use with a kettle body in at least some of the embodiments.

Figures 11a and 11b show a first embodiment of a valve, in first and second positions respectively, for dispensing liquid from an upper chamber to a lower chamber.

10 Figures 12a and 12b show a second embodiment of a valve, in assembled and disassembled configurations respectively, for dispensing liquid from an upper chamber to a lower chamber.

Figures 13a and 13b are schematic diagrams showing respectively a typical kettle with a water filter, and a kettle with a variable volume reservoir according to an embodiment of the invention.

15 Figure 14 is a schematic diagram of one type of variable volume reservoir in an embodiment of the invention.

Figure 15 is a schematic diagram of another type of variable volume reservoir in an embodiment of the invention.

20 Figure 16 is a schematic diagram of a liquid heating appliance in a tenth embodiment, incorporating a reservoir, heating chamber and dispensing portion interconnected by a three position valve.

Figure 17 is a schematic diagram of a liquid heating appliance in an eleventh embodiment, incorporating a pump to transfer the liquid from a reservoir to a heating chamber.

25 Figure 18 is a schematic diagram of a liquid heating appliance in a twelfth embodiment, incorporating a pump and a valve arranged either to circulate heated liquid back to the heating chamber or to dispense liquid from the heating chamber.

Detailed Description of the Embodiments

30 [0032] In the following description, functionally similar parts carry the same reference numerals between different embodiments.

First Embodiment

[0033] The first embodiment comprises a dual-function kettle and hot water dispenser appliance, comprising a kettle body 1 and a base 2 removably connected together by a

cordless electrical connector 3, comprising a kettle connector part and a base connector part. The base 2 is electrically connectable to a power supply so as to supply electrical power to the electrical connector 3, and in this respect is functionally similar to a cordless base as found in conventional cordless kettles.

- 5 [0034] The kettle body 1 has a spout 13 for pouring out water from the reservoir 5, and a handle 14, and includes a heating element 4 arranged to heat water in a reservoir 5 when electrical power is supplied to the element 4 via the connector 3. A thermal control (not shown) is provided to reduce or switch off heating by the element 4 when water in the reservoir 5 reaches a predetermined temperature. The thermal control may be located in the
10 kettle body 1 and/or the base 2 and may include sensing means for sensing the temperature of water in the reservoir 5.

- [0035] A dispenser 6 is provided for dispensing water from the reservoir 5 when the kettle body 1 is located on the base 2. The dispenser 6 may be mechanically or electromechanically operated. The dispenser 6 comprises a dispensing valve (not shown) which, when opened,
15 allows the water to be dispensed through an outlet 7. The kettle body 1 includes a self-sealing valve 8 which is closed so that water does not leak from the reservoir 5 when the kettle body 1 is separated from the base 2, but opens when the kettle body 1 is located on the base so that water may be dispensed through the outlet 7, for example through a dispensing conduit 9. Alternatively the dispensing valve on the kettle body 1 may be normally closed
20 and only operable when the dispenser 6 in the base 2 is activated.

[0036] An optional drainage passage 10 may be provided in the base 2, to allow condensation or spillage from the kettle body 1 to drain safely through the base 2.

- [0037] The base part 2 includes one or more legs 11 which raise the kettle body 1 and the dispenser 6 above the surface on which the appliance rests, so that a receptacle can be placed
25 under the dispenser 6 to receive the dispensed liquid. Hence, the liquid can be dispensed under gravity, without the need for a pump. The legs 11 may be adjustable in height, for example telescopically, to accommodate different sizes of receptacle; Figure 1b shows the legs 11 in retracted position, while Figure 1f shows the legs 11 in extended position.

- [0038] An optional receptacle support tray 12 may be located under the dispenser 6 and may
30 be configured as a drip tray, to store water dripping from the dispenser 6 and/or the drainage passage, or as an electrically heated plate for warming the receptacle. As shown in Figure 1g, the support tray 12 may be slid outwards from between the legs 11, as shown in the foreground, or stowed between the legs 11 so that a taller receptacle can be positioned under the dispenser 3, as shown in the background.

[0039] The kettle body 1 is preferably locatable on the base 2 in only one rotational orientation, to facilitate connection of the reservoir 5 to the dispenser 6. When the kettle body 1 is located on the base 2, the handle 14 is located preferably towards the front of the appliance, for easy access, and the spout 13 is located towards the rear of the appliance.

5 However, the kettle connector part 3a of the cordless connector 3 may be a conventional 360° cordless connector part, so that the kettle body 1 may be connected to a 360° cordless base separate from the base 2.

[0040] In an alternative embodiment, the cordless connector 3 may allow relative rotation between the kettle body 1 and the base 2; the relative rotation may be through a limited
10 angle, or through 360°. In one embodiment, the dispensing conduit 9 connects to the reservoir 5 through the centre of the connector 3, with suitable insulation of the electrical parts.

[0041] In an alternative embodiment, the dispenser 6 may be integrated with the kettle body 1, thus removing the need for the self-sealing valve 8 and/or allowing relative rotation
15 between the kettle body 1 and the base 2. In that case, the dispenser 6 is configured so that the kettle body 1 can rest stably on a surface; for example, the kettle body 1 may have a plurality of downwardly projecting legs or projections so that the dispenser 6 is raised above the surface.

[0042] Further alternative or additional features of the first embodiment will now be
20 described.

[0043] The handle 14 may include a water level gauge 15 in fluid connection with the reservoir 5, to allow easy measurement of the level of water in the reservoir, particularly when the handle 14 is located towards the front of the appliance.

[0044] A power switch 16 may be located on or around the handle 14, so as to be easily
25 accessible when the handle 14 is located at the front of the appliance. The power switch 16 may be for switching on and off and/or varying the power to the element 4. The power switch 16 may be illuminated. The illumination state of the power switch 16 may indicate the switching state or level of power to the element 4.

[0045] One of the legs 11 may carry internally the power connection to the base connector
30 part 3b, so that the connection is not easily visible and does not interfere with dispensing.

[0046] As best shown in Figures 1d and 1e, the base 2 may include an upwardly extending side wall 17 that surrounds at least part of the kettle body 1, thereby giving a more secure location of the kettle body 1 on the base 2. The side wall 17 may be thermally insulating, for example of double walled construction, to reduce heat loss from the reservoir 5.

[0047] A filter may be provided in the dispenser 6 and/or around the self-closing valve 8.

[0048] Any of the above construction embodiments may be combined with any of the heating embodiments, except where they are obviously incompatible.

Second Embodiment

5 [0049] The second embodiment is a variant of the first embodiment, in which the kettle body 1 is modified to heat selectably a large or small volume of water. As shown in Figure 2a, the reservoir 5 includes a partition 20 that divides the reservoir 5 vertically into first and second heating chambers 5a, 5b. A user actuable valve 21 selectively opens and closes fluid communication between the first and second heating chambers 5a, 5b, according to the
10 position of an actuator 22. The lower, first chamber 5a is heated directly by the element 4.

[0050] In this embodiment, boiling is sensed by a steam sensor 23 located within a steam chamber 24 in an upper part of the kettle body 1. A steam tube 25 extends from the first chamber 5a, through the partition 20, to the interior of the steam chamber 24, which is also open to the upper part of the second chamber 5b through an aperture 25. In this way, the
15 steam sensor 23 is able to sense boiling in either the first chamber 5a or the second chamber 5b.

[0051] In Figure 2a, the self-closing valve 8 is in its closed position; in this embodiment, the self-closing valve is a poppet valve biased into a closed position by a spring (not shown). Figure 2b shows the self-closing valve in more detail, in its open position; the valve 8 may
20 be opened by a part in the base that pushes the valve stem upwards when the kettle body 1 is located on the base 2, or when the dispenser 6 is activated.

[0052] As can be seen in Figure 2c, the user actuable valve 21 includes a portion 26 that closes the end of the steam tube 25 when the valve 21 is fully open. In this position, the contents of both the first and second chambers 5a, 5b are heated.

25 [0053] As shown in Figure 2d, when the user actuable valve 21 is closed, the portion 26 does not block the end of the steam tube. In this position, only the contents of the first heating chamber 5a are heated. When the water in the first chamber 5a boils, steam passes up the steam tube 25 and is detected by the steam sensor 23, which causes the power supplied to the element 4 to be switched off or reduced. Water may be dispensed from the first heating
30 chamber 5a by opening the dispensing valve. This may simplify the segregation between the first chamber 5a and the second chamber 5b, compared to conventional kettles that rely on the spout for dispensing water from a first heating chamber.

[0054] The first water chamber 5a can be refilled from the second heating chamber 5b by opening the user actuable valve 21; this valve may then be closed if the user wishes to heat only a small volume of water. In this way, the user may repeatedly heat and dispense small volumes of water without having to refill the reservoir from a water supply. Alternatively, the valve 21 may be left open if the user wishes to heat a larger volume of water, as with a conventional kettle. The valve 21 is positioned laterally towards the spout 13, so that water can be poured from both the first and second chambers 5a, 5b when the valve 21 is open.

[0055] The valve 21 may be substantially watertight in its closed position, or may allow water to leak from the second chamber 5b into the first chamber 5a, so that the first chamber 5a is slowly refilled without the user having to open and close the valve 21.

Third Embodiment

[0056] The third embodiment is a variant on the second embodiment, in that boiling water is dispensed under steam pressure via the steam tube 25 to the dispenser 6, which is integrated with the kettle body 1 and is located in an upper part of the kettle body 1. The base 2 in the third embodiment may be a conventional cordless base.

[0057] The upper end of the steam tube 25 opens into an outlet chamber 30, connected to the outlet 7. When water boils in the first chamber 5a and the valve 21 is closed, the first chamber 5a becomes pressurised and boiling water is discharged into the outlet chamber 30, where the pressure is reduced and water collects before flowing through the outlet 7 into a receptacle. The steam sensor 23 senses when the discharge through the steam tube 25 is predominantly steam and switches off or reduces the heating power in response thereto.

[0058] A pressure relief valve may be provided to prevent excess pressure building up in the first chamber 5a, by releasing pressure above a predetermined threshold. The pressure relief valve may be positioned in the partition 20, so as to release pressure into the second heating chamber 5b, and may be integrated with the valve 21. The pressure relief valve may allow air but not water to leak through when the pressure is above the threshold. The pressure relief valve may additionally allow air or water to enter the first chamber 5a if the pressure decreases below a predetermined threshold.

[0059] The chamber 30 has a connecting aperture 31 to the steam chamber 24, so that steam from the first chamber 5a may be sensed by the steam sensor 23. Preferably, the connecting aperture 31 includes means for preventing water from impinging on the steam sensor 23, such as a tortuous steam path, water trap or the like.

Fourth Embodiment

[0060] The fourth embodiment comprises a flow-through heating apparatus 40 that heats water supplied from the reservoir 5, on demand. The flow through heating apparatus comprises one or more flow-through heaters 41 supplied with the water through respective valves 42. In this embodiment, the heaters 41 are pulse or 'drip-type' heaters of the type conventionally used in drip coffee makers, and the valves 42 are non-return valves. Water boils within the heaters 41 and is discharged towards the outlet 7 by steam pressure. The pressure within the heaters 41 then drops, so that the valves 42 open and more water flows into the heaters 41 from the reservoir 5. The discharged water from the heaters 41 collects in a pressure relief chamber 43 before dispensing, to regulate the flow and avoid 'spurting' of boiling water. A two-way valve 44 is manually operable to dispense the heated water either through the outlet 7, or back into the reservoir 5. In this way, water can be circulated between the reservoir 5 and the flow-through heating apparatus 40 so as to heat up the whole contents of the reservoir 5 to the desired temperature, or water can be dispensed at near boiling temperature through the outlet 7, for example into a receptacle 46. The receptacle 46 may comprise a cup or teapot, or may include a coffee filter so that water flows from the outlet 7 onto the coffee filter and filter coffee collects in the receptacle 46. The appliance may include a heating plate or drip tray on which the receptacle 46 can be located.

[0061] The flow rate of water through the flow-through heating apparatus may be controlled by selectively switching on one or both of the heaters 41. There may be more than two heaters 41 arranged in parallel and/or in series. The valve 44 may be controlled initially to recirculate heated water back into the reservoir 5 and then to dispense water through the outlet 7, so that the water in the reservoir 5 is pre-heated and is dispensed more quickly on demand, through the outlet 7.

[0062] The valve 44 allows the dispensing function to be interrupted, so that water flows back into the reservoir 5 rather than out of the outlet 7. The valve 44 also allows unheated water already in the dispenser 6 to be returned to the reservoir 5 before heated water is dispensed through the outlet 7.

[0063] The selective switching of the heaters 41 and/or of the valve 44 may be actuated manually, or automatically in response to one or more sensors or timers, for example so as to achieve the desired flow rate of hot water from the outlet 7. Sequential switching of the heaters 41 may also allow their heating cycles to be phased to assist in equalising the flow rate.

[0064] The reservoir 5 may be removable from the flow-through heating apparatus 40 so that water may be poured out from the reservoir 5; in this case, the reservoir 5 preferably includes self-sealing valves for connection to each flow-through heater 41. The non-return valves 42 may act as such self-sealing valves and be integrated with the reservoir 5 rather than the flow-through heating apparatus 40.

Fifth Embodiment

[0065] The fifth embodiment is similar to the fourth embodiment, but differs in that the reservoir 5 is partitioned into a first heating chamber 5a and a second chamber 5b, interconnected by a user actuable valve 21. In this embodiment, the second chamber 5b acts as a reservoir for the first heating chamber 5a, and the valve 21 allows a selected volume of water to be dispensed into the first chamber 5a. Water may be returned to the reservoir 5b after heating, through the two-way valve 44.

Sixth Embodiment

[0066] The sixth embodiment is similar to the fourth and fifth embodiments, with the addition of a cordless kettle body 1 removably attachable to a base 2 integrated with the reservoir 5 through a cordless electrical connector 3. In the sixth embodiment, the reservoir 5 is not removable from the flow-through heating apparatus 40. The kettle body 1 may be a conventional cordless kettle body.

Seventh Embodiment

[0067] The seventh embodiment is similar to the sixth embodiment, but the flow-through heater(s) 41 are replaced by a pressurised heating vessel 70 that preheats a user-selectable volume of water to boiling and discharges the water under steam pressure through the outlet 7, in a similar way to the first heating chamber 5a of the third embodiment.

Eighth Embodiment

[0068] The eighth embodiment is functionally similar to the second embodiment, but the first heating chamber 5a extends upwardly to one side of the second heating chamber 5b; this has the advantage of reducing the risk of water passing up the steam tube 25 from the first heating chamber 5a and entering the steam chamber 24, particularly when boiling.

[0069] A level gauge 15 is provided on the upwardly extending side of the first heating chamber 5a, so that the level of water within the first heating chamber 5a is clearly visible to the user. The kettle body 1 is preferably locatable on an elevated base as in the second

embodiment, which makes the level gauge more easily visible. A magnifier may be provided on at least part of the level gauge so that the markings of the gauge are more easily visible.

[0070] The kettle body 1 further includes a filter reservoir 80 fillable via a filling aperture 81, and emptying into the second heating chamber 5b through a filter in a filter housing 82.

5 The filter reservoir 80 may be of variable volume, for example by means of a resiliently biased wall 83, such that the volume of the filter reservoir 80 as it is filled, and reduces as it empties. One or more buoyant members 85 are attached to the filter housing 82, so that the filter is spaced above the surface of water in the second chamber 5b. By integrating the filter reservoir 80 with the second chamber 5b and the first chamber 5a, the total required volume
10 of the kettle body 1 is greatly reduced.

[0071] The kettle body 1 may be removable from its base 2 as in the second embodiment, or may be fixed.

Ninth Embodiment

[0072] The ninth embodiment is similar to the seventh and eighth embodiment, in that water
15 is dispensed into the first heating chamber 5a, where it is heated to boiling and discharged under steam pressure through a discharge tube 25. The discharge tube 25 extends close to the floor of the first heating chamber 5a, and the floor of the first heating chamber 5a slopes downwards towards the lower end of the discharge tube 25. A dry boil control 90 detects when a portion of the heating element 4 is no longer covered by water and switches off the
20 heating element 4. Since this portion is higher than the lower end of the discharge tube 25, some water is still present around the lower end of the discharge tube 25 when a dry boil condition is detected; hence steam is prevented from passing up the discharge tube 25. Another advantage is that high overshoot temperatures can be avoided, because the remaining water cools the lower edge of the element 4.

25 [0073] After the heating element 4 cools, the dry boil detector is arranged to reset so that the heating element 4 can be re-energised, for example once the first heating chamber has been refilled from the second heating chamber 5b. An interlink 91 between the dispenser 6 and the dry boil control 90 may reset the dry boil control 90, for example so that water in the heating chamber 5a is heated only when there is a receptacle in the dispenser 6. The interlink 91
30 could be mechanical or electromechanical.

[0074] The discharge tube 25 may discharge directly through the outlet 7 into a receptacle 46, or into a pressure relief chamber 43, as in the sixth embodiment.

Lid

[0075] As shown in Figure 10, the kettle body 1 in embodiments of the invention may include a lid 19 that slopes downwards towards the spout 13 when open, inwardly of the kettle body 1. The lid 19 may be pivotally mounted around a substantially horizontal axis running approximately through the middle of the lid 19, so that the part of the lid positioned towards the handle 14 is raised up as the lid 19 opens. Alternatively, the pivotal axis of the lid 19 may be adjacent the spout 13 and the lid 19 may open outwardly. In either case, this may facilitate filling under a tap.

[0076] The lid 19 and/or the opening which is closed by the lid 19 may comprise liquid guiding means, such as a funnel, to help direct the water into the reservoir 5 when filling through the opening. The liquid guiding means may include a variably angled surface, which is adjustable to have a different angle relative to the opening depending on the method of filling, such as 90° for filling from a jug and 120° for filling under a tap.

[0077] Alternatively, the lid 19 could include a flap or weir system, for example as disclosed in WO-A-08/139173, particularly any one of embodiments 22 to 25.

[0078] The lid 19 may be removable from the opening that is normally closed by the lid 19.

Spout

[0079] There may be provided a spout flap that allows filling through the spout 13, but substantially closes the spout 13 after filling. The spout flap may be biased closed, but be pushed open by water during filling. Alternatively, the spout flap may be weighted so as to remain substantially at a predetermined angle to the horizontal, so that the spout flap closes the spout 13 when the kettle body 1 is horizontal, but opens when the kettle body 1 is tipped at an angle to the horizontal, for filling.

[0080] The spout flap may reduce heat loss through the spout 13, for example by restricting escape of hot air or steam. The spout flap may be thermally or acoustically insulating. The spout flap may be lockable so as to prevent liquid loss through the spout 13 if the kettle body 1 is overturned.

[0081] The spout flap may act as a pressure relief valve, by opening when the pressure within the reservoir 5 exceeds a threshold differential pressure above the surroundings. The spout flap may open outwardly of the kettle body 1 to relieve pressure.

Filling Reservoir

[0082] Instead of being filled manually, the reservoir 5 may be filled by an installed water supply, such as a mains water supply or a bottled water supply.

Filter

- 5 [0083] Any or all liquid outlets in embodiments of the invention may include a filter. The filter may be a mesh filter, to retain particulate material such as scale. The filter may be a purifying filter, to remove dissolved components of the water.

Thermal Control

- 10 [0084] In any of the above embodiments, there is preferably provided a thermal control responsive to a predetermined thermal state of heated liquid. For example, the thermal control may comprise a steam sensor, a liquid temperature detector such as a thermistor, an agitation/turbulence detector such as described in patent application PCT/GB08/003737 or a bimetallic thermostat that senses the temperature of the liquid through a wall or floor of the heating chamber, such as the 'bitemp' control described in patent application GB-A-
15 2438244.

- [0085] The thermal control may be adjustable to select the predetermined thermal state, such as the temperature, to which it is responsive. The thermal control may be responsive to sensing of the predetermined thermal state to switch off or reduce the heating of the liquid, for example to keep the liquid warm prior to dispensing. The thermal control may be
20 responsive to the predetermined thermal state to indicate to the user that liquid is ready to be dispensed and/or to enable manual actuation of the liquid dispenser. The thermal control may activate the dispensing of the liquid automatically.

- [0086] The thermal control may switch off the heating means before the required temperature is reached so that the stored residual heat within the heating means heats the
25 liquid to the required temperature. The proprietors 'bitemp' control could be used for this purpose.

- [0087] The thermal control may enable the addition of unheated water into the heating chamber toward the end of the heating cycle so that any additional stored energy in the heating means is utilized fully. The thermal control may also determine the temperature of
30 the dispensed water in a similar manner.

Metered dispensing

5 [0088] Figures 11a and 11b show a first embodiment of a valve for metered dispensing of liquid from a reservoir, which may for example be the reservoir 5 or second chamber 5b in the embodiments above. The liquid may be dispensed into the first heating chamber 5a in the embodiments described above.

10 [0089] The valve comprises a tube 110 sealed by a sliding seal against an aperture 111 in a lower part of the reservoir, for example by means of an O-ring. The tube 110 has an aperture 112 in an upper part thereof, communicating between the reservoir and the interior of the tube 110. In the first position, shown in Fig. 11a, the aperture 112 is above the level of water in the reservoir and no water flows out of the reservoir through the tube 110.

[0090] The tube 110 may be pushed downwards to slide through the aperture 111 into a second position as shown in Figure 11b, so that water flows through the aperture 112 and is dispensed through the tube 110. The tube 110 may be moved by an actuator attached to or integrated with one end of the tube.

15 [0091] Figures 12a and 12b show a second embodiment of the valve, which differs from the first embodiment in that water is dispensed by rotating the tube 110. The tube 110 is rotatably mounted within a sleeve 113 within the reservoir, and has a longitudinally extending narrow aperture 112. The outer wall of the tube 110, or at least a part of the outer face surrounding the aperture 112, seals against the inner wall of the sleeve 113.

20 [0092] The sleeve 113 has a plurality of inlet apertures 114 therein, arranged at mutually different heights and azimuthal positions around the sleeve, for example in a spiral pattern. As the tube 110 is rotated within the sleeve 113, different ones of the apertures 114 are aligned with the aperture 112, thus dispensing water from the reservoir to the height of the aligned aperture 114.

25 [0093] Alternative metered dispensing arrangements may be used, for example as disclosed in WO-A-08/139173.

Variable Volume Reservoir

30 [0094] As mentioned above with reference to the eighth embodiment, by integrating the filter reservoir 80 with the second chamber 5b and the first chamber 5a, the total required volume of the kettle body 1 is greatly reduced. This is illustrated with reference to Figures 13a and 13b, showing respectively a typical kettle with a water filter, and a kettle with a variable volume reservoir 80 according to an embodiment of the invention.

[0095] In the typical conventional kettle of Figure 13a, the volume of the filter reservoir 80 is fixed (e.g. 0.75 l). A headroom volume 130 (e.g. 0.625 l – 50% of water volume) must be left above the maximum liquid volume 131 (e.g. 1.25 l), to allow space for the filter housing 82 and clearance between the filter housing 82 and the liquid surface. Hence, the height h1 of the kettle body 1 available for the liquid volume is approximately equal to the height h2 of the kettle body 1 above the maximum liquid volume. In this example, both heights h1 and h2 are 130 mm.

[0096] In a filter kettle according to an embodiment of the invention, the filter reservoir 80 is variable and is intended to contract as the heating reservoir 5 is filled; therefore, the maximum water level is no longer constrained by a fixed headroom volume 130 or a fixed volume required for the reservoir 80. In this example, the maximum boiling volume may be 1.5 l, with a height h1 of 143 mm. The height h2 of the kettle body 1 above the maximum liquid level may be significantly less than that of the conventional kettle; in this example, h2 is 107 mm.

[0097] One specific embodiment of a variable volume reservoir 80 is shown in Figure 14. In this embodiment, the reservoir 80 comprises a plurality of tubes or portions 141 arranged to expand and contract telescopically, with sliding flexible seals 140 therebetween.

[0098] Another specific embodiment of a variable volume reservoir 80 is shown in Figure 15, in which the reservoir 80 comprises an expandable diaphragm 151. The diaphragm 151 may be made from a food grade elastomer such as silicone. The diaphragm may incorporate stepped circumferential ribs so as to expand in a resilient telescopic manner, or could expand and contract uniformly, like a balloon.

[0099] In either embodiment, the reservoir 80 may be biased towards either the smallest or largest volume, in other words towards an expanded or a contracted position. The reservoir 80 may expand and contract in relation to volume of the water contained therein. The reservoir 80 may be expandable so as to retract as water escapes therefrom through the filter housing 82, so as to reduce the overall size of the kettle body 1. The reservoir 80 may be biased by a spring mechanism.

[00100] The reservoir 80 could be biased to its minimum volume, and expands with the weight of the water contained therein. The reservoir 80 would then contract as the water is filtered. Alternatively the reservoir 80 could be biased to the fully open position and contract as the water level in the reservoir 5 rises.

[00101] The reservoir 80 may incorporate a float mechanism so that its volume is influenced by the water level in the reservoir 5, for example to retract as the water level in the reservoir 5 rises.

[00102] In an alternative embodiment, the reservoir 80 may also expand in a horizontal direction.

Tenth Embodiment

[00103] Figure 16 shows a further embodiment where the reservoir 80 is interconnected to the heating chamber 5 via a three-position valve 160 that is also connected to the dispensing outlet 7. The valve 160 may be mechanically and/or electromechanically operated.

[00104] The reservoir 80 is positioned above or adjacent to the heating chamber 5 and dispenses unheated liquid into the heating chamber 5 under gravity. Heated liquid is dispensed from the heating chamber 5 to the outlet 7 under gravity.

[00105] In a first position, the valve 160 allows transfer of liquid from the reservoir 80 into the heating chamber 5; in a second position, the valve 160 is closed and in a third position the valve 160 allows liquid to flow from the heating chamber 5 to the outlet 7.

[00106] A heater (not shown) is arranged to heat the contents of the heating chamber 5. The heater can be actuated manually but preferably the heater is activated automatically as the valve 160 is turned to the first position. In this case, heating begins immediately that liquid enters the heating chamber 5. The valve 160 may be configured to dispense a predetermined volume of liquid into the heating chamber 5 or alternatively the user may determine this volume of liquid by manual actuation of the valve 160 into the second position.

[00107] In the second position the valve remains closed until the heating cycle is completed. The valve may be actuated to the third position by the user or alternatively the valve may be actuated automatically by a thermal control upon the liquid reaching a predetermined temperature, at which point the heater is deactivated and the liquid dispensed automatically.

[00108] Preferably the length of conduit between the heating chamber 5 and the valve 160 should be minimised to avoid a cold slug of liquid being dispensed at the beginning of the dispensing phase.

[00109] In an alternative embodiment, the heater may be switched off when the liquid reaches a first predetermined temperature, so that any residual heat stored in the heater can

be fully dissipated in heating the liquid to a second, higher predetermined temperature. The valve 160 may be actuated to the third position when the second temperature has been reached, or at an earlier point so that the residual heat heats the liquid as the liquid is dispensed.

- 5 **[00110]** After the liquid has been dispensed the valve remains in the third position until the user requires further heated liquid, at which time the valve is returned to the first position and heating restarts.

Eleventh Embodiment

- 10 **[00111]** A reservoir 80 that relies on gravity for dispensing will, by necessity, need to be in an elevated position, which may cause problems of stability and also problems in refilling the reservoir 80.

- 15 **[00112]** In an alternative embodiment shown in Figure 17, liquid is transferred by a pump 170 from the reservoir 80 to the heating chamber 5 from which the heated water is then dispensed by means of a dispenser 6. The pump 170 may be connected in a conduit between the reservoir 80 and the heating chamber 5, or may alternatively be submerged in the reservoir 80.

[00113] The reservoir 80 and pump 170 can be combined as an integrated unit and powered via a cordless electrical connector so that the unit can be removed from the rest of the appliance, for filling.

- 20 **[00114]** The filling level of the heating chamber 5 can be determined by the user by the duration of operation of the pump 170 or alternatively predetermined for example by a timer (not illustrated) that energises the pump 170 for a set time in response to a user actuation, such as pressing a button.

- 25 **[00115]** Preferably the pump 170 and the heater of the heating chamber 5 are energised simultaneously. Upon the liquid reaching the desired temperature, the heater is de-energised and the liquid is automatically dispensed by the dispenser 6, under the control of the thermal control.

- 30 **[00116]** Optionally, the pump 170 may be arranged to add additional liquid from the reservoir 80 to the heating chamber 5 during or after heating of the heating chamber 5. For example, the pump 170 may be energisable manually at any time, to dispense a user-determined volume of liquid into the heating chamber. Alternatively, as described above, the thermal control may actuate the pump 170 to add liquid to the heating chamber after the heater is de-energised. In one embodiment, the volume of additional liquid is determined so

that the residual heat in the heater is sufficient to bring the total volume of liquid in the heating chamber 5 to the required temperature. Alternatively, the volume of additional liquid may be determined so as to reduce the temperature of the liquid in the heating chamber to a desired level. For example, the thermal control may de-energise the heater when the liquid in the heating chamber 5 is detected to be at boiling point (e.g. 100°C), and may then control the pump 170 to add unheated liquid to the heating chamber 5 such that the total volume of liquid is at a desired sub-boiling temperature (e.g. 80°C). The thermal control may detect when the desired temperature is reached and then switch off the pump 170. Alternatively, the control may determine how much additional liquid should be added to bring the temperature of liquid in the heating chamber 5 down to the desired level, based for example on the volume of liquid heated within the heating chamber 5. This embodiment is particularly advantageous where the pump 170 is arranged to dispense a first predetermined volume of liquid into the heating chamber 5 prior to heating; the second predetermined volume of liquid added to the heating chamber 5 after heating may therefore be a fixed volume.

[00117] The user may pre-select a volume and/or temperature of liquid to be dispensed, and the control may determine what volume of liquid is to be heated in the heating chamber 5 and what volume of liquid is to be added to the heating chamber 5 after heating so as to reach the selected volume of liquid, at the required temperature. In this way, the user need not be aware that that the reservoir has dispensed two separate volumes of liquid and the final amount dispensed will be equal to the original volume chosen by the user.

[00118] To perform the above operation, the control may need to detect or otherwise determine the temperature of the liquid in the reservoir 80, the temperature of the liquid in the heating chamber 5 and/or the volume of liquid heated in the heating chamber 5. The control may also need to determine the state of the heating element 4, for example to determine whether residual heat remains in the heating element 4 after a heating operation, which will affect the final temperature of the dispensed liquid. The state may be determined by a thermal sensor in thermal contact with the heating element 4.

[00119] Similar functionality may be provided in the tenth embodiment, by switching the valve 160 into the first position so as to allow additional liquid to enter the heating chamber after heating, prior to switching the valve 160 into the third position.

[00120] The dispenser 6 may incorporate a second pump, so that the heating chamber 5 need not be elevated above the dispensing area. In that case, both the reservoir 80 and the heating chamber 5 may be positioned at or below the level of the dispensing area. For

example, the reservoir 80 and/or the heating chamber 5 may be built in below the level of a worktop.

[00121] In each embodiment that includes a pump, the pump may include an anti siphon feature so that liquid cannot be siphoned back through the pump after the pump has
5 been deenergised. For example, a vent may be included in the conduit downstream of the pump 170. Alternatively, the downstream conduit may open into the heating chamber 5 above the maximum liquid level in the heating chamber 5.

[00122] An overflow, such as an overflow conduit, may be provided from the heating chamber 5 to the reservoir 80 to prevent the heating chamber 5 being overfilled. The
10 overflow may also provide a steam escape and/or pressure equalisation for the heating chamber 5. Alternatively, the pump 170 may incorporate a cut-out that de-energises the pump 170 when a maximum liquid level is reached in the heating chamber 5, for example if the end of a conduit downstream of the pump 170 is submerged.

[00123] For appliances that require the liquid to be dispensed by gravity it is
15 preferable that all the liquid that has been heated is dispensed. The dispenser 6 is preferably attached directly onto the base of the heating chamber 5 and a sump or pipe may be used for this purpose. The dispenser 6 may dispense from the lowest point of the heating chamber 5, either through the base or side thereof. A sump or pipe can be provided for this purpose and may be attached to the heating chamber 5 or the heating element 4, for example using a laser
20 welding technique or alternatively the floor of the heating chamber 5 may be set at an angle so that the outlet 7 is positioned at the lowest point.

Twelfth Embodiment

[00124] Figure 18 shows a further embodiment where the reservoir 80 is
interconnected to the heating chamber 5 via a valve 21 by which the user can select the
25 quantity of water to be heated in the heating chamber 5. The reservoir 80 is positioned above or adjacent to the heating chamber 5 and dispenses unheated liquid into the heating chamber 5 under gravity.

[00125] During the heating process the pump 170 circulates the water through a
dispensing valve 160. In the first position of the dispensing valve 160, the water is
30 recirculated back into the heating chamber 5, while in a second position the water is dispensed through the outlet 7. The height of the dispensing valve 160 is such as to enable a cup or other suitable vessel to be placed beneath the outlet 7. The height of the dispensing valve 160 may be above the height of the reservoir 80.

[00126] The dispensing valve 160 can be actuated manually or automatically. The water circuit may include a thermostat (not shown) so that the heating means of the heating chamber can be reduced or disconnected as the water reaches the desired temperature. It is expected that the heated water flowing over the thermostat will enhance the accuracy of the water temperature sensing.

[00127] This embodiment may eliminate the possibility of a cold slug of water in the conduit between the dispensing valve 160 and the heating chamber 5.

[00128] This embodiment may include a second valve 190 that in a first position directs water into the heating chamber and in a second position diverts water into the reservoir 80. With the valve 190 in the second position, the dispensing valve 160 in the first position and the valve 21 is open, the combined contents of the heating chamber 5 and the reservoir 80 will be heated as water is pumped from the heating chamber 5 and through the dispensing valve 160 and the second valve 190 into the reservoir 80 and thence through the valve 21 back in to the heating chamber 5.

[00129] The valve 190 may be proportional, in that it is capable of an intermediate position between the first and second positions, in which a proportion of the water passing through the valve 190 is diverted into the reservoir 80 and the remainder passes directly to the heating chamber 5. The proportion may be variable, depending for example on the position of the valve 190.

[00130] In one example, the valve 190 is controlled, in response to the liquid in the circuit reaching a predetermined temperature, to divert a proportion of the heated water into the reservoir 80, so that the water in circulation is at the correct temperature for dispensing whilst the water in the reservoir 80 is heated to the desired temperature. The heated water may then be dispensed through the dispensing valve 160 in the second position.

[00131] In a further embodiment the flow directing functions of valve 160 and valve 190 may be combined into one valve, for example having three positions to divert the water pumped from the heating chamber 5 respectively to the outlet 7, reservoir 80 and heating chamber 5.

[00132] Alternatively the appliance may be configured so that the heated water can be poured directly from the reservoir 80, for example if the reservoir 80 is detachable and has a sealing valve or other arrangement to prevent water leaking through the opening to the valve 21, or alternatively the complete appliance may be electrically detachable from the power supply, for example by means of a cordless electrical connector.

[00133] In an alternative embodiment, the apparatus may be arranged to switch off the heater when the liquid reaches a first predetermined temperature, so that any residual heat stored in the heater can be fully dissipated in heating the liquid to a second, higher predetermined temperature. The dispensing valve 160 may be actuated to the second position
5 when the second temperature has been reached, or at an earlier point so that the residual heat heats the liquid as the liquid is dispensed. The switching of the heater and/or the dispensing valve 160 may be performed automatically by a control in response the liquid reaching the first predetermined temperature.

[00134] After the liquid has been dispensed the valve may return to its original
10 position in readiness for the next heating cycle.

User-variable thermally sensitive control

[00135] The heating element 4 for heating water in the heating chamber 5 may be controlled by a user-variable thermally sensitive control in which the temperature threshold at which the control operates is adjustable by the user, for example as disclosed in GB-A-
15 2354927. The circulation and/or dispensing of water as described in the embodiments above may be controlled by such a control, so as to allow user selection of the dispensing temperature.

Heat Sink

[00136] Embodiments of the invention may include one or more electrical or
20 electronic components, such as a triac as part of an electronic control system for switching power to a heater, that require cooling to ensure correct operation and/or prevent overheating. For example, the heat sink required for a triac is typically one Watt per Amp; typically, a triac suitable for a continuous use at 3kw from a 240 VAC power supply will require a 13 Watt heat sink. Known heatsinks include dedicated metal heatsinks or methods
25 that use the mass of the appliance, for example the heating means or the heating chamber, as the heatsink. However the former can add additional cost and weight to the appliance and the latter becomes less effective as a heat sink as the liquid increases in temperature.

[00137] Advantageously, in embodiments of the invention that include a reservoir of unheated liquid, such as the reservoir 80, this reservoir may be used as a heat sink for the one
30 or more electrical or electronic components. For example, the component(s) may be in good thermal contact with a wall or floor of the reservoir 80. Since the contents of the reservoir 80

are unheated, and the volume of liquid in the reservoir 80 is typically greater than that of the heating chamber 5, the reservoir 80 provides a more suitable heatsink for the component(s).

[00138] Alternatively, the dispenser 6 may be used as a heat sink. In some embodiments, a quantity of unheated liquid may be retained between the heating chamber 5 and the dispenser 6, or within the mechanism of the dispenser 6 itself. The component(s) described above may be in good thermal contact with this quantity of unheated liquid, which thereby acts as a heat sink for the component. An additional advantage of this arrangement is that the otherwise unheated liquid is heated to some degree by the component, thereby reducing the cooling effect of the unheated liquid on the liquid that is dispensed.

10 Cordless Base

[00139] The kettle body 1 may interface with the cordless base 2 in either a vertical or horizontal direction. The cordless connector 3 may be spring loaded so that there is movement between the kettle body 1 and the cordless base 2 after the electrical connections are made to allow a liquid connection to be made through the self-closing valve 8, which
15 may be an electromechanical valve that is opened by the power connection being made through the electrical connector 3.

Heating Element

[00140] The heating element 4 could be immersed or underfloor. The element 4 could be a printed, sheathed, diecast, induction or halogen heater. The element 4 may include one
20 or more additional keep warm element. The element 4 could be radiant, i.e. heating from above the liquid level. The element 4 may be installed horizontally, or alternatively at an angle, for example to ensure that a dry boil protector is at the highest point of the element 4; this is particularly important in embodiments that are designed to 'dry boil' as part of the heating or dispensing process. The main heating element 4 could also include a secondary
25 heat exchanger to heat or increase the temperature of the liquid during the dispensing process.

[00141] The appliance could include a plurality of elements to increase the total heating power, or for other functions. The elements could be arranged to run in sequence if the total load is greater than the power available.

30 [00142] Preferably the heating element 4 should have low mass to minimise the energy required to heat small volumes of liquid.

[00143] The heating element 4 or elements may be sealed within the heating chamber 5 by the applicant's Easifix™ technique as described in WO 99/17645 or by side compression seals as disclosed in NL1014983. Alternatively, particularly if the available space is limited, the heating element(s) can be attached onto a metal heating chamber 5 by a laser welding technique as disclosed in WO2007/136256.

[00144] The appliance may include an additional in-line flow-through heater as part of the dispenser 6, to increase the water temperature in case the stored water is cooler than required, or to heat water separately to the main kettle. This additional heater may be of the pulse type normally incorporated in drip coffee makers. The additional heater may be dual function, for example have two heating faces, one to heat stored water via a stainless plate and one via a tube that acts as an in-line heater.

[00145] The appliance may also incorporate a sealed or semi-sealed chamber that uses the pressure generated by the boiling process to evacuate the water from the heating chamber to the dispensing unit. The element for this heating chamber may be sloped with the dry boil protector at the highest point. The discharge pipe may be positioned at the lowest point. More than one discharge pipe may be incorporated to supply different adjacent vessels. Alternatively a plurality of pipes could discharge into one vessel – either direct or through a collection chamber.

Dispenser

[00146] There may be a predetermined relationship between the volume of water required, the dispensing valve and the water boiling process so that when the desired volume is chosen, only that amount is boiled and then it is dispensed automatically.

[00147] The dispenser 6 may be designed to allow a fixed volume to be dispensed, or variable so that any pre-heated amount can be dispensed. The dispenser 6 may include a timer function to control the duration of operation of the dispenser 6 and hence the volume dispensed. The dispenser 6 could include a safety feature or interlock so that water cannot be dispensed unless a receptacle is present and/or the water is at a preset temperature.

[00148] The dispenser may include a level detector, such as an optical detector, arranged to detect when the receptacle is full or nearly full, and inhibit dispensing at that point, for example, by receiving an indication of the height of the receptacle, and filling to just below that height.

[00149] The dispenser may include a pressure relief chamber or collection point so that the force of the water pressure is reduced before dispensing. This chamber or collection

point may also serve to regulate the water flow, which is particularly important when more than one heated water source is incorporated in the appliance. The chamber or collection point may include an overflow that may return unused water back into the reservoir.

[00150] The dispenser point may incorporate a three-way valve that diverts unused water back into the reservoir when the outlet is closed. An electrical switch may be incorporated or interlinked with this valve and may include a timer or thermostat so that unheated water is returned to the reservoir, ensuring that dispensed water is at the correct temperature. The electrical switch could be sequentially controlled to switch additional heating elements.

10 Kettle Body & Base

[00151] The kettle body 1 and/or base 2 may include an adjustable height feature which may serve one of a number a number of purposes:

- increase height to allow taller vessels to be filled under the dispensing unit.
- decrease height for storage; the body 1 may include a switch so that the appliance cannot be switched on unless at a suitable height.
- a rotating, folding or tipping feature to allow the kettle body to fold or rotate for easier pouring and/or easier storage and/or smaller packaging
- rotation may also provide a feature for refilling a second vessel within the appliance and/or to limit the water capacity on filling.
- rotation/tipping may allow the user to pour heated water from the kettle body 1 without removing from the base 2.

[00152] The kettle body 1 and/or the base 2 may be insulated to decrease the heat loss from the heated liquid after this has reached its set temperature, for example by means of a double wall, vacuum or insulating material between the walls.

25 Support tray

[00153] The support tray 12 for the receptacle to be filled could be adjustable to support different shaped vessels and could include other features such as

- a heater to keep the vessel warm after dispensing.
- a component that senses the presence of the receptacle
- a weight sensor that switches off the dispenser 6 when a threshold has been reached

Controls & Indicators

[00154] Controls and indicators for the appliance may include one or more of the following:

- On/off switch
- 5 • Water level indicator
- Temperature indicator
- Water metering
- Timer

[00155] The handle 14 may be dual function and could include the any of the above
10 controls. Alternatively or additionally, the handle 14 may act as additional water storage and/or metering device.

[00156] Water level indicators may be supplied in both the reservoir and the heating chambers. The elevated height of these indicators may make them easier for the user to read.

Anti Bacterial User Contactable Surface

15 [00157] Embodiments of the invention may be used by many different users, and the parts contacted by the multiple users may harbour germs and bacteria.

[00158] Advantageously, at least some of the parts likely to be touched or actuated by the user comprise an antibacterial agent to prevent bacterial contamination and cross-contamination. The antibacterial agent may be coated on or incorporated or impregnated in
20 the part. The antibacterial agent may comprise silver or a silver compound.

Multi Plug

[00159] The appliance may be fitted with a Multiplug™ connection, for example as described in PCT/GB08/002808, that would allow electrical output greater than that which is normally available through a single plug. The appliance could have more than one heating
25 element supplied by the Multiplug™ connection.

[00160] The loads could be split into two, for example one element in the kettle powered via a cordless connector, and one element in the main appliance, permanently connected. However it may be advantageous to supply greater than 3 kW power in the kettle, either as a larger heat source to boil the water quicker, or split between a kettle part and an
30 auxiliary heater.

[00161] Where the kettle body 1 does not have a 360° connector, then a separate cordless connector 3 may be provided for each element. For example the live connections

may be provided through an Otter A12 connector and the neutral connections through an Otter CS2 connector. The steam sensor of an Otter A11 control may be used to switch off both loads.

[00162] Where the kettle body 1 does have a 360° connector, there may be provided a 5-pin cordless connection system, comprising two live, two neutral and one earth connection through a single cordless connector. The connector could be a plug and socket type (e.g. equivalent to Otter CS4/CP7 connectors), or alternatively the connector could be integrated into an electromagnetic control, such as an Otter A11 or A12 type of control, or an electronic control. For example, the connector could be based on an Otter A12 control, with two additional rings. The inner three connectors would be Earth, Live 1 and Live 2; the additional outer rings would be Neutral 1 and Neutral 2. The steam switch would switch off both the live connections, and would still provide lift off switch off functionality.

[00163] Primary protection for each element could be through the standard bimetals of the A1 with secondary protection achieved by either a thermal fuse (for mechanical elements), or a fusible track for a printed element.

[00164] The element sheaths or tracks could either be concentric or crescent shaped (each taking up half of the element). In embodiments where the elements cannot be configured in this way, then the elements could be controlled separately, but a stand-alone steam switch (such as in the Otter A1 control) could still switch off both live connections.

[00165] For corded Multiplug™ heaters, the heating elements may be controlled and/or switched separately, but they may alternatively be interlinked, for example:

- **On/Off** - an on/off switch is configured so that it switches on both supplies through different contacts. This could be achieved at the same time or progressively through a rotary switch.
- **Control** - a separate thermostat may be used for each element, or alternatively one thermostat with two sets of contacts; these could function at the same time or progressively. Alternatively the primary element may be thermostatically controlled and there may be a separate switch for the auxiliary (boost) element. The auxiliary switch could be timed, or include a preset thermostat, or switch off automatically. Alternatively the base load could run continuously with the auxiliary (or boost load) thermostatically controlled.
- **Safety** - an overheat protector may be provided for each element, or a single overheat protector may be provided for the whole appliance that switches off both loads. A double

pole stat may provide a protector for two separate lives. These protectors may be self - resetting or may be manual reset.

[00166] The above interlinks may be provided for types of electrical appliance other than liquid heaters.

5 **Remote Control**

[00167] An appliance according to an embodiment of the invention may include a remote control, as described for example in WO 08/155538. Such a remote control is particularly advantageous with an appliance having two or more loads.

Flow-through Heaters

10 [00168] The flow-through heater, preheated reservoir, dispenser and/or control in an embodiment of the invention may be as described in WO 08/139205.

Alternative Embodiments

[00169] The embodiments described above are illustrative of rather than limiting to the present invention. Alternative embodiments apparent on reading the above description
15 may nevertheless fall within the scope of the invention.

Claims

1. A liquid heating appliance comprising a liquid reservoir, a liquid heating chamber, a pump for transferring liquid from the liquid reservoir to the liquid heating chamber, and a user-variable control for varying the temperature of the liquid to be dispensed.
- 5 2. The liquid heating appliance of claim 1, wherein the control is arranged to transfer an additional quantity of liquid from the reservoir to the heating chamber subsequent to heating of the liquid in the liquid heating chamber.
3. A liquid heating appliance comprising a liquid reservoir, a liquid heating chamber, means for transferring liquid from the liquid reservoir to the liquid heating chamber, and a control arranged to transfer an additional quantity of liquid from the reservoir to the heating chamber subsequent to heating of the liquid in the liquid heating chamber.
- 10 4. The appliance of claim 3, wherein the means for transferring comprises a pump.
5. The appliance of any one of claims 2 to 4, wherein the additional quantity of liquid is determined according to the residual heat in a heating element of the heating chamber.
- 15 6. The appliance of any one of claims 2 to 5, wherein the additional quantity of liquid is determined so as to reduce the temperature of liquid within the heating chamber to a predetermined level.
7. The appliance of claim 6, wherein said level is selectable by a user.
8. The appliance of any preceding claim, including means for selecting the volume of liquid to be dispensed, and means for determining the quantity of liquid to be heated in the heating chamber and the additional quantity to be added after heating, such that the selected volume is dispensed.
- 20 9. A liquid heating appliance comprising a liquid reservoir, a liquid heating chamber, and a dispenser interconnected by a valve having at least three valve states, wherein in the first valve state liquid is able to pass from the reservoir into the liquid heating chamber, in the second valve state the valve is closed, and in the third valve state the dispenser is enabled to dispense liquid from the liquid heating chamber.
- 25 10. The appliance of claim 9, wherein the liquid heating chamber comprises a heater arranged to be energised when the valve is in the second valve state.
- 30 11. The appliance of claim 10, wherein the heater is arranged to be energised when the valve is in the first valve state.

12. The appliance of any one of claims 9 to 11, wherein the heater is arranged to be de-energised when the valve is in the third valve state.
13. The appliance of any one of claims 9 to 12, including a thermal control arranged to change the valve to the third valve state in response to detection of a predetermined thermal condition of liquid in the liquid heating chamber.
14. The appliance of any one of claims 9 to 13, including means for automatically changing the valve from the first to the second state when a predetermined volume of liquid has passed into the heating chamber.
15. A liquid heating appliance comprising a liquid heating chamber, a reservoir for supplying liquid to the heating chamber, a pump for pumping liquid from the heating chamber, and a dispensing outlet, the appliance including flow directing means having a dispensing state in which liquid is pumped from the heating chamber to the dispensing outlet and a recirculating state in which liquid pumped from the heating chamber is circulated back to the heating chamber.
16. The appliance of claim 15, wherein the flow directing means is selectively arrangeable in the recirculating state to circulate the liquid back to the heating chamber via the reservoir or directly to the heating chamber.
17. The appliance of claim 16, wherein the flow directing means comprises separate means to select between the dispensing state and the circulation state, and means to selectively circulate the liquid back to the heating chamber via the reservoir or directly to the heating chamber.
18. An appliance of claim 16 or 17, wherein the flow directing means is selectively arrangeable in the recirculating state to circulate a proportion of the liquid directly back to the heating chamber and the remainder via the reservoir.
19. The appliance of claim 18, wherein the proportion is variable.
20. The appliance of any one of claims 15 to 19, wherein the flow directing means is switchable between the circulating and dispensing states in response to a liquid temperature sensor.
21. The appliance of claim 20, wherein the liquid temperature sensor is arranged to sense the temperature of the liquid as the liquid is pumped.

22. A liquid heating appliance having a user-contactable surface including an antibacterial agent.
23. A liquid heating appliance having a liquid reservoir, a liquid heating chamber arranged to receive liquid from the reservoir and an electrical or electronic component in thermal contact with the reservoir such that the reservoir acts as a heat sink for the component.
24. A liquid heating appliance having a liquid heating chamber and a dispenser for dispensing liquid from the liquid heating chamber through an outlet, the dispenser being arranged that a volume of liquid is retained between the liquid heating chamber and the outlet, the appliance including an electrical or electronic component in thermal contact with said volume of liquid which thereby acts as a heat sink for the component.
25. The appliance of claim 23 or 24, wherein the component comprises an electronic switch for switching heating power to the liquid heating chamber.
26. A liquid heating appliance comprising a liquid heating reservoir detachably mounted on a base, wherein liquid is dispensable from the reservoir both by lifting the reservoir from the base and pouring liquid from the reservoir, and by means of a dispenser for dispensing liquid from the reservoir when mounted on the base, and wherein the dispenser is integrated with the base.
27. A liquid heating appliance comprising a liquid heating reservoir detachably mounted on a base, wherein liquid is dispensable from the reservoir both by lifting the reservoir from the base and pouring liquid from the reservoir, and by means of a dispenser for dispensing liquid from the reservoir when mounted on the base, and wherein the dispenser is arranged to dispense liquid from the reservoir substantially by gravity alone.
28. A liquid heating appliance comprising a liquid heating reservoir detachably mounted on a base, wherein liquid is dispensable from the reservoir both by lifting the reservoir from the base and pouring liquid from the reservoir, and by means of a dispenser for dispensing liquid from the reservoir when mounted on the base, wherein the base is adjustable in height.
29. A liquid heating appliance comprising first and second heating chambers, a user-actuable valve for selectively interconnecting the first and second chambers, and means for heating liquid within the first heating chamber such that liquid within the second chamber is also heated when the valve is open.

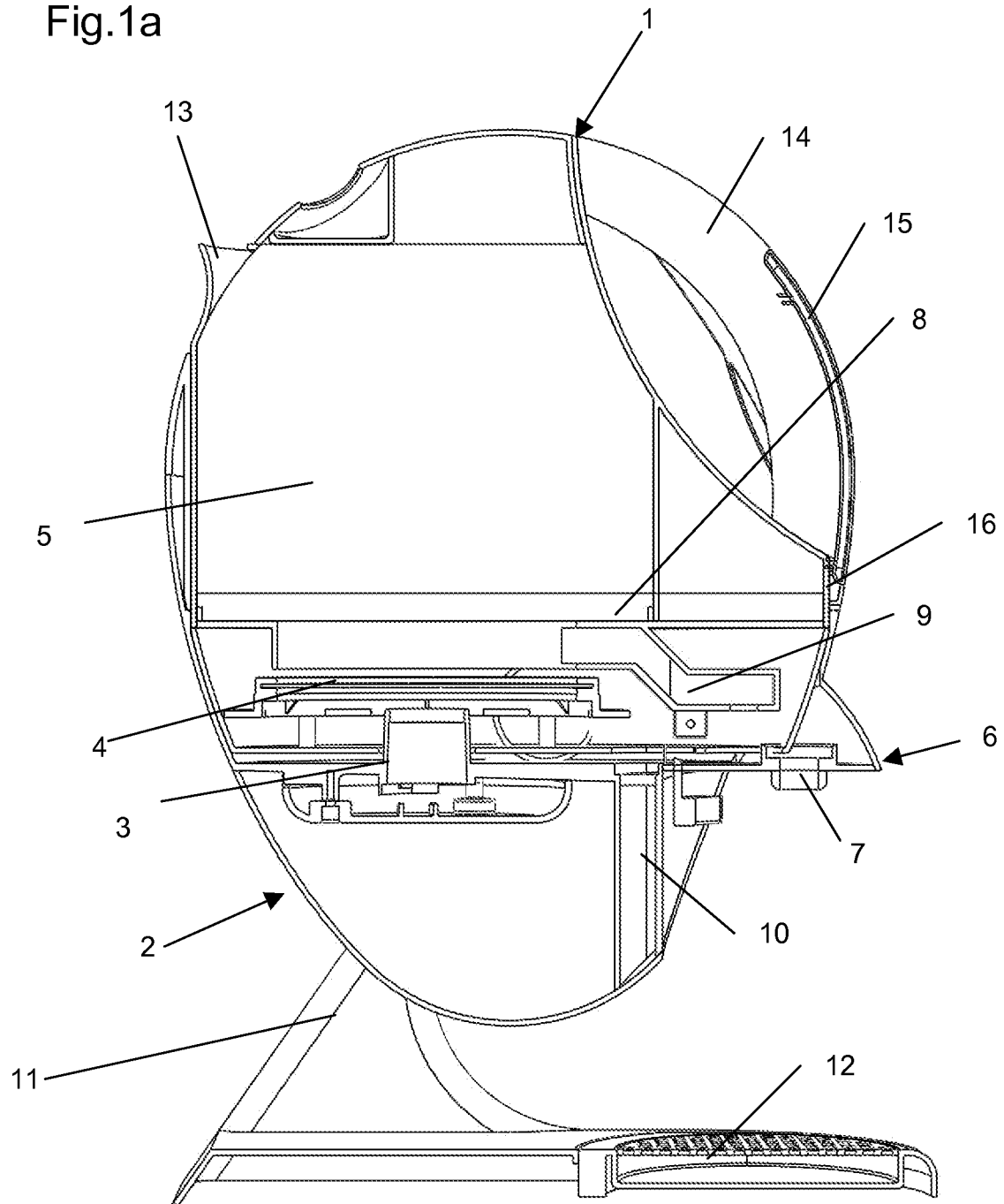
30. The liquid heating appliance of claim 29, including a unitary steam sensor arranged to detect steam from both the first heating chamber and the second heating chamber.
31. The liquid heating appliance of claim 30, including an outlet connected to the first chamber, such that steam is released through said outlet to said steam sensor when the
5 valve is closed.
32. The liquid heating appliance of claim 29 or 30, including an outlet connected to the first chamber, such that liquid is dispensed through said outlet by steam pressure when the valve is closed.
33. The liquid heating appliance of claim 31 or 32, wherein said outlet is closed when the
10 valve is open.
34. The liquid heating appliance of claim 29, wherein at least part of the first chamber is arranged to one side of the second chamber.
35. The liquid heating appliance of claim 29, wherein at least part of the first chamber is arranged to below the second chamber.
- 15 36. A liquid heating appliance comprising a liquid reservoir arranged to supply liquid to a heating chamber by means of a valve, the heating chamber being arranged to dispense liquid under steam pressure, wherein the valve is actuatable by a user.
37. The appliance of claim 36, wherein the valve is actuatable to supply a variable volume of liquid into the heating chamber.
- 20 38. A liquid heating appliance comprising a flow-through heater removably connectable to a liquid reservoir so as to recirculate heated liquid to the liquid reservoir.
39. A liquid heating appliance comprising a flow-through heater connectable or connected to a liquid reservoir via a two-way valve so as selectively to dispense heated liquid or recirculate heated liquid to the liquid reservoir, the valve and/or heater being controlled
25 by sequential switching means.
40. A liquid heating appliance comprising a liquid reservoir and a heater arranged to heat water removed from the reservoir, and a cordless liquid heating vessel having a cordless base integrated with the liquid reservoir.
41. The appliance of claim 40, wherein the heater comprises a flow-through heater.
- 30 42. The appliance of claim 40, wherein the heater comprises a liquid heating chamber.

43. A liquid heating appliance comprising a liquid reservoir and a liquid heating chamber arranged to heat liquid removed from the reservoir and to dispense heated liquid through an outlet by steam pressure, wherein the floor of the liquid chamber slopes to one side relative to the horizontal.
- 5 44. The appliance of claim 43, including a dry boil detector arranged to reduce or terminate heating of the liquid when a portion of the floor above the lower side is no longer immersed.
45. The appliance of claim 43 or 44, wherein the outlet comprises a passage having an inlet towards the lower side of the floor.
- 10 46. A liquid heating vessel having a handle at one side thereof and a pivotally openable lid, wherein the axis of opening of the lid is displaced away from an end of the lid closest to the handle.
47. The liquid heating vessel according to claim 46, wherein the axis of opening extends approximately centrally of the lid.
- 15 48. The liquid heating vessel according to claim 46 or 47, wherein at least a part of the lid opens inwardly of the vessel.
49. A liquid heating appliance comprising a reservoir arranged to dispense liquid into a heating chamber by means of a user actuatable valve, wherein the valve is arranged to empty the reservoir to a level determined by the actuation thereof.
- 20 50. The appliance of claim 49, wherein said level is determined by sliding a valve member.
51. The appliance of claim 49, wherein said level is determined by rotating a valve member.
52. A liquid heating appliance comprising a reservoir arranged to dispense liquid into a heating chamber, wherein the reservoir has a variable volume determined by the level of liquid contained therein.
- 25 53. The appliance of claim 52, wherein the reservoir is biased towards a minimum volume and is expanded away from the bias by the liquid contained therein.
54. A liquid heating appliance comprising a reservoir arranged to dispense liquid into a heating chamber, wherein the reservoir has a variable volume determined by the level of liquid contained in the heating chamber.

55. The appliance of claim 54, wherein the reservoir includes a buoyant portion arranged to float within the heating chamber.
56. An electrical liquid heating appliance comprising first and second heating loads supplied by discrete power supplies and controlled by a common control.
- 5 57. The appliance of claim 56, wherein the common control comprises a thermal sensor.
58. The appliance of claim 56, wherein the common control comprises a user-actuable switch.
59. The appliance of claim 56, wherein the common control comprises an overheat protector.
60. An appliance of any previous claim including a user-variable thermally sensitive control
10 arranged to control the temperature at which the liquid is dispensed.
61. An appliance of any previous claim, wherein a user is enabled to determine the volume of liquid to be heated and to select the volume of heated water to be dispensed.

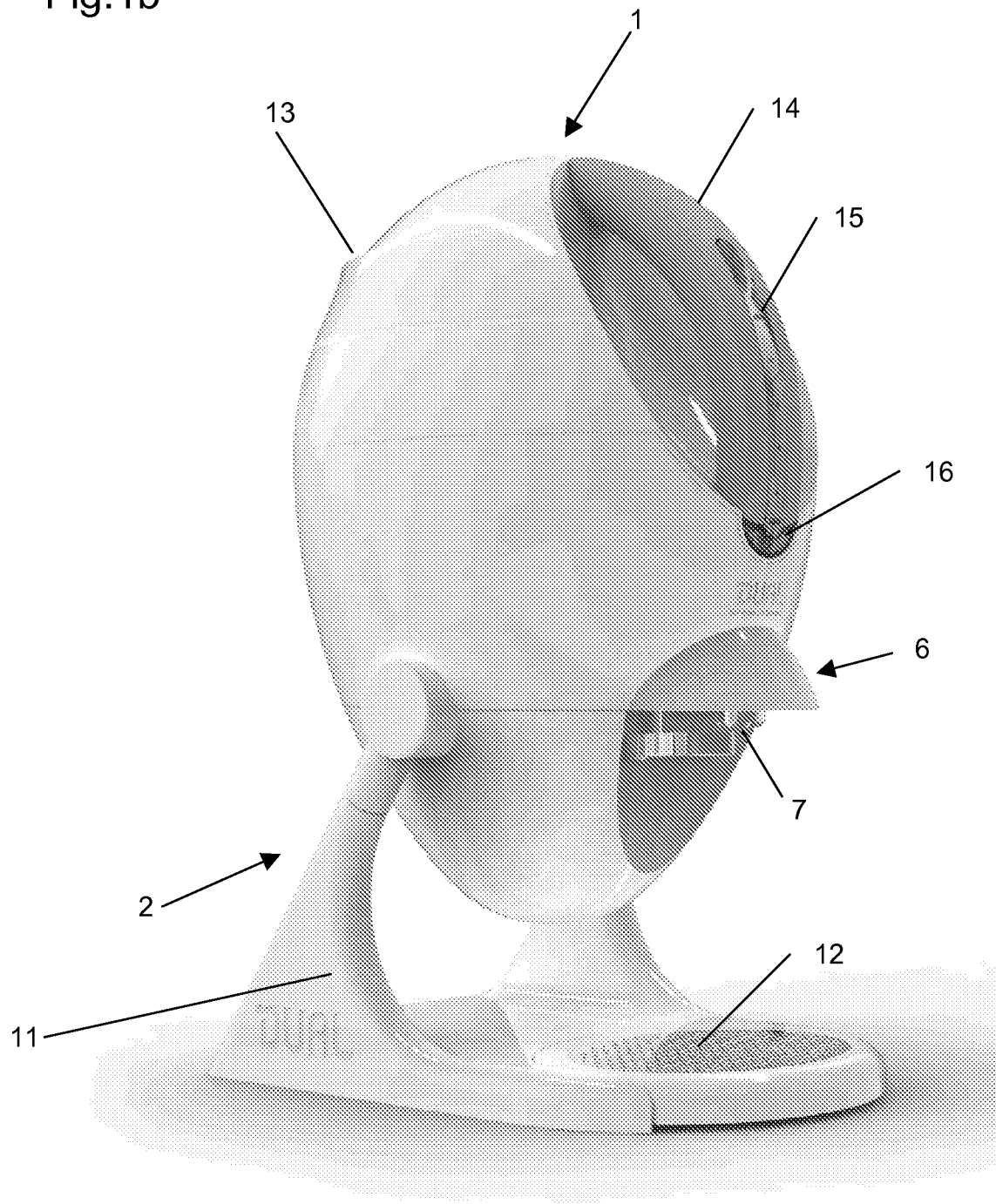
1/24

Fig.1a



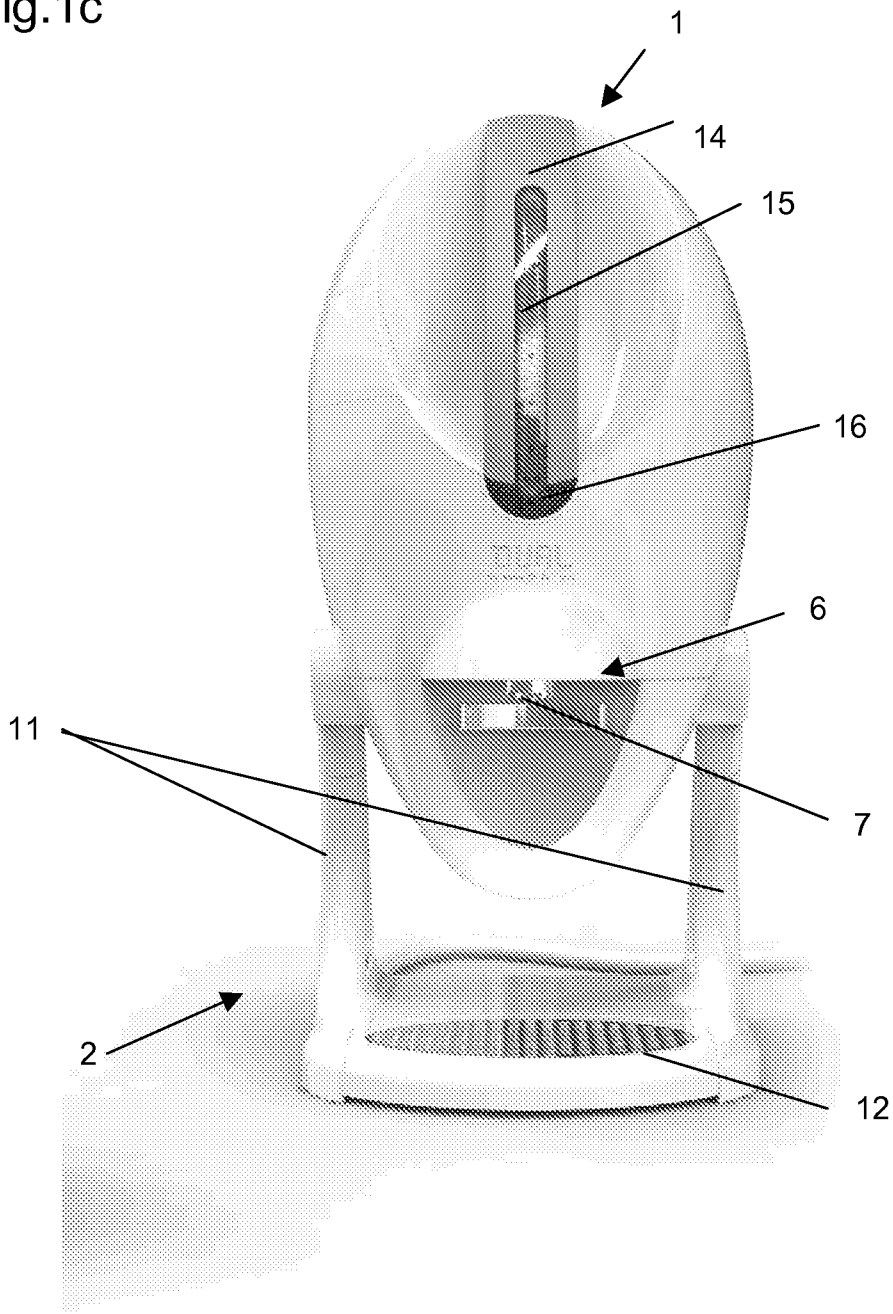
2/24

Fig.1b



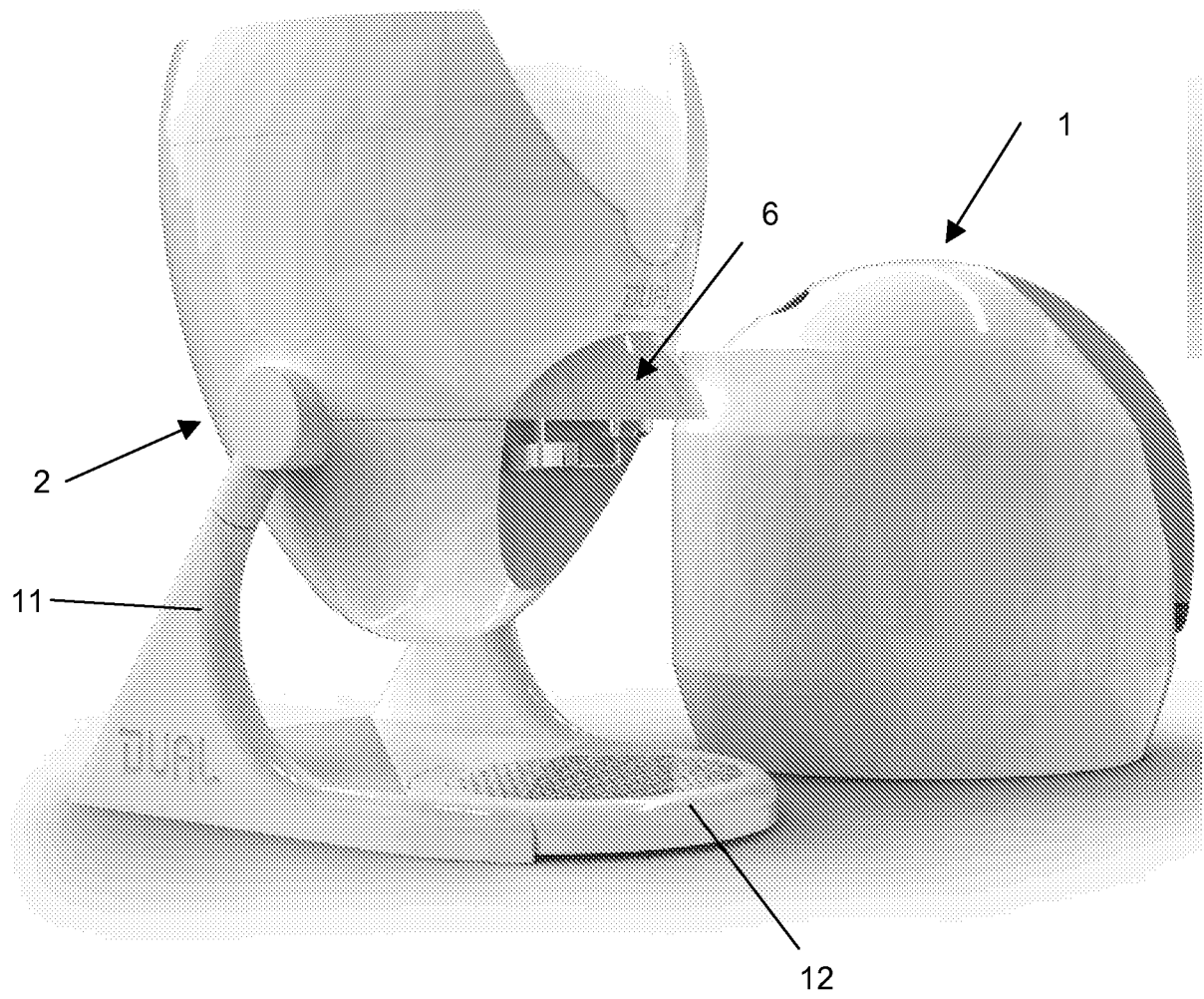
3/24

Fig.1c



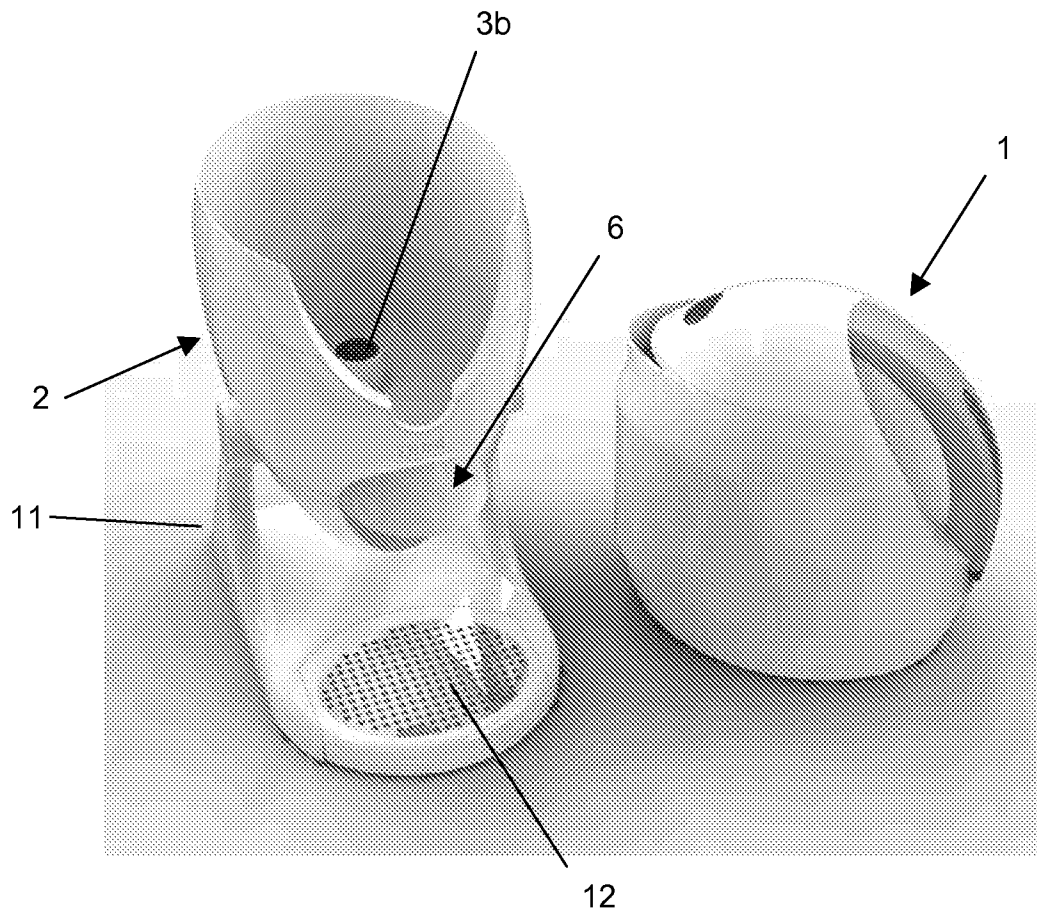
4/24

Fig.1d



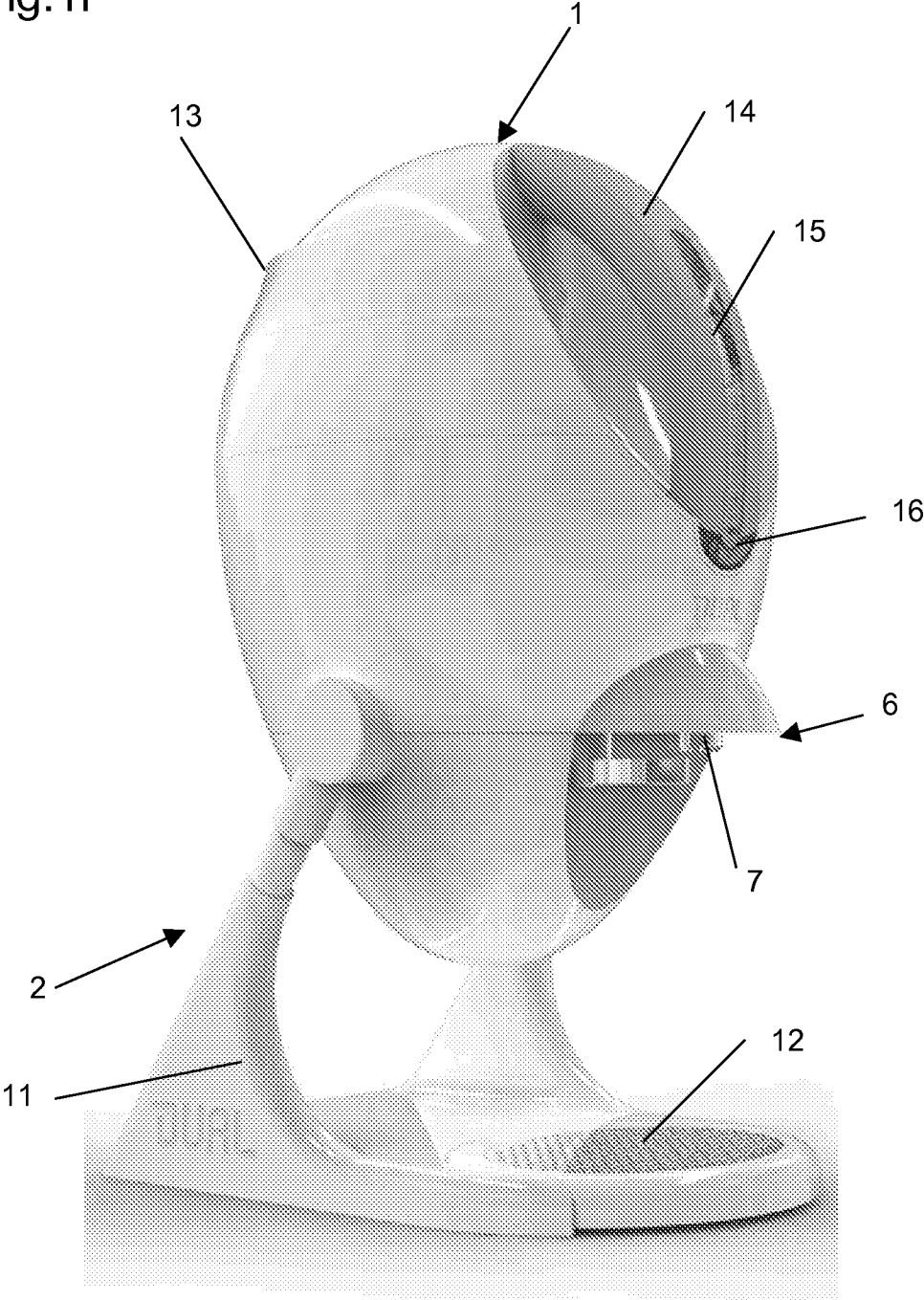
5/24

Fig.1e



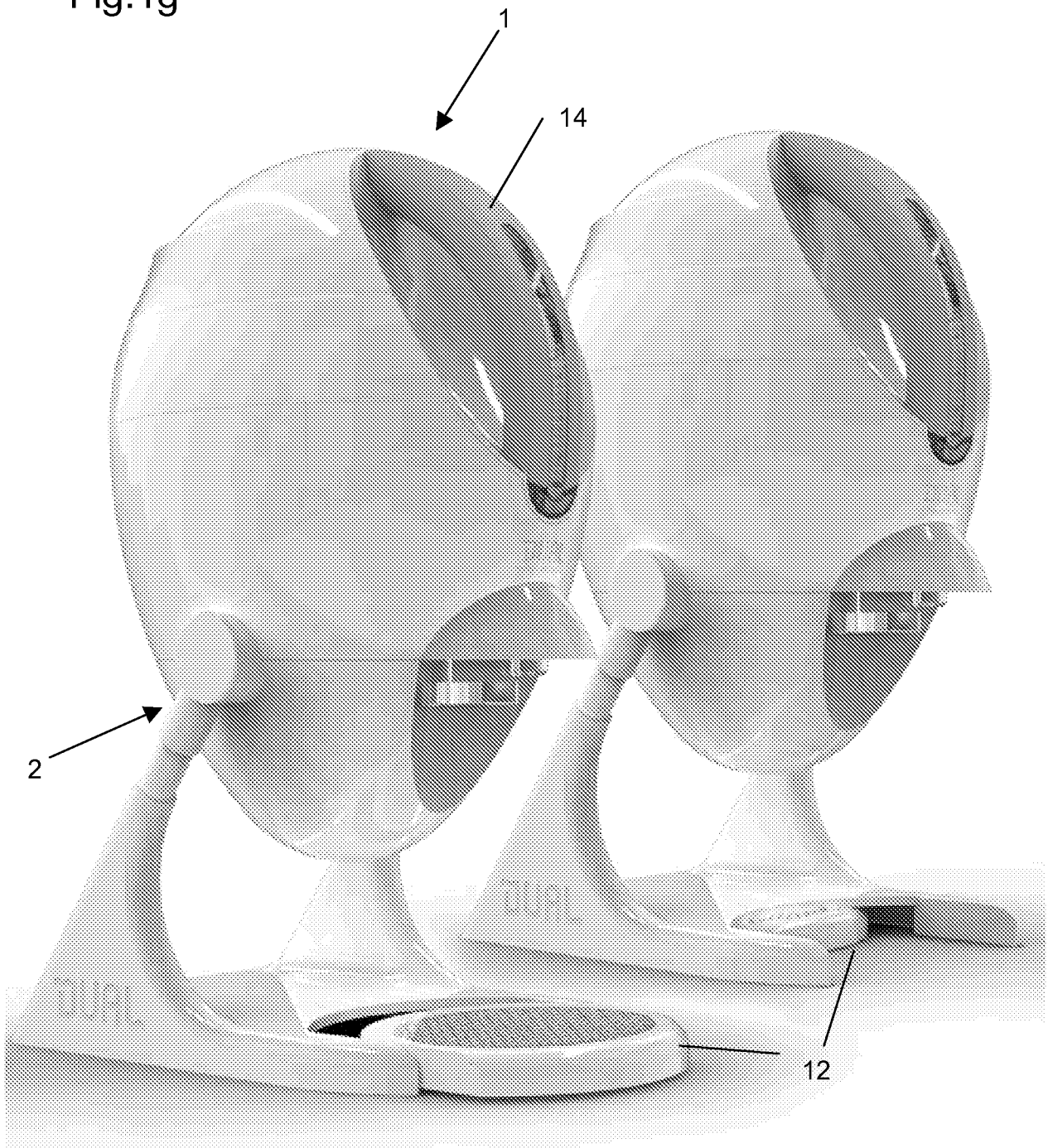
6/24

Fig.1f



7/24

Fig.1g



8/24

Fig. 2a

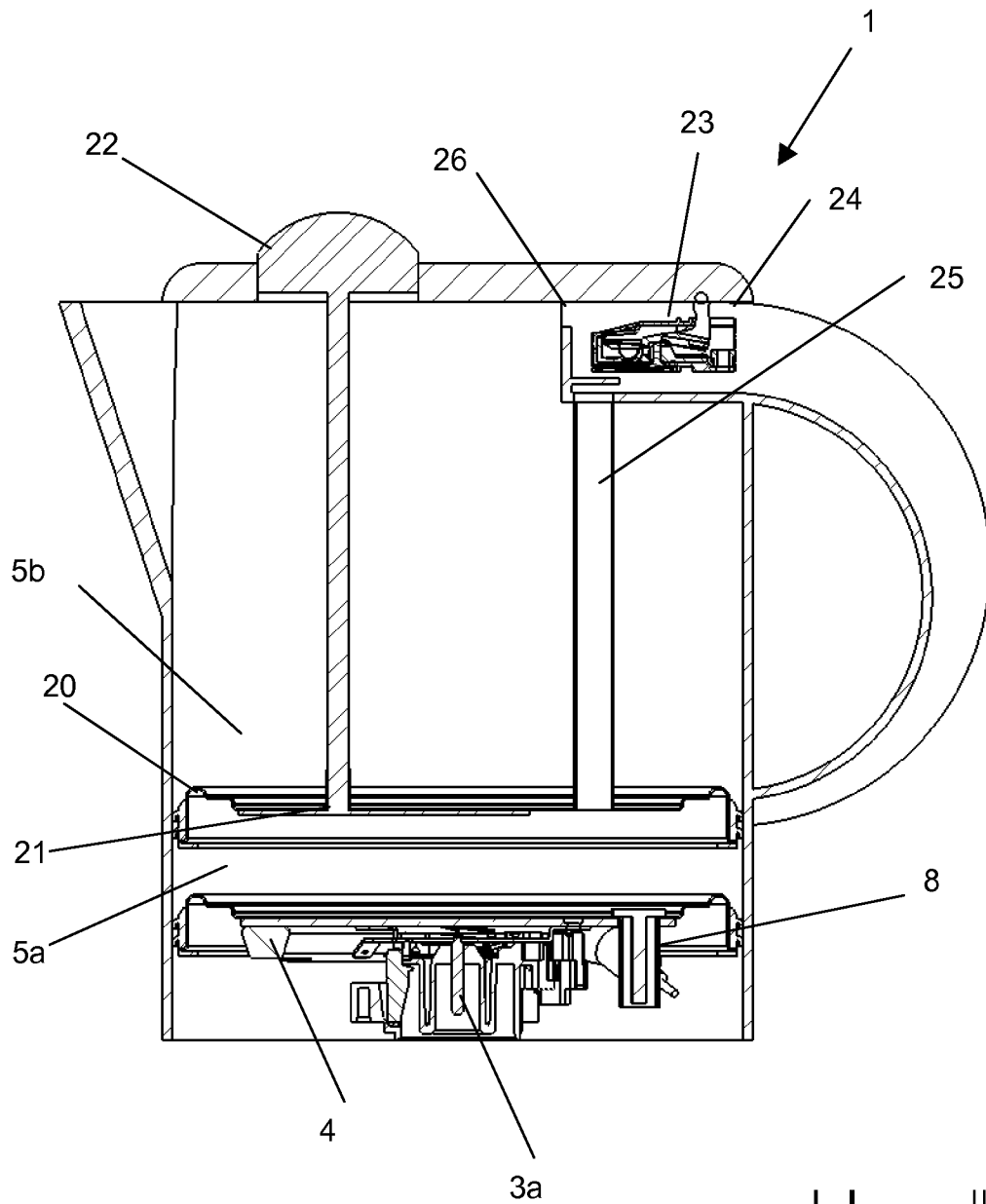
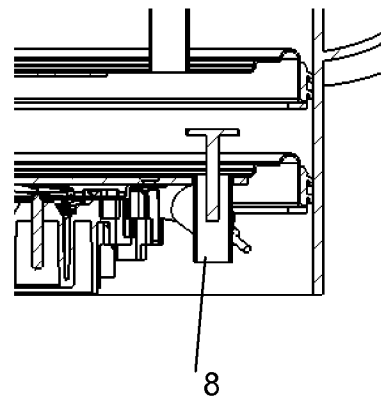


Fig. 2b



9/24

Fig. 2c

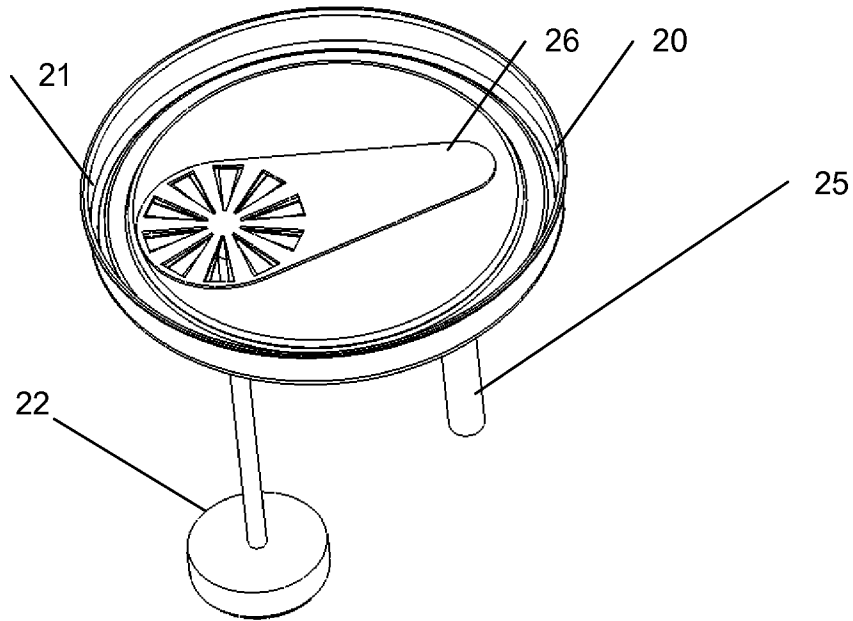
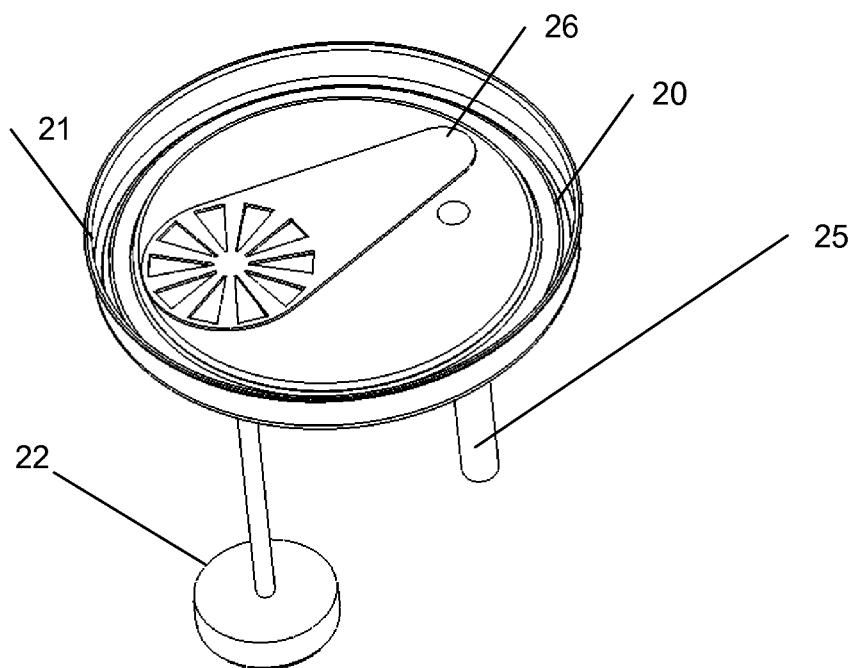
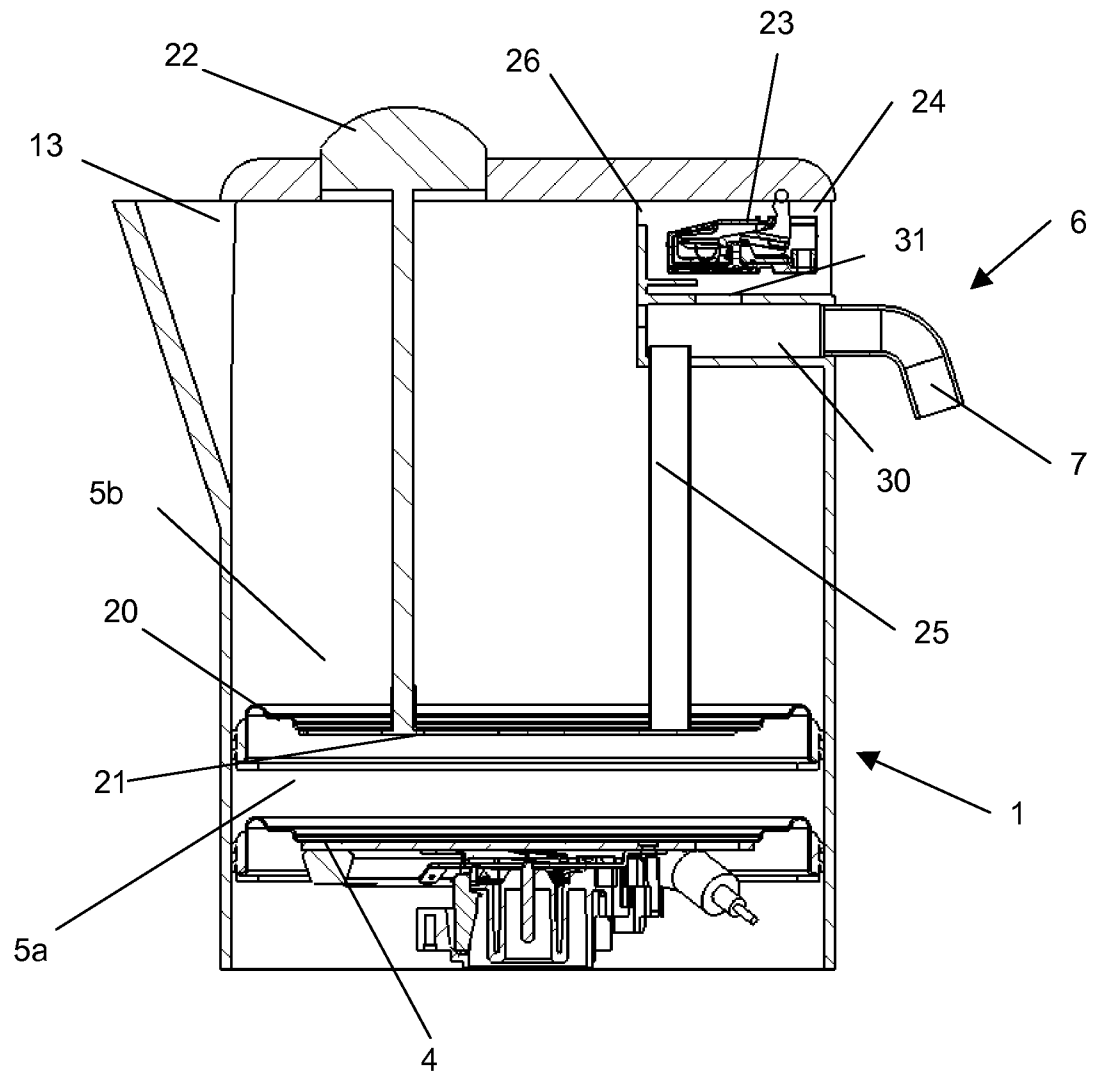


Fig. 2d



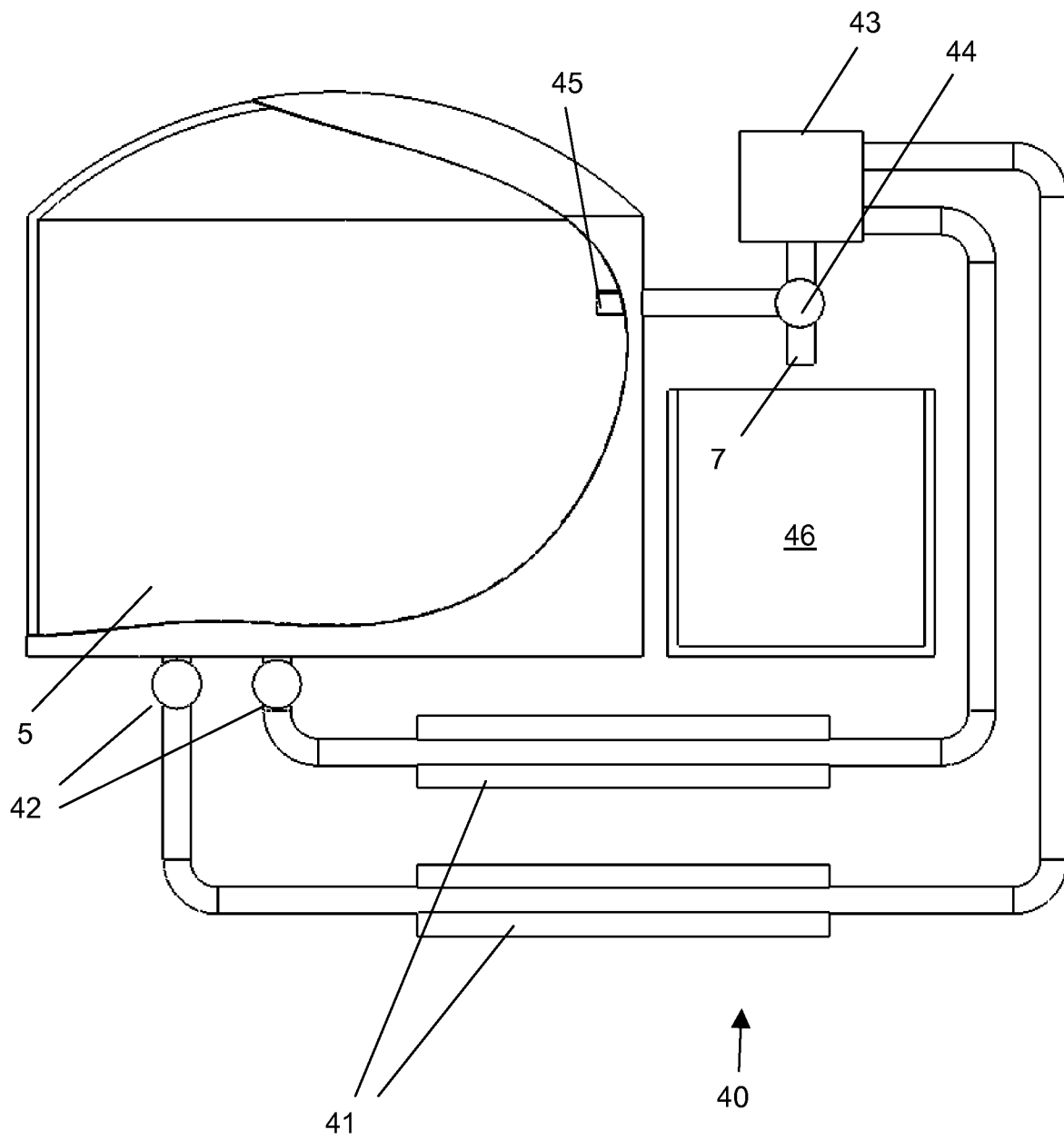
10/24

Fig. 3



11/24

Fig. 4



12/24

Fig. 5

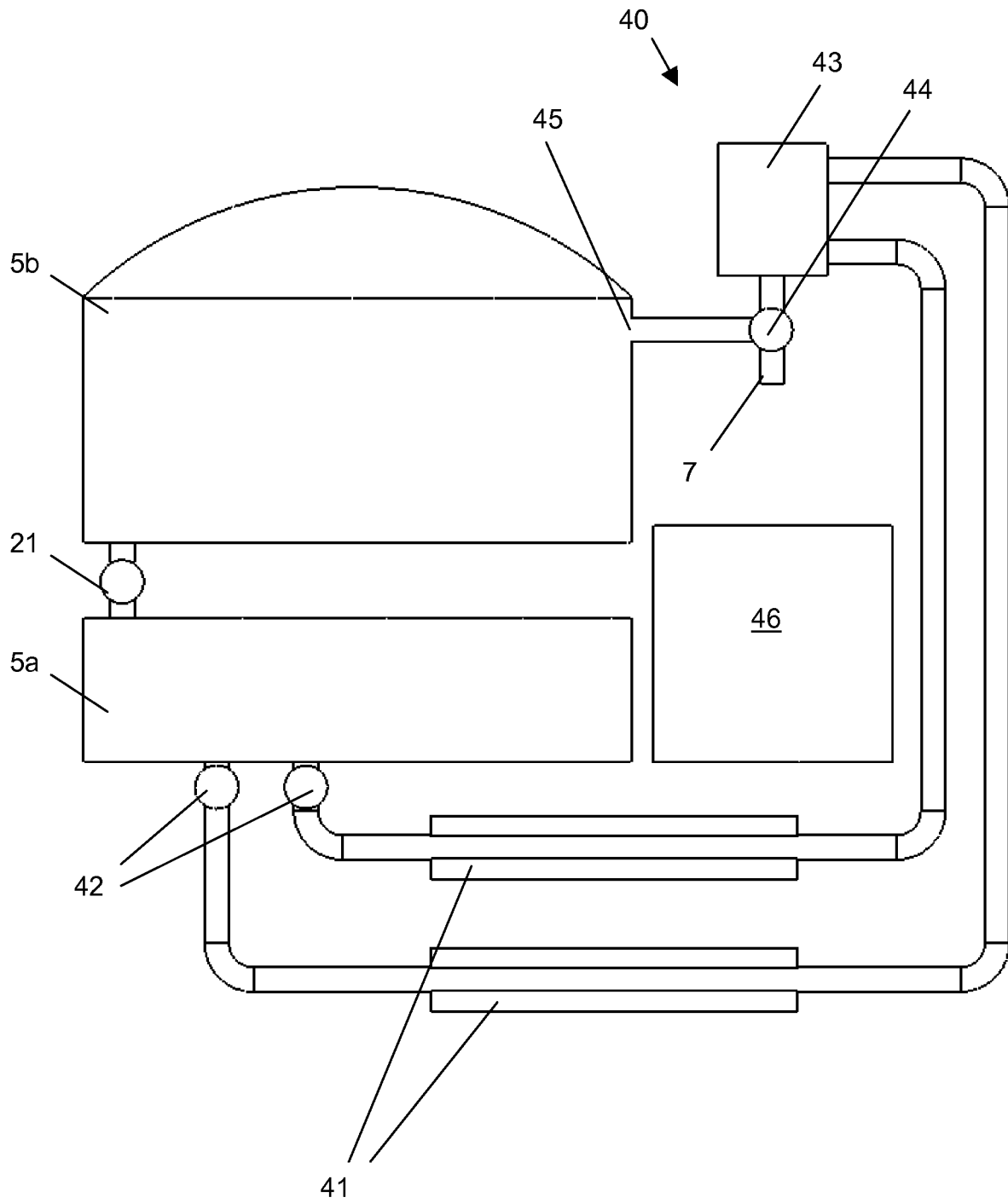


Fig. 6

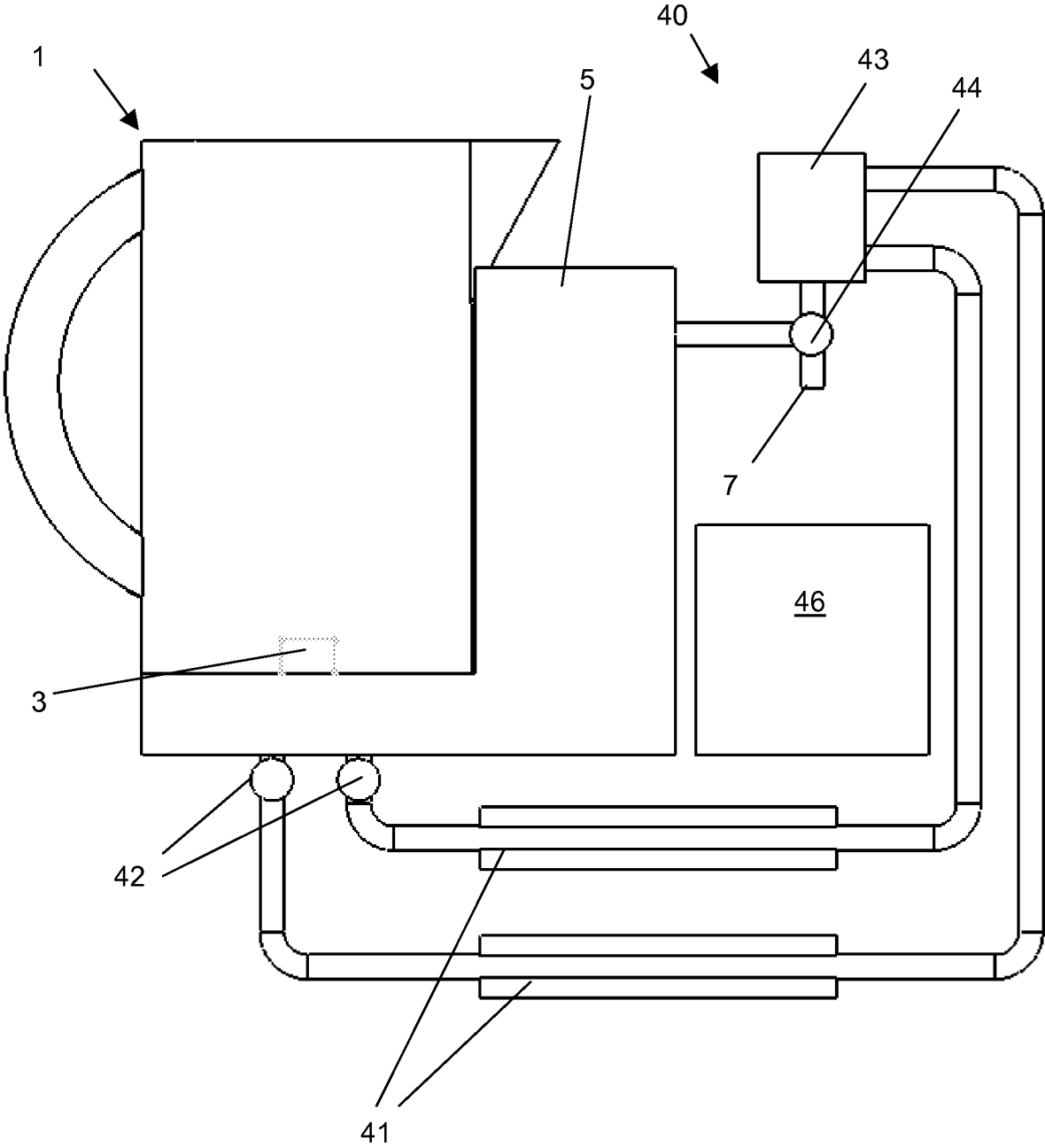
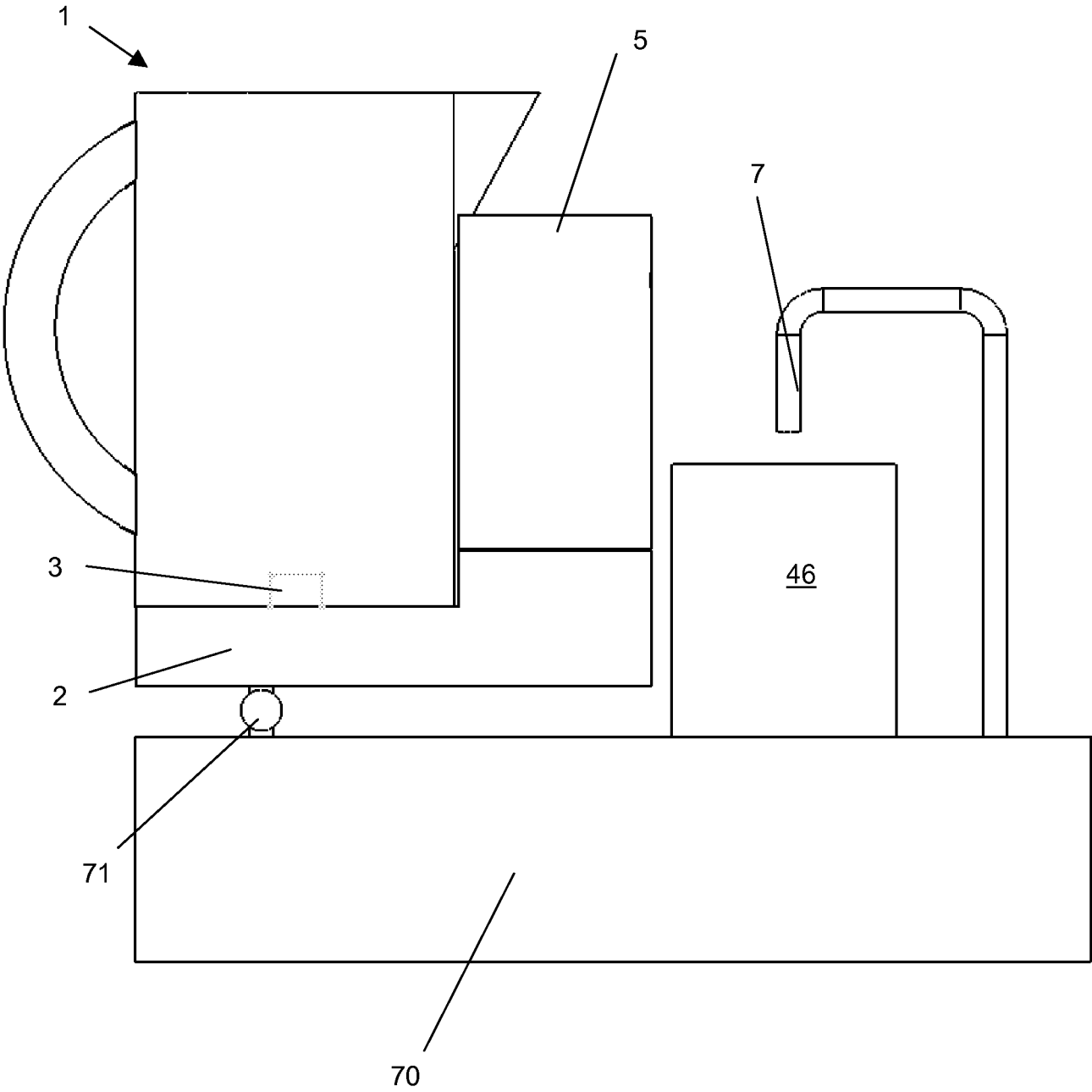


Fig. 7



15/24

Fig. 8

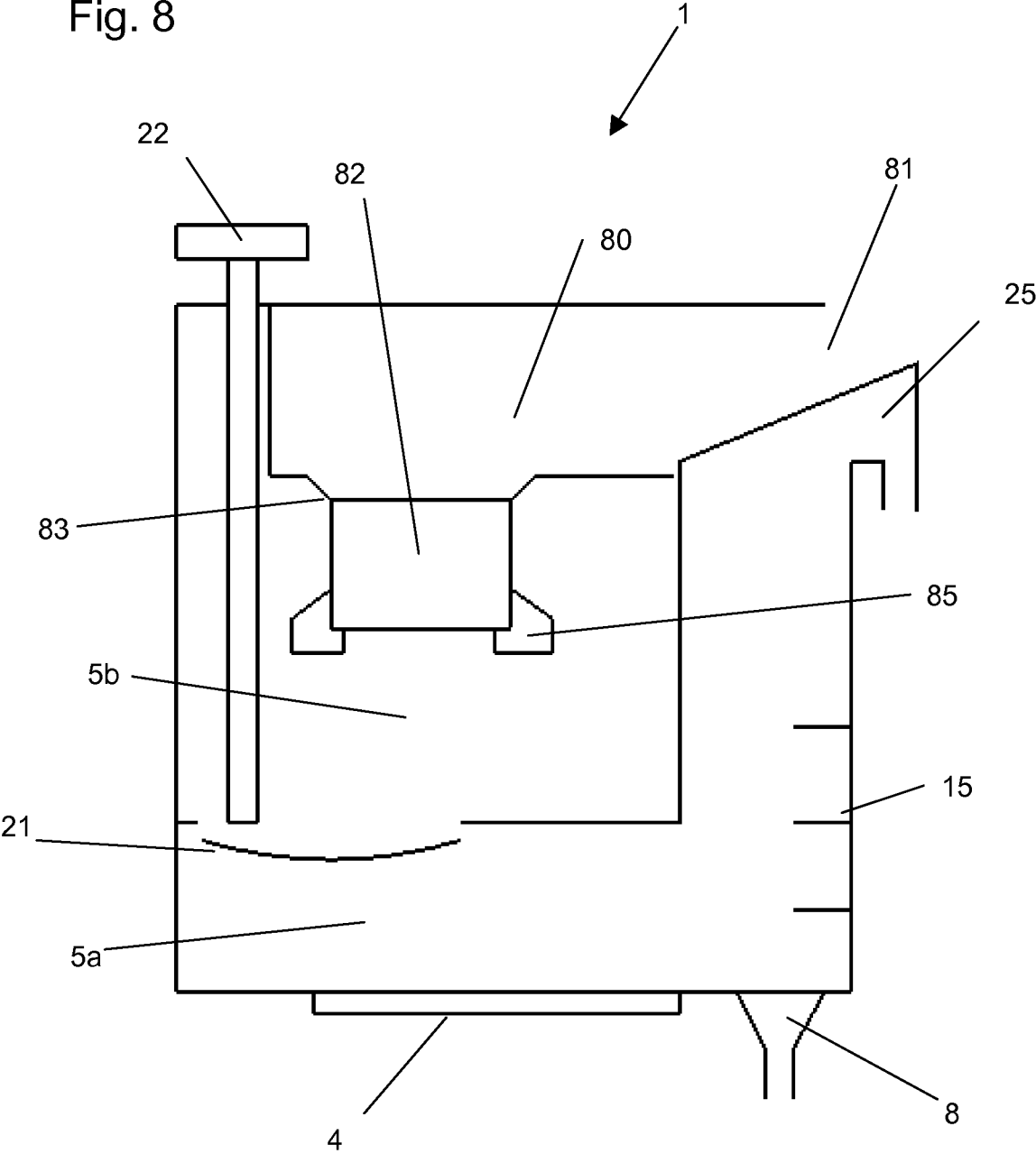
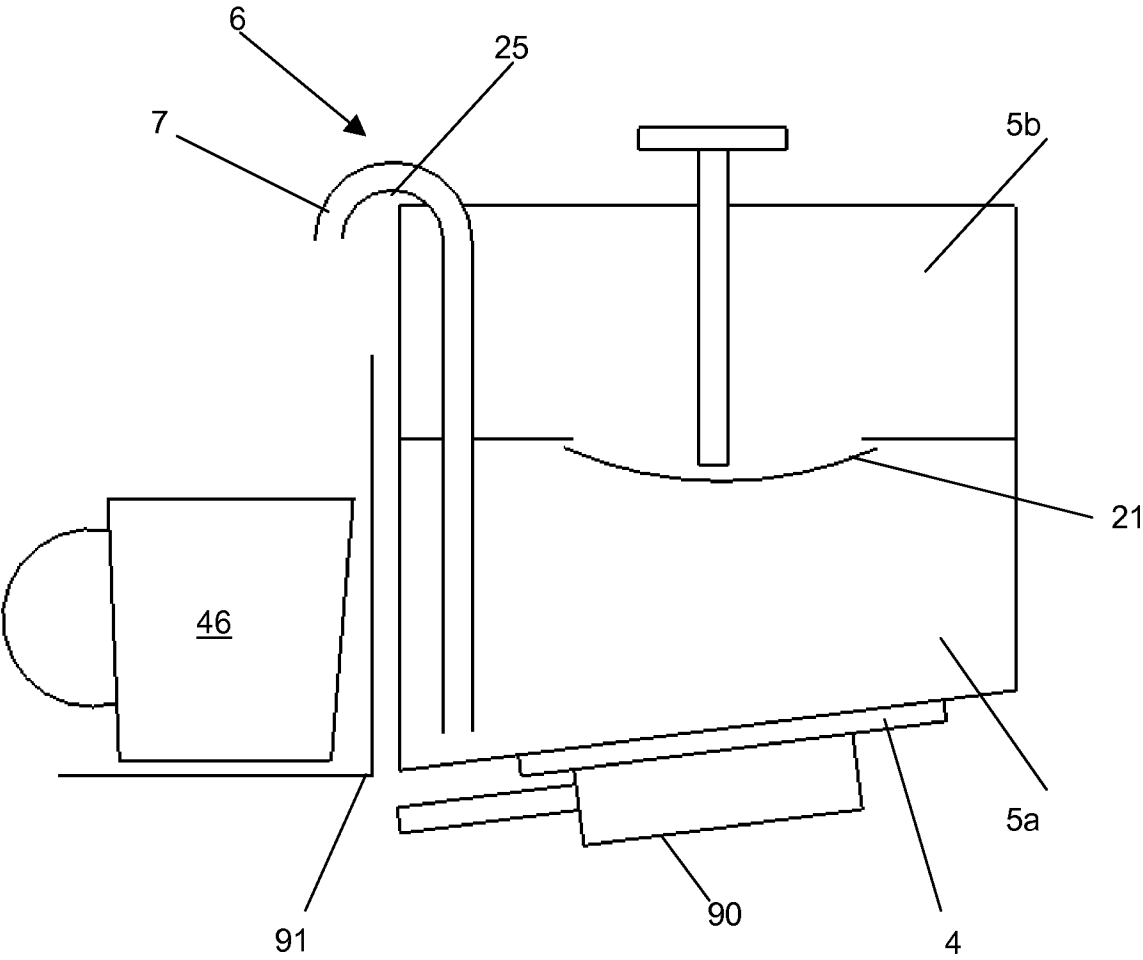
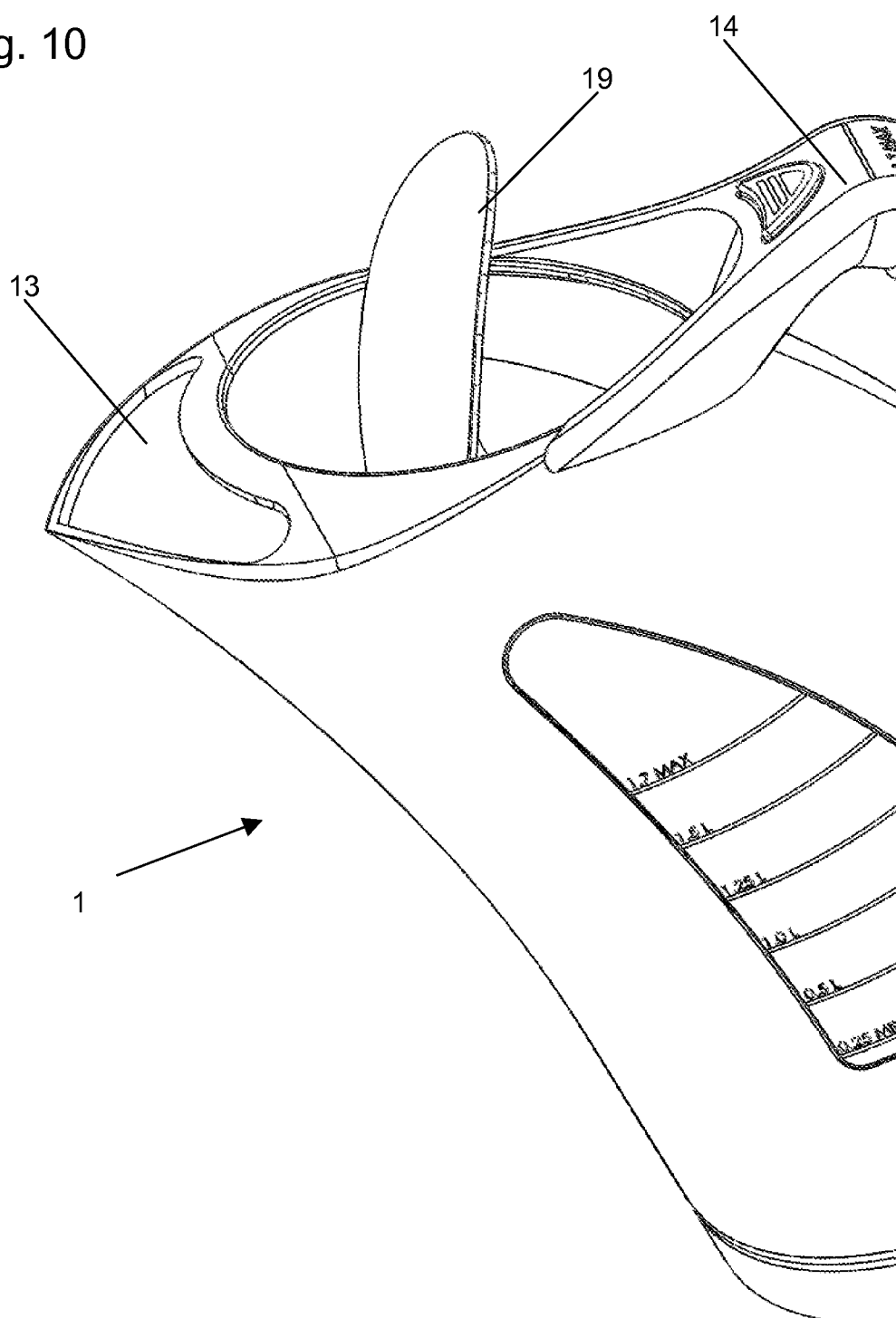


Fig. 9



17/24

Fig. 10



18/24

Fig. 11a

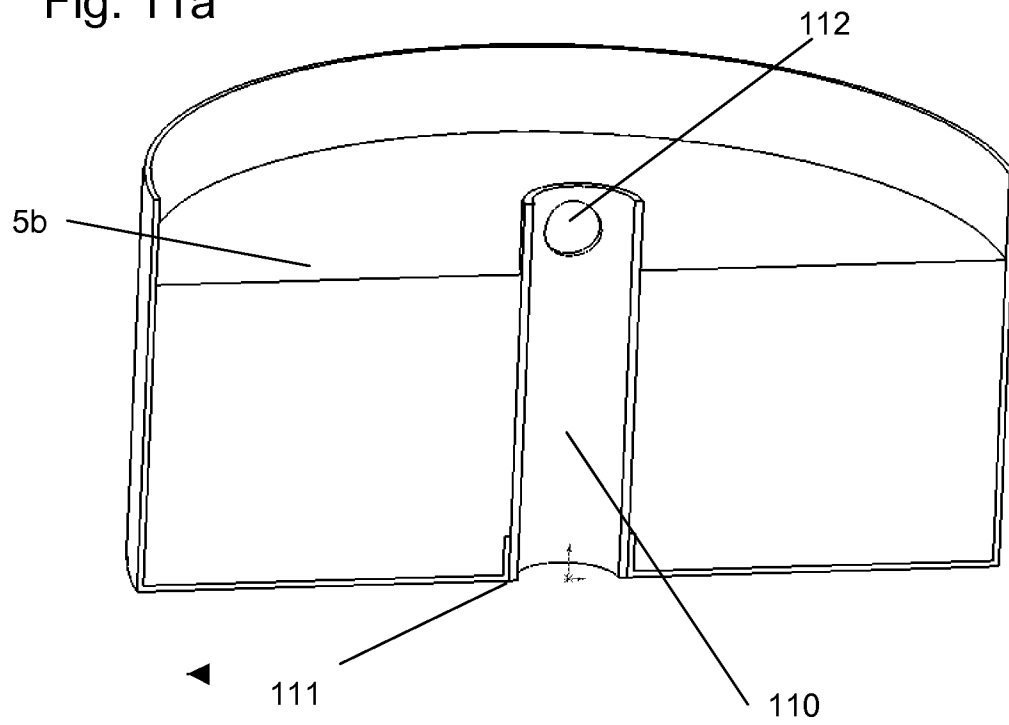
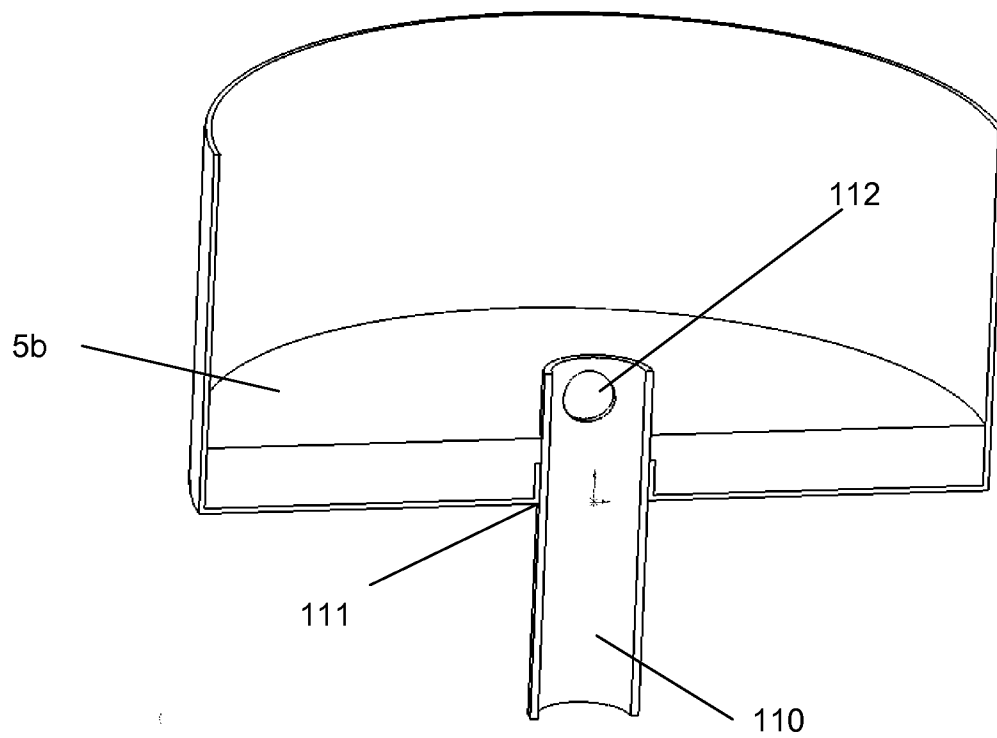


Fig. 11b



19/24

Fig. 12a

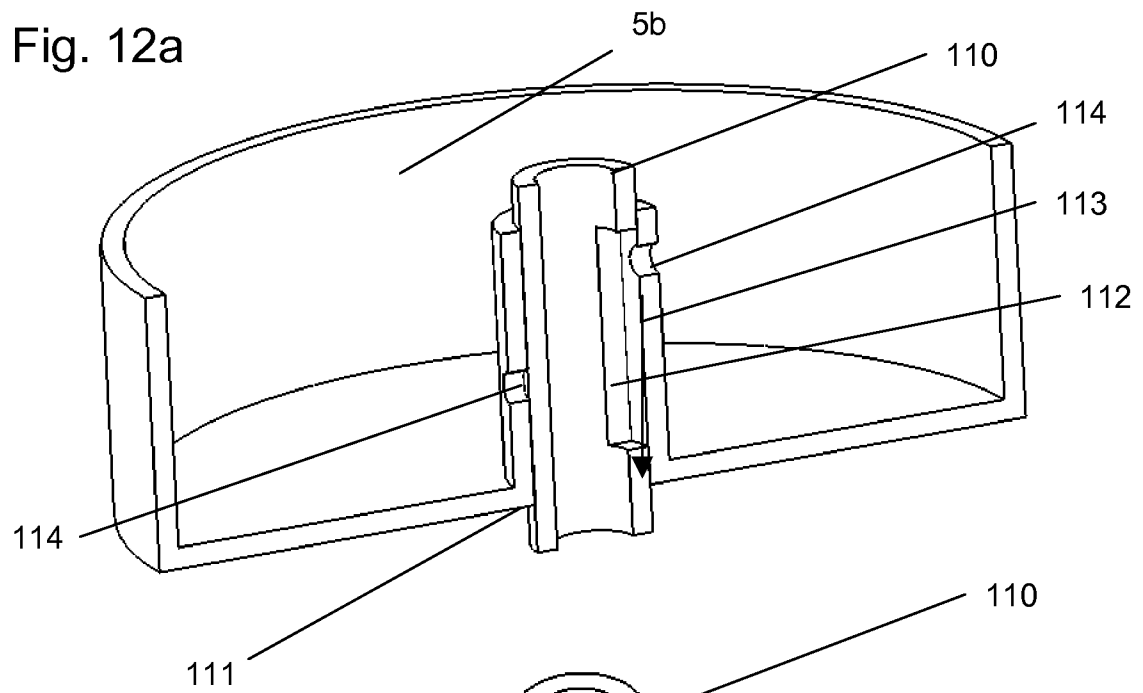
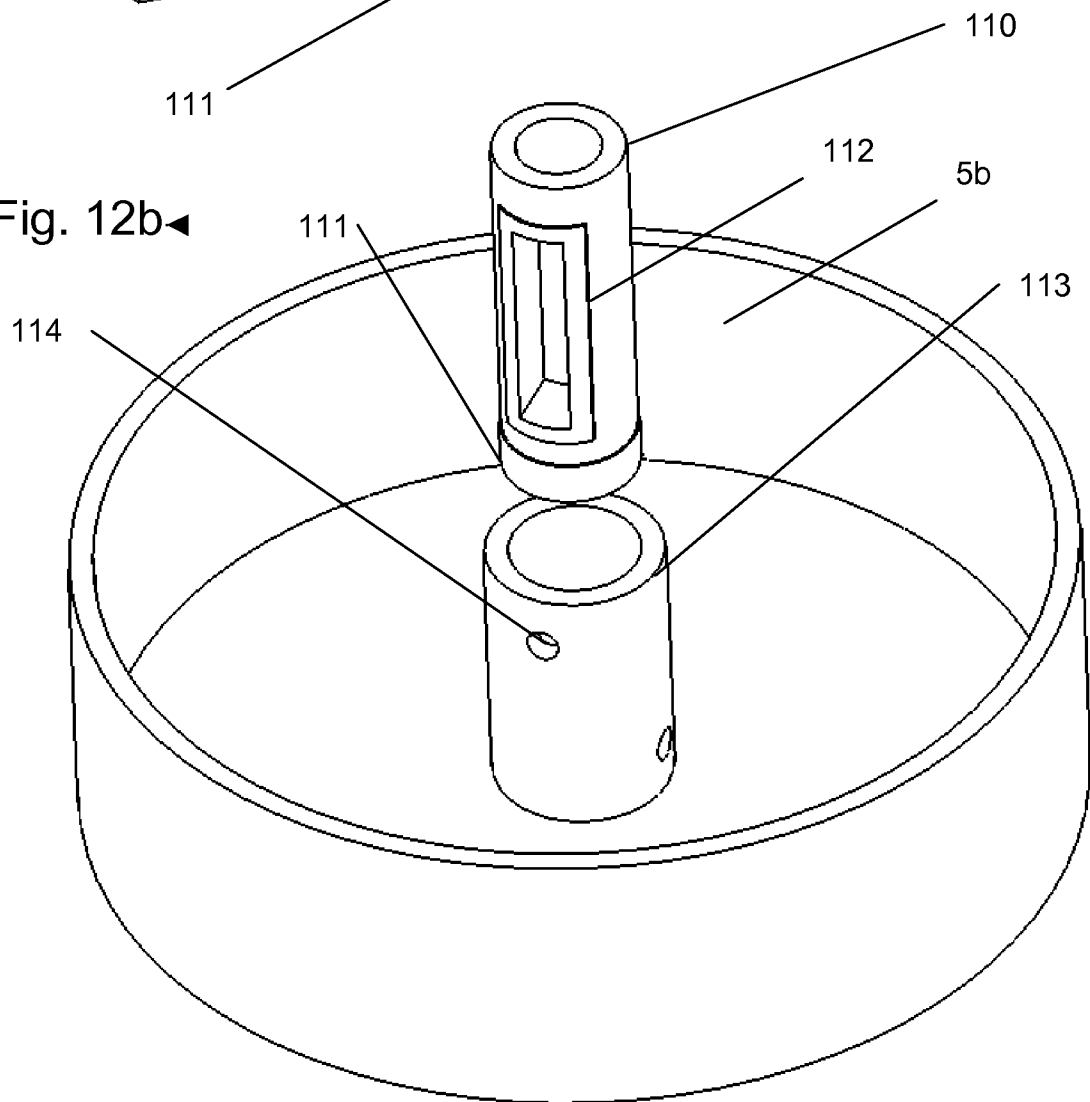


Fig. 12b



20/24

Fig. 13a

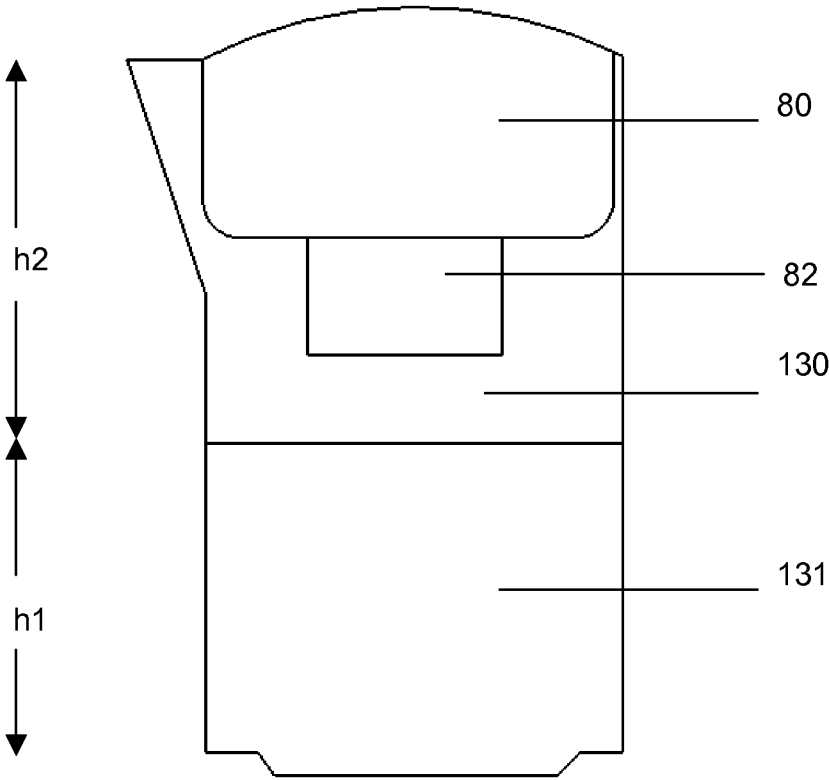


Fig. 13b

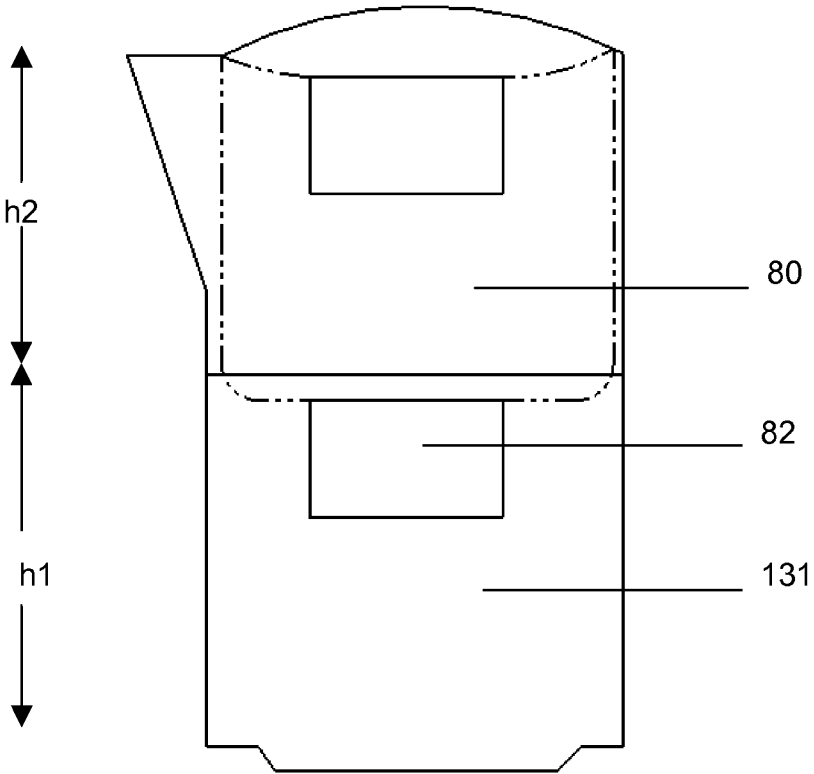


Fig. 14

21/24

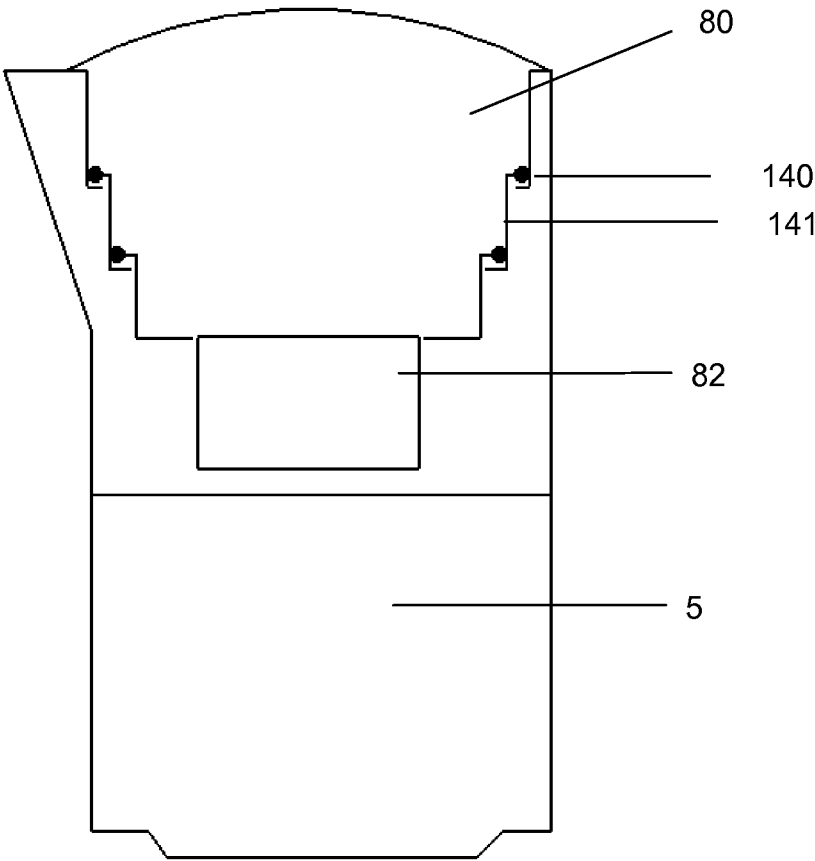
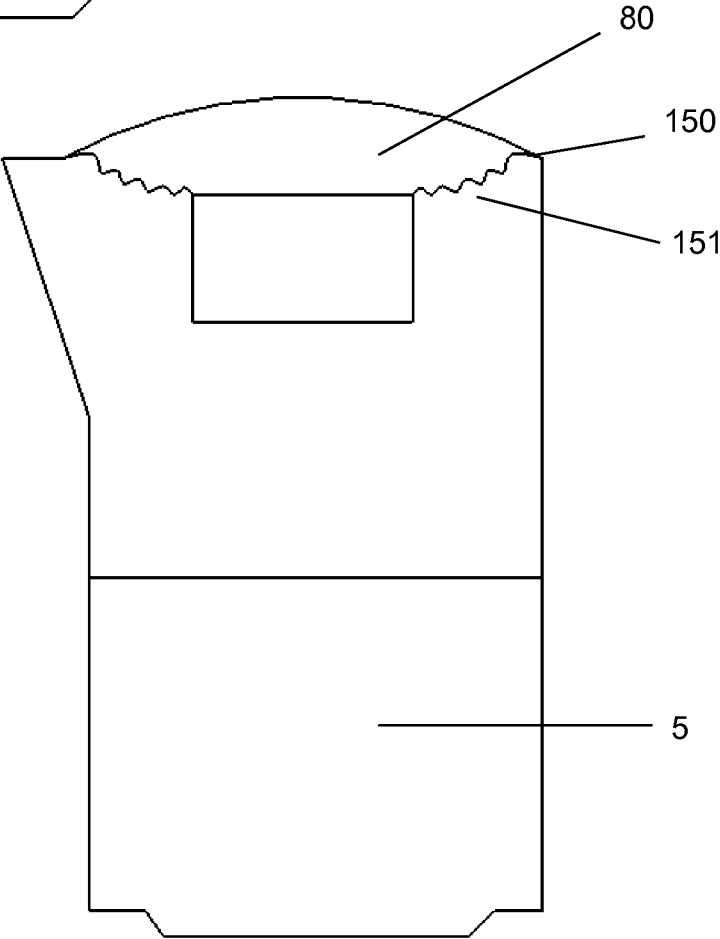
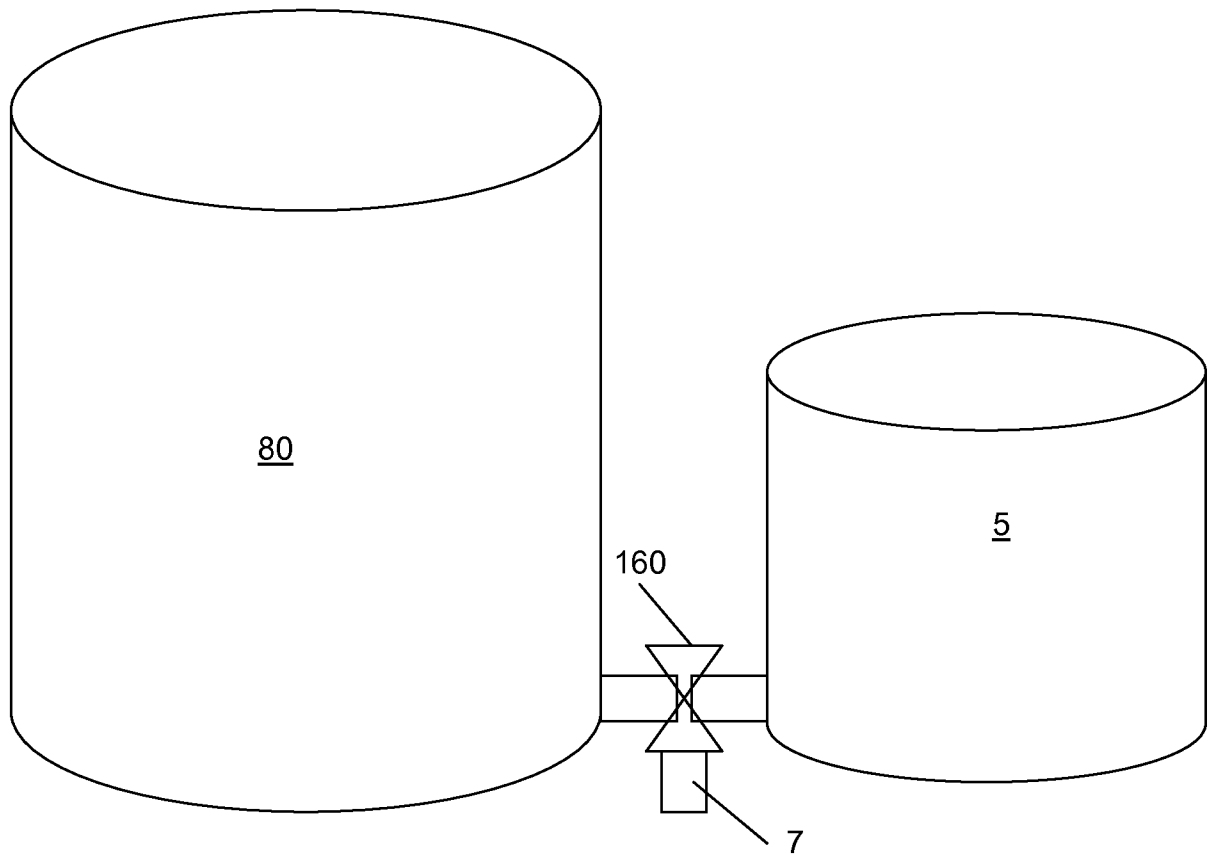


Fig. 15



22/24

Fig. 16



23/24

Fig. 17

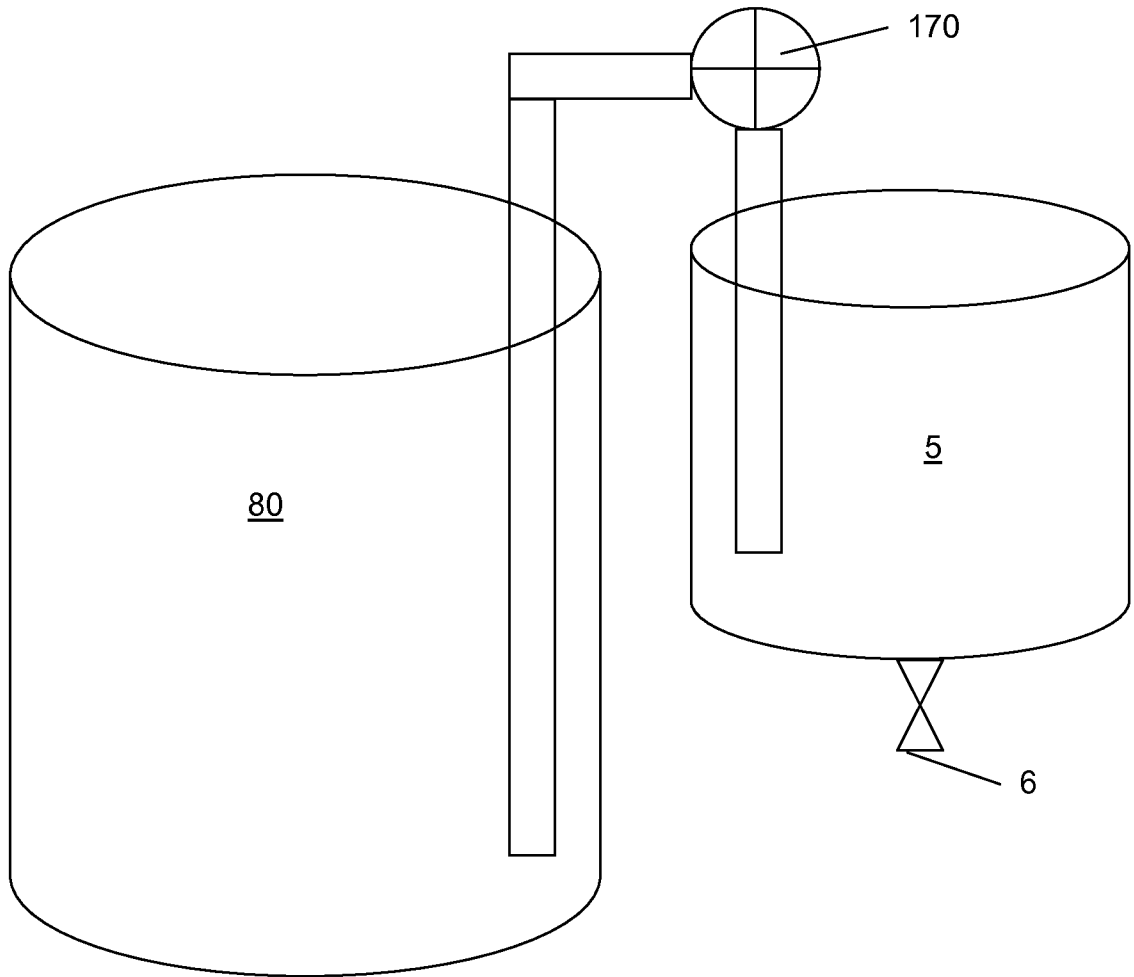


Fig. 18

