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(54) Household appliance for the supplying of cooled water or other beverage and relative operation method

(57) Household appliance (2) for the supplying of cooled water or other beverage having a tank (4) communicating directly with a source (8) supplying the beverage at above atmospheric pressure; means (5) for controlling the outflow of the water or other beverage from the tank (4); a cooling assembly (9) for cooling the beverage inside the tank (4); and a control unit (10) for controlling the cooling assembly (9) to bring the beverage inside the tank (4) to, and maintain it at, a reference temperature below or equal to the freezing temperature (T_0) of the beverage; the household appliance (2) also having freezing control means (13) for assisting irregular, non-homogeneous crystallization of the beverage to obtain a semisolid frozen drink mixture.

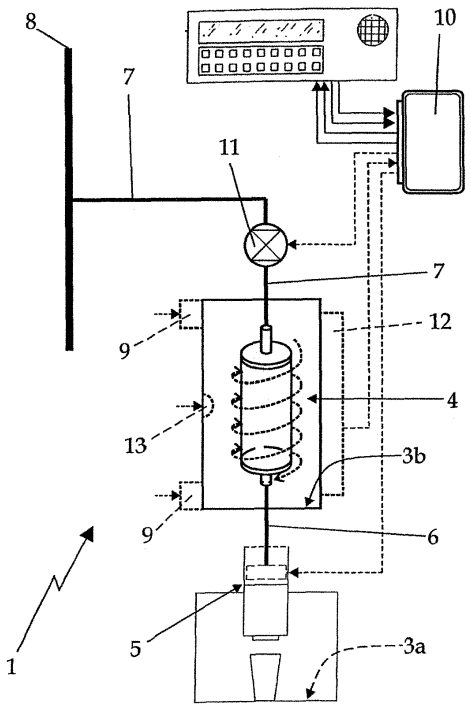

Fig. 2

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Description

[0001] The present invention relates to a household appliance for the supplying of cooled water or other beverage and to the relative operation method.

[0002] More specifically, the present invention relates to a household cooled-drink dispenser integrated in a household appliance as a free-standing or built-in refrigerator or a stand-alone unit, to which the following description refers purely by way of example.

[0003] As is known, household refrigerators have been marketed for some years now in which the door has a built-in cooled-water dispenser, which substantially comprises a tank for storing water or any other beverage to be dispensed; a cooling assembly for bringing the water inside the tank to, and maintaining it at, a predetermined reference temperature above the freezing temperature (i.e. 0°C) of water and normally ranging between 8°C and 15°C; and a metering valve located at a drink dispensing recess formed in the outer surface of the refrigerator door. The valve is connected to the bottom of the tank by a connecting pipe, and is designed to only allow controlled outflow of water from the tank to the drink dispensing recess underneath when the recess is engaged by a glass or other container to receive the water.

[0004] Unfortunately, integrating the cooled-drink dispenser inside the door of the refrigerator reduces the capacity of the tank and performance of the cooling assembly, thus seriously affecting operation of the dispenser.

[0005] The cooled-drink dispenser in fact can only dispense the water or any other beverage at the desired temperature after the tank has been filled by the user with the desired beverage, and after the cooling assembly has brought the beverage inside the tank to the set reference temperature.

[0006] In addition to the above operating drawbacks, the inside of the tank is an ideal receptacle for mould and bacteria, with all the risks this involves in the event the cooled-drink dispenser is only used sporadically, and the beverage is allowed to stagnate inside the tank for long periods of time.

[0007] It is an object of the present invention to provide a cooled-drink dispenser for household appliances as free-standing or built-in refrigerators or stand-alone units, designed to eliminate the aforementioned drawbacks.

[0008] According to the present invention, there is provided an appliance (in particular a household appliance) for the supplying of cooled water or other beverage as claimed in Claim 1 and preferably, though not necessarily, in any one of the dependent Claims.

[0009] According to the present invention, there is also provided an operating method of an appliance for the supplying of cooled water or other beverage.

[0010] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a view in perspective of a household refrigerator featuring a cooled-drink dispenser in accordance with the teachings of the present invention;

Figure 2 shows, schematically, the cooled-drink dispenser integrated in the Figure 1 refrigerator;

Figure 3 shows, schematically, a variation of the cooled-drink dispenser shown schematically in Figure 2;

Figure 4 shows, schematically, an alternative embodiment of the cooled-drink dispenser of the present invention; and

Figure 5 illustrates part of the dispenser of Figure 4 in a working condition.

[0011] With reference to Figures 1 and 2, number 2 indicates as a whole a household appliance, preferably a refrigerator, having integrated therein a cooled-drink dispenser 1, so as to be suitable to supply cooled water or other beverage.

[0012] The cooled-drink dispenser 1 is preferably integrated inside a door 3 of the appliance 2.

[0013] The cooled-drink dispenser 1 comprises a tank 4 for temporarily storing water or any other beverage to be dispensed. In particular, the tank 4 is designed so that it can be completely filled by the water or other beverage, although during operations it can be also partially refilled.

[0014] The dispenser 1 also comprises a metering valve 5 which, in the example shown, is located at a drink dispensing recess 3a formed in the outer surface of door 3 of refrigerator 2. The valve 5 is connected to tank 4 by a connecting pipe 6, and is designed to only permit controlled outflow of water or any other beverage from tank 4 to recess 3a when recess 3a is engaged by a glass or other container to receive the water.

[0015] The tank 4 is completely housed, in the example shown in Figs. 2, inside a cooling compartment 3b formed in the door 3 above recess 3a; alternatively, as shown in the embodiment of Figure 4 described later, the tank 4 may have parts extending outside the compartment 3b. The cooled-drink dispenser 1 also comprises a second connecting pipe 7 permanently connecting tank 4 to a source 8 of pressurized water or other beverage so that tank 4 is always completely filled with water and does not contain air. The dispenser 1 further comprises a cooling assembly 9 which, on command, cools the liquid inside tank 4, and an electronic central control unit 10 which controls cooling assembly 9 on the basis of signals from a temperature sensor (not shown) for determining the temperature of the liquid inside tank 4, so as to bring the water or other beverage inside tank 4 to, and maintain it at, a reference temperature below or equal to the freezing temperature To (i.e. 0°C) of water or other beverage.

[0016] More specifically, source 8 supplies water or any other beverage continuously at above atmospheric pressure, and the cooled-drink dispenser 1 preferably, though not necessarily, also comprises an on-off valve 11 located along connecting pipe 7, upstream from tank 4, and which, on command, isolates tank 4 from source

8 to cut off flow of water or other beverage.

[0017] In the example shown, source 8 is defined by the drinking water circuit of the building in which refrigerator 2 is located.

[0018] Tank 4 is advantageously defined by a variable-capacity container 4, which is preferably airtight.

[0019] In the example shown, tank 4 is defined by a tubular body made of elastically deformable material, for instance silicone. The tubular body may be closed hermetically at both ends by two caps of rigid material to form a variable-volume closed container. The two caps are connected to the two connecting pipes 6 and 7 to allow water to flow from source 8 to metering valve 5 via the whole of tank 4. Alternatively, the two ends may be properly extruded so as to fit with the two connecting pipes, and/or they can be fastened to the connecting pipes by means of hose clamps.

[0020] In an alternative embodiment, tank 4 may be defined by a hermetically closed rigid container of constant internal volume and housing a closed capsule or container made of elastically deformable material and filled with gas.

[0021] The length, the internal diameter and the wall thickness of the tank 4 may vary depending on the design and specifications of the dispenser, such as the amount and the temperature of the liquid to be dispensed. In the schematic illustrations of Figure 2, the tank is a relatively short and large cylinder, while in the illustration of Figure 4 it is an elongated tubular body. For example, the tank 4 can be a silicone tube of 1 m length and 18 mm internal diameter.

[0022] In the example shown, cooling assembly 9 comprises a number of electric fans which, on command, circulate, inside compartment 3b, a stream of cold air at a temperature below temperature T_0 and/or a stream of hot air at a temperature above temperature T_0. The electronic central control unit 10 is able to control the fans to alternate and/or mix the two air streams to bring the liquid inside tank 4 to, and maintain it at, around freezing temperature T_0. The stream of cold air may come from the freezer compartment of refrigerator 2 storing frozen food requiring a temperature of -25°C to -20°C, and the stream of hot air may come from the fresh-food compartment of refrigerator 2 storing fresh food requiring a temperature of 2°C to 8°C.

[0023] The fans may be replaced by a conventional heatpump refrigeration circuit in which the evaporator is housed inside compartment 3b, close to tank 4, or by other refrigeration means.

[0024] With reference to Figure 2, the cooled-drink dispenser 1 may also comprise a sensor 12 for determining and communicating to the electronic central control unit 10 the amount of solid-state water or other beverage contained at all times inside tank 4. Moreover, depending on the design of the tank 4, the dispenser may also comprise means for preventing the formation of a single block of frozen liquid occupying the whole volume of tank 4 so as to obtain a biphasic (liquid state plus solid state) frozen liquid mixture, and preferably for assisting irregular, non-homogeneous crystallization of the liquid inside tank 4, so as to obtain a semisolid, high-viscosity, frozen liquid mixture.

[0025] More specifically, the cooled-drink dispenser 1 may comprise a freezing process control device 13 designed to force the liquid freezing inside tank 4 to crystallize irregularly and non-homogeneously into a semisolid, high-viscosity mixture or slurry.

[0026] In the example shown in Figure 2, the freezing process control device 13 is defined by an ultrasonic-frequency vibration emitter positioned close to tank 4, and which, under the control of electronic central control unit 10, breaks up the ice or crystallized beverage formed in tank 4 to obtain said semisolid, high-viscosity mixture of frozen water or other beverage.

[0027] As an alternative to vibration emitter, the formation of a block of ice or frozen beverage inside tank 4 may also be prevented by cyclically and locally heating areas of tank 4 under the control of electronic central control unit 10, e.g. by means of a number of appropriately controlled resistors arranged inside the tank, to prevent the ice or frozen beverage crystals from adhering permanently to and forming layers on the walls of the tank.

[0028] In an alternative embodiment, tank 4 may also be designed and/or cooled to restrict the formation of ice or frozen beverage crystals to certain predetermined points on the wall of the tank. In which case, freezing process control device 13 may be defined by an electrically operated propeller or stirring body housed inside tank 4 to keep the liquid inside the tank moving and detach the ice or frozen beverage crystals from the wall as they are formed.

[0029] In the embodiment illustrated in Figure 4, the dispenser 1 can be realized without any freezing process control device, since the tubular body defining the tank 4 is so designed that, even if ice is formed therein so as to obstruct the passage when no liquid is supplied, it can radially expand when there is a sufficient pressure of liquid at its entrance, so as to allow liquid flow. As shown in Figure 5, the dispenser 1 of Figure 4 is therefore designed so as to allow passage of a liquid 20 between the ice formed inside tank 4, indicated with 19, and the internal wall of tank 4. The radial arrows indicate the outwardly expansion of the tank 5 when liquid (water or other beverage) is supplied at a pressure higher than atmospheric pressure.

[0030] To achieve the required liquid pressure, the dispenser 1 may also include a pump 18 along pipe 6. Alternatively, a pump could be included along pipe 7.

[0031] As shown in the embodiment of Figure 4, the dispenser 1 may be designed so that some portions 4a of the tank 4, but their ending parts, are internal the compartment 3b, while others, indicated with 4b, are external. The internal portions 4a are preferably straight and parallel with each other, while the external portions 4b, defining interconnection portions, are preferably bent. The

external portions 4b and the endings parts of portions 4a are substantially at environmental temperature, so that ice formation is prevented in these parts.

[0032] Alternatively, the tank 4 could be a uniform elongated tube properly bent inside the compartment 3b, but the bending radius should be such as to allow the tube expansion when ice is completely formed inside. In fact, the Applicant has observed that, if ice obstructs the passage in a bent portion of the tank, the tank could be unable to expand in that portion to allow liquid flow if the bent is sharp.

[0033] Advantageously, also the initial and the final portions of the tank 4, indicated with 4c and 4d respectively, are external the compartment 3b, so that ice formation is prevented also in these zones, to facilitate liquid flow when the valves 5 and/or 11 are opened.

[0034] Operation of the cooled-drink dispenser 1 will now be described, assuming on-off valve 11 is fully open to connect tank 4 directly to source 8 and to fill tank 4 completely with water from source 8. The temperature of the water supplied by source 8 is obviously greater than the temperature of water or other beverage coming out of cooled-drink dispenser 1.

[0035] In actual use, electronic central control unit 10 controls cooling assembly 9 to bring the liquid inside tank 4 rapidly to below the freezing temperature To of water and so freeze the liquid. If the dispenser comprises also a freezing process control device 13 (i.e. the means for preventing the formation of a block of frozen liquid inside tank 4), the control unit 10 also controls device 13 to force the water or other beverage freezing inside tank 4 to crystallize irregularly and non-homogeneously into a biphasic or semisolid, high-viscosity, frozen drink mixture or slurry.

[0036] By means of sensor 12, electronic central control unit 10 continuously controls the percentage of water that has passed from the liquid state to the solid or semisolid frozen water mixture state inside tank 4, and controls cooling assembly 9 so that the percentage of water in the solid or semisolid mixture state does not exceed a predetermined maximum threshold ranging between 50% and 90% of the maximum capacity of tank 4, so as to ensure free circulation of the water at all times inside tank 4. As previously explained, this control may be absent in the embodiment of Figure 4.

[0037] The cooled-drink dispenser 1 is ready to dispense cooled water as soon as a sufficient amount of solid or semisolid frozen water mixture is produced inside tank 4.

[0038] Insertion of a glass inside recess 3a in door 3 opens metering valve 5 to allow the water in tank 4 to flow along connecting pipe 6 into the glass.

[0039] Tank 4 being connected directly to pressurized-water source 8, the outflow of cooled water from tank 4 along connecting pipe 6 is accompanied by a simultaneous inflow into tank 4 of an equal amount of water at ambient temperature from source 8. Inside tank 4, the water at ambient temperature from source 8 mixes with and partly melts the solid or semisolid frozen water mixture to form cooled water at a temperature of 8°C to 15°C (i.e. at a temperature below ambient temperature), which flows immediately along connecting pipe 6 into the glass.

[0040] In the embodiment of Figure 4, if the tank 4 is obstructed by ice, the wall of the tank 4 expand outwardly due to the pressure of the incoming liquid, so as to allow passage of liquid between the ice block and the wall itself.

[0041] By appropriately regulating ambient-temperature water flow into tank 4 (which can be done by electronic central control unit 10 appropriately controlling on-off valve 11) and the amount of solid or semisolid frozen water mixture inside tank 4, cooled water at a temperature of 8°C to 15°C can be obtained inside tank 4 for immediate supply along connecting pipe 6 into the glass.

[0042] Cooled-drink dispenser 1 has numerous advantages. Above all, it provides for dispensing a quantity of cooled water, at a temperature ranging between 8°C and 15°C, much greater than the nominal capacity of tank 4, by using the solid or semisolid frozen water mixture as a thermal flywheel to rapidly cool the water from source 8.

[0043] The fact that tank 4 is always filled completely with water at a temperature of substantially 0°C considerably reduces the growth-rate of mould and bacteria.

[0044] Clearly, changes may be made to the household appliance 1 as described herein without, however, departing from the scope of the present invention.

[0045] For example, with reference to Figure 3, the cooled-drink dispenser 1 may comprise, downstream from tank 4, an electrically operated hydraulic mixer 14 for mixing the cooled water flowing out of tank 4 along connecting pipe 6 with the ambient-temperature water from source 8.

[0046] More specifically, hydraulic mixer 14 is a three-way mixer having a first inlet connected to tank 4 by connecting pipe 6; a second inlet connected to connecting pipe 7, upstream from tank 4 and downstream from on-off valve 11, by a bypass pipe 15; and one outlet connected to metering valve 5 by a connecting pipe 16.

[0047] In this variation, electronic central control unit 10 controls hydraulic mixer 14 on the basis of signals from a temperature sensor for determining the temperature of the water supply to metering valve 5, so as to adjust the temperature of the water supplied to metering valve 5 by appropriately mixing the cooled water from tank 4 with the ambient-temperature water directly from source 8.

[0048] In another embodiment the household appliance 1 described above may have other uses. For example it can be used for cooling down the water in entrance to a traditional icemaker. In that case metering valve 5 is replaced by a traditional electrically controlled throttle valve or on-off valve located just before the icemaker so as to control the outflow of the water from tank 4 to the icemaker.

Claims

1. An appliance (2) for the supplying of cooled water or other beverage, comprising an airtight tank (4) for temporarily storing the water or other beverage, a flow control device (5) for controlling the outflow of the water or other beverage from the tank (4), a cooling assembly (9) for cooling the water or other beverage inside said tank (4), and a control unit (10) for controlling said cooling assembly (9) to bring the water or other beverage inside the tank (4) to, and maintain it at, a predetermined reference temperature;
the appliance (2) being **characterized in that** said tank (4) is suitable to be completely filled by the water or other beverage and it communicates with a source (8) supplying said water or other beverage at a pressure higher than atmospheric pressure, and **in that** said control unit (10) is configured to control said cooling assembly (9) to bring the water or other beverage inside said tank (4) to, and maintain it at, a reference temperature below or equal to the freezing temperature (T_0) of said water or other beverage, so as to freeze the water or other beverage.

2. An appliance as claimed in Claim 1, further comprising a freezing control device (13) operating on said tank to produce in said tank a liquid and solid state mixture.

3. An appliance as claimed in claim 1 or 2, **characterized in that** said tank (4) is a closed, variable-capacity container (4).

4. An appliance as claimed in any one of the foregoing claims, **characterized in that** said tank (4) comprises a tubular body made of an elastomeric material.

5. An appliance as claimed in claim 4, **characterized in that** said tubular body is made of silicone.

6. An appliance as claimed in any one of the foregoing claims, **characterized in that** it further comprises a cooling compartment (3b) housing at least part of said tank (4), said cooling assembly (9) being suitable to cool said compartment (3b).

7. An appliance as claimed in claim 6, **characterized in that** said tank (4) comprises a plurality of longitudinal portions (4a) at least partially internal said compartment (3b), and at least one interconnection portion (4b) connecting two consecutive longitudinal portions (4a) and external said compartment (3b).

8. An appliance as claimed in claim 7, **characterized in that** said tank (4) comprises also an initial portion (4c) and a final portion (4d) external said compartment (3b).

9. An appliance as claimed in any one of the foregoing claims, **characterized by** also comprising an on-off valve (11) interposed between the tank (4) and said source (8); said on-off valve (11) being configured so as to isolate, on command, said tank (4) from said source (8) to cut off flow of the beverage.

10. An appliance as claimed in any one of the foregoing claims, **characterized by** also comprising a hydraulic mixer (14) having two inlets connected respectively to said tank (4) and to said source (8), and one outlet connected to said flow control device (5); said hydraulic mixer (14) being configured to mix, on command, the cooled water or other beverage from the tank (4) with the ambient-temperature water or other beverage from said source (8), and to feed the resulting mixture to said flow control device (5) for controlling the outflow of the water or other beverage.

11. An appliance as claimed in claim 2, **characterized in that** said freezing control device (13) comprise a frequency vibration emitter (13) positioned close to the tank (4), and suitable to break up the frozen water or beverage clusters formed inside the tank (4) to obtain said semisolid frozen drink mixture.

12. An appliance as claimed in claim 2, **characterized in that** said freezing control device (13) comprises means for keeping the water or other beverage inside the tank (4) moving at all times.

13. An appliance as claimed in any one of the foregoing claims, **characterized in that** said source (8) is defined by the drinking water circuit of the building in which the household appliance (2) is located.

14. An appliance as claimed in any one of the foregoing claims, **characterized in that** the flow control device (5) comprises a metering valve (5) connected to the tank (4) and designed to permit controlled outflow of the water or other beverage from the tank (4) into a container positioned temporarily at the metering valve (5).

15. An appliance as claimed in any one of the foregoing claims, **characterized in that** it comprises a door (3), and **in that** said tank (4), said flow control device (5) and said cooling assembly (9) are located on said door (3).

16. A method for the supplying of cooled water or other beverage, **characterized by** comprising the steps of:

    - temporarily storing water or other beverage in an airtight tank (4) suitable to be completely filled by the water or other beverage;
    - cooling the water or other beverage inside said

tank at a reference temperature below or equal to the freezing temperature (T_0) of said water or other beverage, for freezing the water or other beverage;
- supplying further water or other beverage from a source of water or other beverage to said tank at a pressure higher than atmospheric pressure; and
- controlling the outflow of the water or other beverage from the tank.

17. Method as claimed in claim 16, comprising the further steps of:

- controlling the freezing process of said water or other beverage in said tank (4) so as to obtain a liquid and solid state mixture;
- mixing said liquid and solid state mixture with water or other beverage at a higher temperature to obtain a liquid-state cooled water or other beverage; and
- dispensing said liquid-state cooled water or other beverage.

18. Operating method as claimed in claim 16 or 17, wherein the tank (4) comprises an elastic tube suitable to house said frozen water or other beverage and to expand radially when supplied with said further water or other beverage at a pressure higher than atmospheric pressure.

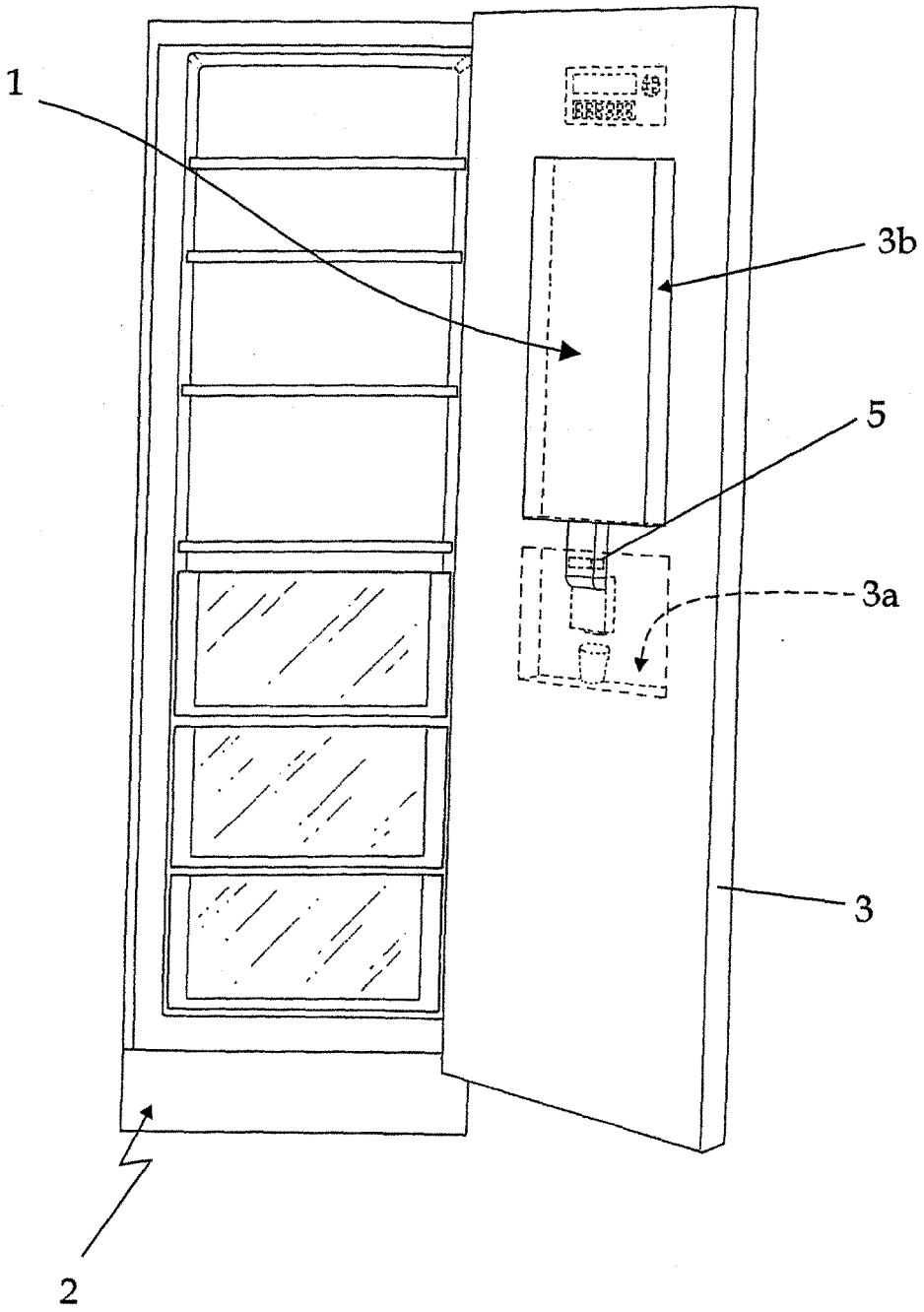

Fig. 1

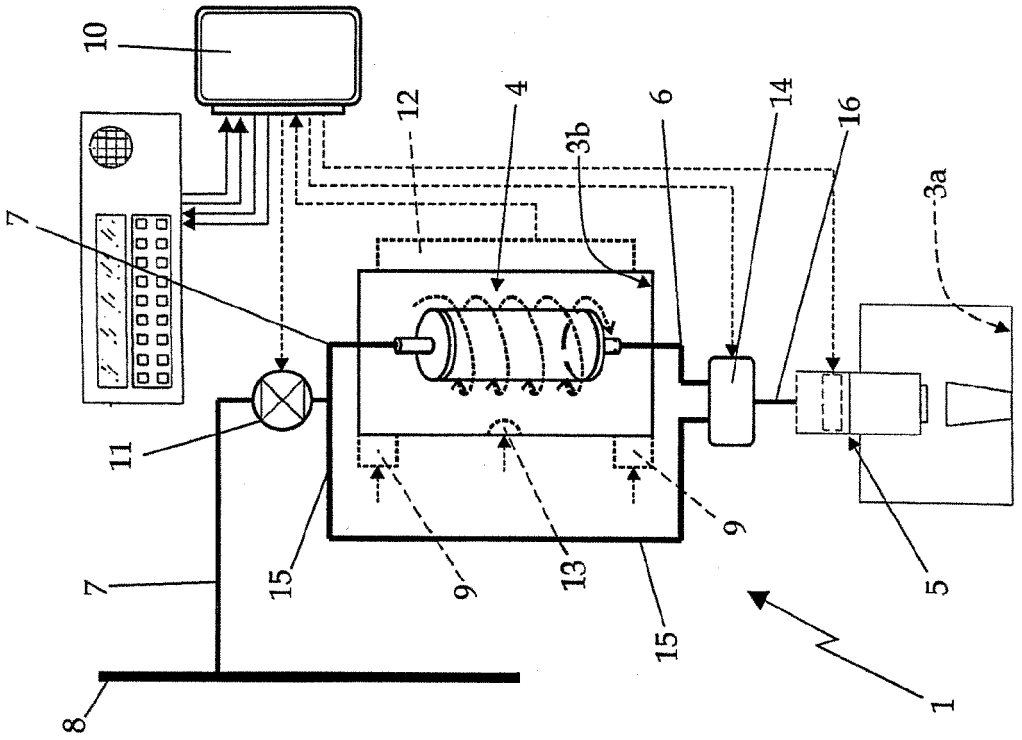
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Fig. 3

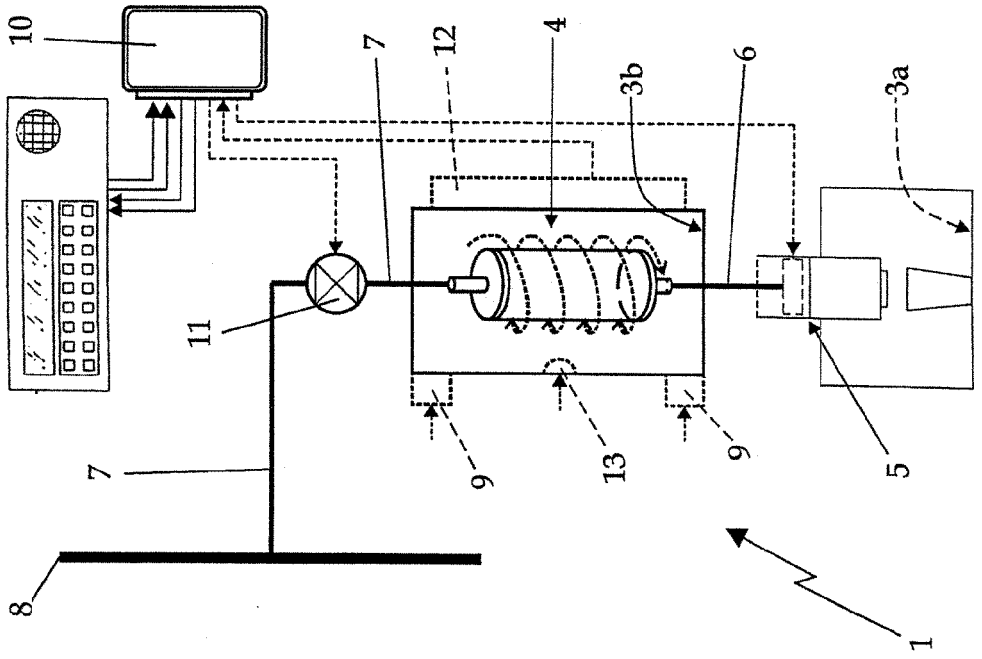
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Fig. 2

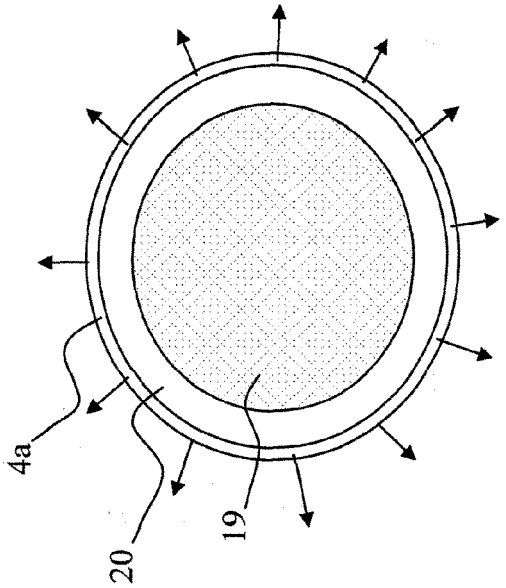

Fig. 5

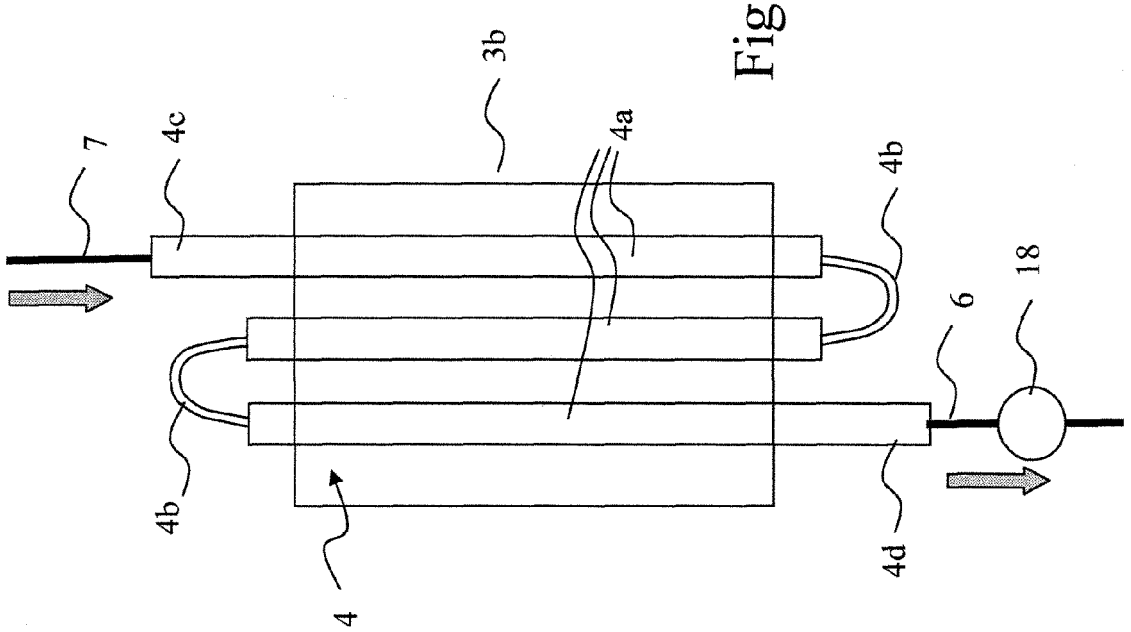

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 07 11 4478

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TECHNICAL FIELDS SEARCHED (IPC)
F25D
A23G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 February 2008	CORREIA DOS REIS, I

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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