(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 489 597 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
29.05.2019 Bulletin 2019/22

(51) Int Cl.:
F25B 21/04 *(2006.01)* ***F25D 31/00*** *(2006.01)*

(21) Application number: **17203295.5**

(22) Date of filing: **23.11.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **RIPRUP Company S.A.**
St. Peter Port GY1 WQ (GG)

(72) Inventor: **BRAUN, Benjamin**
75334 Straubenhardt (DE)

(74) Representative: **Wittmann, Günther**
Patentanwaltskanzlei Wittmann
Frans-Hals-Straße 31
81479 München (DE)

(54) FLOW-TYPE WATER TEMPERING DEVICE FOR A BEVERAGE DISPENSER

(57) The present invention discloses a flow-type water tempering device and a beverage dispenser, comprising:
- a first heat exchanger comprising a water inlet for water to be tempered and a water outlet for tempered water;
- a flow controller for controlling the flow of water through the first heat exchanger;
- a Peltier element comprising a first side and a second side, wherein the first side is thermally coupled with the first heat exchanger, wherein the Peltier element further comprises a connector for supplying the Peltier element with electric current; and
- a controller adapted to control supply of current to the connector of the Peltier element such that the first side of the Peltier element cools the first heat exchanger and controls the flow controller such that water flows through the first heat exchanger;
wherein the controller is adapted to control the power delivered to the connector of the Peltier element such that the Peltier element is operated above a predetermined coefficient of performance.

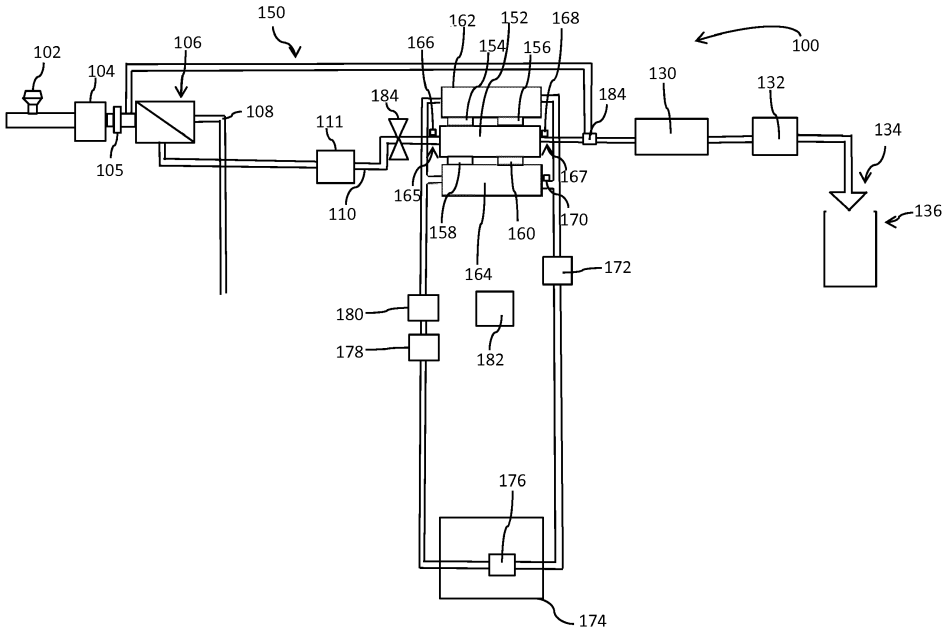

Fig. 1

EP 3 489 597 A1

Description

[0001] The present invention relates to a flow-type water tempering device and a beverage dispenser having such flow-type water tempering device. Water tempering devices are used in beverage dispenser to dispense water or a beverage to a user having the desired temperature.

Related art

[0002] Beverage dispensers are known by the person skilled in the art. Beverage dispensers may be connected to a water tap, wherein the beverage dispenser comprises filter devices for filtering the water from the tap and cooling devices for cooling the beverage to a desired temperature. The beverage dispenser may also comprise a carbonization device for introducing CO_2 into the water. Further, a flavoring device may be comprised by the beverage dispenser in order to bring a flavor desired by a user to the beverage.

[0003] A beverage dispenser generally comprises a cooling device to cool the beverage to desired temperature. This cooling devices may be implemented by an evaporator, in which a fluid is expanded or evaporated. Such cooling devices based on evaporators also require a compressor and condenser. The noise emitted by a compressor is increasingly not accepted by users. Further, the heat radiated from the condenser is reduces the comfort for a user.

[0004] EP 1 797 382 A1 discloses a device for cooling a fluid. A Peltier element may be used for removing heat from a cooling accumulator. The cooling accumulator contains expanded graphite and a phase change material, which passes through a solid-liquid phase change at or above 273K. Such cooling accumulator requires additional space in the beverage dispenser.

[0005] DE 100 15 869 A1 discloses a cooling module having a Peltier element and fan. Fans increase the noise of the cooling module.

Summary of the invention

[0006] It is an object of the present invention to provide a cooling device that emits less noise and requires less space as compared to prior art cooling devices for beverage dispensers.

[0007] The object of the present invention is achieved by a flow-type water tempering device according to claim 1 and a beverage dispenser according to claim 13. The depending claims relate to preferred embodiments.

[0008] A flow-type water tempering device (below tempering device) comprises a first heat exchanger, a Peltier element and a controller. The first heat exchanger comprises a water inlet for water to be tempered and a water outlet for tempered water. The Peltier element comprises a first side and a second side. The first side of the Peltier element is coupled to the first heat exchanger. The Peltier element further comprises a connector for supplying the Peltier element with electric power (current). The controller is adapted to control supply of power (current) to the connector of the Peltier element such that the first side of the Peltier element cools the first heat exchanger. The controller is adapted to control the current and/or power delivered to the connector of the Peltier element such that the Peltier element is operated above a predetermined coefficient of performance.

[0009] Prior art cooling devices for beverage dispensers are implemented by a cooling circuit having an evaporator, condenser and compressor. In such devices, the water to be cooled is generally stored in a tank thermally coupled to the evaporator of the cooling circuit. In such tanks bacteria can multiply deteriorating the quality of the water to be cooled. In contrast thereto, the water flows during cooling through the water tempering device according to the invention. The water in the first heat exchanger does not stagnate during tempering. Thereby, multiplication of bacteria and deterioration of water due to stagnation can be avoided. If the Peltier element is operated such that it is operated above a predetermined coefficient of performance, the amount of heat that is delivered to the ambience is reduced.

[0010] The controller may control the current and/or power delivered to the connector of the Peltier element such that the Peltier element is operated at or below 60 %, preferably at or below 40 %, more preferred at or below 30 % of the rated power of the Peltier element. In another embodiment the controller may control the current and/or power delivered to the connector of the Peltier element such that the Peltier element is operated at or above a coefficient of performance of 60 %, preferably at or above a coefficient of performance of 70 %, more preferred at or above a coefficient of performance of 80 %, most preferred at or above a coefficient of performance of 70%.

[0011] The tempering device may comprise a second heat exchanger thermally coupled to the second side of the Peltier element. The tempering device may further comprise a third heat exchanger thermally coupled to ambient media. The ambient media may be air, such as the air of a room, in which the beverage dispenser is located. The tempering device further comprises a heat exchange fluid circulating through the second and third heat exchanger. By means of the heat exchange fluid the heat generated at the second side of the Peltier element can be passed to the ambience by the third heat exchanger. Thereby, the temperature at the second side of the Peltier element can be kept as low as possible, preferably close to the ambience temperature such as maximal 5 K above the ambient temperature. Thereby, the coefficient of performance of the Peltier element can be increased and overall heat dissipation reduced.

[0012] In one embodiment the heat exchange fluid may be water, such as demineralized water. In another embodiment the heat exchange fluid may comprise a phase change material, such as water and paraffin (e.g. an

emulsion of water and paraffin). In another embodiment the phase change material may comprise water and salt hydrates. The phase change material may perform a liquid-solid phase change, when the temperature of the phase change material changes from 280 K to 293 K.

[0013] The water tempering device may comprise a flow controller adapted to control the flow of water through the first heat exchanger. The flow controller may be a pump, a valve, a nozzle or a combination thereof. The flow controller may control the amount and/or velocity of water passing through the first heat exchanger. The controller is adapted to control the supply of current to the connector of the Peltier element such that the first side of the Peltier element cools the first heat exchanger and to control the flow controller such that water flows through the first heat exchanger.

[0014] In one embodiment the controller is adapted to control the supply of current to the connector of the Peltier element such that the first side of the Peltier element cools the first heat exchanger and controls the flow controller such that water flows through the first heat exchanger. In this embodiment water flowing through the first heat exchanger is cooled. In another embodiment the controller may be adapted to control the supply of current to the connector of the Peltier element such that the first side of the Peltier element heats the heat exchanger and to control the flow controller such that water flows through the heat exchanger. In this operation mode water flowing through the heat exchanger is heated. In both embodiment the water does not stagnate in the first heat exchanger.

[0015] The tempering device may further comprise an output temperature sensor determining the temperature of the water exiting the first heat exchanger, wherein the output temperature sensor is connected to the controller and wherein the controller is adapted to control the supply of current to the connector of the Peltier element such that water exiting the first heat exchanger has a temperature in a predetermined temperature range and/or to control the flow velocity of water such that water exiting the first heat exchanger has a temperature in a predetermined temperature range. Thereby, the beverage can be held at a temperature or temperature range set or desired by the user. The controller may heat or cool the water flowing through the heat exchanger as desired by the user and set by the user.

[0016] Additionally or alternatively the tempering device may further comprise an input temperature sensor determining the temperature of the water entering the first heat exchanger, wherein the input temperature sensor is connected to the controller. The controller may be adapted to control the supply of current and/or power to the connector of the Peltier element such that water exiting the first heat exchanger has a temperature in a predetermined temperature range and/or to control the flow velocity of the water such that water exiting the first heat exchanger has a temperature in a predetermined temperature range. The flow velocity of water passing through the heat exchanger may be controlled by the flow controller. The first heat exchanger and the Peltier element, respectively may cool or heat the water passing the first heat exchanger as desired and set by the user.

[0017] In one embodiment the flow controller is adapted to control the flow velocity of water such that water exiting the heat exchanger has a predetermined temperature. The lower the flow velocity of water in the first heat exchanger the more heat can be removed from the water or passed to the water.

[0018] In one embodiment of the tempering device at least one Peltier element is sandwiched between the first heat exchanger and the second heat exchanger. Thereby, an efficient transfer of heat from the second side of the Peltier element to the second heat exchanger and an efficient removal of heat from the first heat exchanger to the first side of the Peltier element may be achieved. On each side of the first heat exchanger a plurality of Peltier elements may be arranged between the first and respective second heat exchanger. In a preferred embodiment the first heat exchanger is sandwiched between a plurality of Peltier elements arranged at both sides of the first heat exchanger adjacent to each other. The Peltier elements and the first heat exchanger are sandwiched between at least two second heat exchangers. This configuration allows an efficient transfer of heat from the water to the Peltier elements and from the Peltier elements to the second heat exchanger. Further, space is used efficiently, such as space of a beverage dispenser having the water tempering device according to the present invention.

[0019] In one embodiment the tempering device further comprises a circulation pump circulating the heat exchange fluid between the second and third heat exchanger. The controller is adapted to control the circulation pump such that circulation pump circulates heat exchange fluid, if the temperature of the heat exchange fluid exceeds a predetermined value. The heat exchange fluid may be thermally coupled to a heat exchange fluid sensor that is operatively coupled with the controller. Thereby, the heat exchange fluid circulates through the second and third heat exchanger until the temperature of the heat exchange fluid falls under a predetermined value. The controller may activate the circulation pump as soon as a user selects a beverage at the beverage dispenser and/or as soon as the Peltier element removes heat from the first heat exchanger.

[0020] The flow-type water tempering device may be adapted to store heat generated by the Peltier element. The tempering device may comprise at least one buffer reservoir adapted to temporarily store the circulating heat exchange fluid. The buffer reservoir may be located in the third heat exchanger. The buffer reservoir may be located between the third heat exchanger and the Peltier element and/or the buffer reservoir may be located between the second heat exchanger and the third heat exchanger. The buffer reservoir can store the heat generated by the Peltier element. Thereby, the flow-type water

tempering device according to the present invention may have a smaller heat dissipation area for releasing heat to the ambience as compared to prior art heat exchangers. Due to the smaller heat dissipation area the third heat exchanger requires less space as compared to a condenser of a prior art refrigeration circuit. According to the present invention the heat emitted by the Peltier element is passed to the ambience during a comparably long period. This adds also to the comfort of the user, since no fan is required to pass ambient air over the third heat exchanger. Further, the user experiences a higher subjective well-being, since a lower peak heat radiation is emitted by the third heat exchanger to the ambience as compared to prior art devices. The buffer reservoir may be thermally insulated in order to temporarily store the heat. The heat exchange fluid may flow through the buffer reservoir.

[0021] In one embodiment the buffer reservoir may store and/or buffer energy in the form of heat (heat energy) of at least 142 kJ, preferably of at least 284 kJ, more preferred of at least 426 kJ, still more preferred of at least 568 kJ, most preferred of more than 710 kJ. If the coefficient of efficiency η of the at least one Peltier element is approximately 85 % to 90% approximately 142 kJ are required to cool 2 l of water by 17 K. A power of approximately 600 W has to be supplied to the at least one Peltier element at a flow rate of 0.5 l/min of the water in the first heat exchange for approximately 4 min. The buffer reservoir may store the heat energy for at least 10 min., preferably for at least 20 min., more preferred for at least 30 min. The heat stored in the buffer reservoir is transferred before lapse of 4 hours, more preferred before lapse of 2 hours, most preferred before lapse of 1 hour to the ambience.

[0022] In one embodiment the buffer reservoir volume formed by the at least one buffer reservoir is at least 50 %, preferably at least 60 %, more preferred at least 70 %, still more preferred at least 80 %, most preferred 90 % of the volume of the heat transfer fluid of the flow-type water tempering device.

[0023] Preferably, the buffer reservoir has a volume of at least 0.5 l, preferably a volume of at least 1 l, more preferred of at least 1.5 l, still more preferred a volume of at least 2 l, most preferred a volume of at least 2.5 l. For cooling water at a rate of 0.5 l per minute by about 17 K a power of approximately 600 W is required. This heat is stored by the buffer reservoir and is passed by the third heat exchanger over a comparably period of time to the ambience, such as at least 10 minutes, more preferred at least 20 minutes, most preferred at least 30 minutes. The heat stored in the buffer reservoir is transferred before lapse of 4 hours, more preferred before lapse of 2 hours, most preferred before lapse of 1 hour to the ambience by the third heat exchanger.

[0024] By the buffer reservoir and/or by the use of a heat exchange fluid having a phase change material, the tempering device is adapted to store heat and pass it over a longer period of time to the ambience as compared to prior art devices. Thereby, comfort of the user can be improved and smaller sized heat dissipation areas of the third heat exchanger may be used.

[0025] It is to be understood that the term a Peltier element comprises a plurality of Peltier elements arranged adjacent to the first heat exchanger. The first heat exchanger may be a comparably flat heat exchanger, wherein on both sides of the heat exchanger Peltier elements may be arranged. The term second heat exchanger also comprises a plurality of heat exchangers that may be arranged adjacent to the second side of the Peltier element. A plurality of Peltier elements may be arranged adjacent to one second heat exchanger. The flow-type water tempering device may comprise a plurality of buffer reservoirs, wherein at least one buffer reservoir may be formed integrally with the third heat exchanger.

[0026] The water tempering device may further comprise a circulation pump circulating the heat exchange fluid between the second and third heat exchanger. The controller is adapted to control the circulation pump such that the circulation pump circulates the heat exchange fluid, if power is supplied to the at least one Peltier element and, and if the power supply to the at least one Peltier element is switched off by the controller, the controller controls the circulation pump after a predetermined time span such that no heat exchange fluid is circulated by the circulation pump. Thereby no heat is transported by the heat exchange fluid from the third heat exchanger into the second heat exchanger. The predetermined time span may be shorter than 30 seconds, preferably shorter than 15 seconds, most preferred 0 seconds.

[0027] The invention also relates to a beverage dispenser comprising the flow-type water tempering device described above. The beverage dispenser may further comprise a filter device having an inlet and an outlet, wherein the inlet of the filter device is coupled via optional further components to a water source, such as a tap or a tank and the outlet of the filter device is coupled to the water inlet of the first heat exchanger. The filter device may comprise a single filter or a plurality of filters, such as activated carbon filter, reverse osmosis filter and the like. The beverage dispenser may also comprise a mineralization device having an inlet and an outlet, wherein the inlet of the mineralization device is connected to water outlet of the first heat exchanger. The beverage dispenser also comprises an output section coupled to the outlet of the mineralization device. The water tempering device is tempering the water after filtration. To the filtered water minerals are added, since the water has been demineralized during filtration.

[0028] The beverage dispenser may comprise a valve located downstream of the outlet of the first heat exchanger, wherein the valve is configured to direct water in a first position to the output section and to direct the water in a second position to the inlet of the filter device. The controller may be configured in a filter cleaning mode to apply a current to Peltier element that heats the water

in the heat exchanger and switch the valve into the second position. Thereby, the filter device is thermally cleaned, thermally disinfected or the like.

[0029] The output section may comprise a nozzle for dispensing the beverage into a vessel of the user, such as a glass, carafe or bottle. The output section may also comprise a UV light emitter.

[0030] The beverage dispenser may comprise a heating device, wherein the inlet of the heating device is connected to the outlet of the filter device and the outlet of the heating device is connected to the water inlet of the first heat exchanger. The controller is configured in a cleaning mode to apply a current to the heating device that heats water in the heating device. The water flows through the first heat exchanger, the mineralization device and the output section for cleaning and disinfecting the same.

Short description of the drawing

[0031] The invention is now explained in further detail with reference to an exemplary and non-districting embodiment, wherein:

Figure 1 shows a schematic of a beverage dispenser according to the present invention having the flow-type water tempering device according to the present invention.

Detailed description of the drawing

[0032] Reference is made to figure 1 showing an embodiment of a beverage dispenser 100, such as a water dispenser according to the present invention. The general operation of a beverage dispenser and the underlying filter devices are known to the person skilled in the art and will for the sake of brevity not be explained in detail.

[0033] The water dispenser 100 according to the present invention is connected to a water tap 102 in a room. The water flows from the water tap 102 to an activated carbon filter 104 for filtering chlorine and sediments. Thereafter, the water passes through a reverse osmosis filter 106, in which the water is divided into a concentrate that flows via conduit 108 to a concentrate outlet and into a solvent flowing through conduit 110 to a heating device 111 and a flow-type water tempering device 150.

[0034] The flow-type water tempering device 150 (below tempering device 150) operates such that the water passing through the tempering device 150 has a desired temperature or a temperature set by the user at the outlet of the tempering device 150.

[0035] Water having passed the tempering device 150 is mineralized by a mineralization device 113. Thereafter, a UV emitting device 132 can remove any bacteria that may possibly be in the water, before the water is output by a nozzle 134 into a vessel 136 of a user. The vessel 136 may be a glass, a cup, a bottle, a carafe or the like. It is to be understood that the beverage dispenser 100 may further comprise a flavoring device (not shown) to give the beverage the desired flavor and/or a carbonization device (not shown) for carbonizing the beverage.

[0036] The first heat exchanger, but also further components of the flow-type heat exchanger and/or water dispenser may be made of V4A steel, stainless steel, any steel suitable for use for food or the like.

[0037] The water dispenser 100 comprises the heating device 111 for heating the filtered water. The water may be heated such that the tempering device 150, mineralization device 130, the conduits connecting these devices, and the nozzle 134 be cleaned, disinfected or the like.

[0038] The flow-type water tempering device 150 according to the present invention comprises a first heat exchanger 152, through which water to be cooled passes. An optional inlet sensor 166 measures the temperature of the water flowing through the water inlet 165. The outlet sensor 168 measures the temperature of water flowing through the water outlet 167 of the first heat exchanger 152. The values determined by the inlet sensor 166 at the inlet of the first heat exchanger 152 and by the outlet sensor 168 at the outlet 167 are transmitted to the controller 182 controlling the operation of the tempering device 150.

[0039] If the controller 182 determines that water in the first heat exchanger 152 has to be cooled, the controller 182 supplies a current to the plurality of Peltier elements 154, 156, 158 and 160. The current flow in the Peltier elements 154-160 causes that heat is removed from the first side of the Peltier elements 154-160 directed to the first heat exchanger 152 and that heat is delivered to the second side of the Peltier elements 154-160 facing the second heat exchangers 162, 164. Thereby, water in the first heat exchanger 152 is cooled. The operation of a Peltier element is known to the person skilled in the art and will not be explained herein in further detail.

[0040] The controller 182 can supply current to the Peltier elements 154-160 as soon as water is flowing through the first heat exchanger 152. The water may be pumped through the first heat exchanger 152 by a pump 105. In another embodiment the controller 182 may supply a current to the Peltier elements 154-160 as soon as a user starts the process of selecting a beverage in order to speed up cooling of the water in the first heat exchanger 152.

[0041] During the process of cooling, the controller 182 may open the flow controller 184 in order to allow water entering the first heat exchanger 152. Further, during cooling the outlet temperature sensor 168 determines the temperature of the water at the water outlet 167 and transmits the determined temperature to the controller 182. Responsive to the temperature determined by the outlet sensor 168, the controller 182 can control the current and/or power delivered to the Peltier-Elements 154-160. Alternatively and additionally, the controller 182 can control the amount of water and/or the velocity of

water passing the first heat exchanger 152 by the flow controller 184. By this control the controller 182 can assure that water output at the outlet 167 of the first heat exchanger 152 has the appropriate temperature, i.e. the set temperature.

[0042] The controller 182 may also receive the water temperature at the water inlet 165 from the inlet temperature sensor 166 in order to adapt the control of the supply of current to the Peltier element 154-160.

[0043] The controller 182 is adapted to control the current and/or power delivered to the connector of the Peltier elements such that the Peltier elements 154-160 are operated above a predetermined coefficient of performance.

[0044] The water flows during cooling through the water tempering device 150 according to the invention. The water in the first heat exchanger 152 does not stagnate during tempering. Thereby, multiplication of bacteria and deterioration of water due to stagnation can be avoided. If the Peltier elements 154-160 are operated such that they are operated above a predetermined coefficient of performance, the amount of heat that is delivered to the ambience is reduced.

[0045] The controller 182 may control the current and/or power delivered to the connector of the Peltier element such that each Peltier element 154-160 are operated at or below 60%, preferably at or below 40%, more preferred at or below 30% of the rated power of the respective Peltier element 154-160. In another embodiment the controller 182 may control the current and/or power delivered to the connector of the Peltier elements such that the Peltier elements 154-160 is operated at or above a coefficient of performance of 60 %, preferably at or above a coefficient of performance of 70 %, more preferred above a coefficient of performance of 80 %, most preferred above a coefficient of performance of 90 %.

[0046] The Peltier elements 154-160 deliver heat to the second heat exchangers 162, 164. Through the second heat exchangers 162, 164 a heat exchange fluid passes. The heat exchange fluid may be water. Further, the heat exchange fluid may comprise a phase change material (PCM). The heat exchange fluid may comprise both water and phase change material, such as water and paraffin. A circulation pump 180 passes the heat exchange fluid through the second heat exchangers 162, 164 to the third heat exchanger 176 transferring the heat to the ambience. Since the heat exchange fluid comprises a phase change material, the heat transfer fluid can store more heat as water, since the heat transfer fluid has a higher heat capacity as compared to water and the heat is released to the ambience over a longer period of time but with a lower peak heat release value.

[0047] In order to increase the heat storage capabilities of the tempering device 150 at least one buffer reservoir 172, 174, 178 may be passed by the heat exchange fluid when circulating between the second heat exchangers 162, 164 and the third heat exchanger 174. The at least one buffer reservoir 172, 174, 178 cause that the heat transferred by the Peltier elements 154-168 is stored over a longer period of time within the tempering device 150, before it is released to the ambience by the third heat exchanger.

[0048] The buffer reservoir may be embodied by a single buffer reservoir or a plurality of buffer reservoir. A buffer reservoir may comprise a tank or the like.

[0049] In one embodiment the buffer reservoir 172, 174, 178 may store and/or buffer energy in the form of heat (heat energy) of at least 142 kJ, preferably at least 284 kJ, more preferred of at least 426 kJ, still more preferred of at least 568 kJ, most preferred more than 710 kJ. If the coefficient of efficiency η of the at least one Peltier element 154-160 is approximately 85 % to 90% approximately 142 kJ are required to cool 2 l of water by 17 K. A power of approximately 600 W has to be supplied to the plurality of Peltier elements at a flow rate of 0.5 l/min. The buffer reservoir may store the heat energy at least 10 min., preferably at least 20 min., more preferred at least 30 min. The heat stored in the buffer reservoir is transferred before lapse of 4 hours, more preferred before lapse of 2 hours, most preferred before lapse of 1 hour to the ambience.

[0050] In one embodiment the buffer reservoir volume formed by the at least one buffer reservoir 172, 174, 178 is at least 50 %, preferably at least 60 %, more preferred at least 70 %, still more preferred at least 80 %, most preferred 90 % of the volume of the heat transfer fluid of the flow-type water tempering device.

[0051] Preferably, the at least one buffer reservoir 172, 174, 178 has a volume of at least 0.5 l, preferably a volume of at least 1 l, more preferred of at least 1.5 l, still more preferred a volume of at least 2 l, most preferred a volume of at least 2.5 l. For cooling water at a rate of 0.5 l per minute by about 17 K a power of approximately 600 W is required. This heat is stored by the buffer reservoir and is passed by the third heat exchanger over a comparably period of time to the ambience, such as at least 10 minutes, more preferred at least 20 minutes, most preferred 30 minutes. The heat stored in the buffer reservoir is transferred before lapse of 4 hours, more preferred before lapse of 2 hours, most preferred before lapse of 1 hour to the ambience.

[0052] In a preferred embodiment the at least one buffer reservoir 174 is formed integrally with the third heat exchanger 176. Prior art heat exchangers are optimized for transferring a large amount of heat by comparably large fins the ambience. According to the present invention the third heat exchanger 176 comprises a buffer reservoir 174 that is adapted to store the heat energy. The third heat exchanger 176 and the buffer reservoir 176 of the third heat exchanger are adapted to buffer the energy extracted from the water plus the energy (power) supplied to the Peltier element during one beverage cooling operation state for a predefined time span. The predefined time span may be at least 10 min., preferably at least 20 min., more preferred at least 30 min. The bev-

erage cooling operation state may comprise cooling the beverage that is dispensed into a user vessel. The amount of beverage dispensed to the user vessel in one beverage cooling operation may be at least 2 l (corresponding to approximately 142 kJ stored in the buffer reservoir), preferably at least 4 l (corresponding to approximately 284 kJ stored in the buffer reservoir), more preferred at least 6 l (corresponding to approximately 426 kJ stored in the buffer reservoir), still more preferred at least 8 l (corresponding to approximately 568 kJ stored in the buffer reservoir), and most preferred at least 10 l (corresponding to approximately 710 kJ stored in the buffer reservoir).

[0053] The flow-type water tempering device 100 comprises two operation states. In the cooling operation state a beverage (demineralized water) is cooled and the heat extracted form the beverage flowing in the first heat exchanger 152 plus the energy (power) delivered to the Peltier elements 154-160 is transported by the heat exchange fluid from the second heat exchanger 162, 164 to the at least one buffer reservoir 174 as heat energy. The buffer reservoir 174 stores the heat energy over a predetermined time span and passes the heat energy over the predetermined time span to the ambience in the heat dissipation state. Consequently the third heat exchanger 176 according to the present invention may comprise fins with a smaller size (as compared to a prior art heat exchanger) reducing the total size and volume of the third heat exchanger 176.

[0054] The buffer reservoir 174 may be formed by the third heat exchanger 176, for example the fins of the third heat exchanger 176 may be formed around or at the buffer reservoir 174.

[0055] Since the buffer reservoir 174 of the third heat exchanger 176 can store (buffer) heat energy transported by the heat exchange fluid the flow-type water tempering device 100 can be operated in a flow-type manner although during the beverage cooling state more energy is extracted from the water (and supplied to the Peltier elements 154-160) as is passed to the ambience by the third heat exchanger 176.

[0056] The buffer reservoir 172, 174, 178 does not have to be insulated. In one embodiment, the buffer reservoir 172, 174, 178 can be thermally insulated, for example if the buffer reservoir 172, 178 is positioned in a conduit between the second and third heat exchanger. In a preferred embodiment the buffer reservoir 174 can be formed integrally with the third heat exchanger 176. It is to be understood, that in this embodiment the buffer reservoir 174 may transfer the heat energy stored to the third heat exchanger 176 to dissipate the heat stored in the buffer reservoir 174 to the ambience.

[0057] In one embodiment a heat exchange fluid sensor 170 is thermally coupled with the second heat exchanger 164 and transmits the temperature of the heat exchange fluid to the controller 182. As soon as the temperature of the heat exchange fluid exceeds a predetermined threshold, the controller 182 controls the circulation pump 180 such that it circulates heat exchange fluid between the second heat exchangers 162, 164 and third heat exchanger 176.

[0058] In a preferred embodiment the controller 182 controls the circulation pump 180 such that the circulation pump 180 is activated, if the at least one Peltier element 154-160 is supplied with power. The controller 182 may deactivate the circulation pump 180 as soon as the power supply to the at least one Peltier element 154-160 is deactivated. This embodiment avoids that hot heat exchange fluid can reenter the second heat exchanger 162, 164 after the cooling operation state.

[0059] In one embodiment, the tempering device 150 may comprise a valve 184 through which water passes to the second filter 106. The controller 182 may supply the Peltier elements 154-160 such that water in the first heat exchanger 152 is heated and switch the valve 184 such that the water is passed to the revere osmosis filter 106 in order to thermally clean or disinfect the reverse osmosis filter 106. After cleaning the reverse osmosis filter 106 the valve 184 is switched back to the regular position in which water leaving the first heat exchanger 152 is passed to the mineralization device 130.

[0060] Figure 1 shows that the first heat exchanger 152 is sandwiched between a plurality of Peltier elements 154, 156, 158,160. Two second heat exchangers 162, 164 are sandwiched around the Peltier elements 154, 156, 158,160. In this configuration the Peltier elements 154, 156, 158, 160 are arranged onto opposite sites of the first heat exchanger 152. The two second heat exchangers 162, 164 are also arranged at two opposite sites of the first heat exchanger 152, wherein the Peltier elements 154, 156, 158 160 are interposed between the two second heat exchangers and the first heat exchanger. This allows a comparably flat flow-type water tempering device 100 that has a large heat transfer area between the Peltier elements 154-160 and the first heat exchanger 152 as well as the second heat exchangers 162, 164.

[0061] The present invention has the advantage that the water tempering device 150 and the beverage dispenser 100 according to the present invention emit less noise to the environment, particularly a room. Further, the tempering device 150 and the beverage dispenser 100 according to the present invention release heat generated during cooling the water over a longer period of time, but with a lower peak heat radiation value. Thereby, the comfort of a user is improved and a smaller third heat exchanger 176 may be used.

Claims

1. A flow-type water tempering device, comprising:

- a first heat exchanger comprising a water inlet for water to be tempered and a water outlet for tempered water;

- a Peltier element comprising a first side and a second side, wherein the first side is thermally coupled with the first heat exchanger, wherein the Peltier element further comprises a connector for supplying the Peltier element with electric power; and
- a controller adapted to control supply of power to the connector of the Peltier element such that the first side of the Peltier element cools the first heat exchanger and water flowing through the first heat exchanger from the inlet to the outlet;
- **characterized in that** the controller is adapted to control the power delivered to the connector of the Peltier element such that the Peltier element is operated above a predetermined coefficient of performance.

2. The flow-type water tempering device according to claim 1, wherein the controller controls the power delivered to the connector of the Peltier element such that

- the Peltier element is operated at or below of 30 % of the rated power of the Peltier element;
- the Peltier element is operated at or below of 40 % of the rated power of the Peltier element;
- the Peltier element is operated at or below of 60 % of the rated power of the Peltier element;
- the Peltier element is operated at or above an coefficient of performance of 60 %;
- the Peltier element is operated at or above an coefficient of performance of 70 %;
- the Peltier element is operated at or above an coefficient of performance of 80 %;
- the Peltier element is operated at or above an coefficient of performance of 90%.

3. The flow-type water tempering device according to claim 1 or 2, further comprising

- a second heat exchanger thermally coupled to the second side of the Peltier element;
- a third heat exchanger thermally coupled to an ambient media; and
- a heat exchange fluid circulating through the second and third heat exchanger.

4. The flow-type water tempering device according to claim 3, wherein the heat exchange fluid comprises at least one of the following:

- a phase change material;
- a phase change material comprising water and paraffin;
- a phase change material comprising water and salt hydrates.

5. The flow-type water tempering device according to any one of claims 1 to 4, further comprising a flow controller for controlling the flow of water through the first heat exchanger, wherein the controller is adapted to control the supply of current to the connector of the Peltier element such that the first side of the Peltier element cools the first heat exchanger and to control the flow controller such that water flows through the first heat exchanger.

6. The flow-type water tempering device according to any one of claims 1 to 5, wherein the controller is adapted to control the flow velocity of water such that water exiting the first heat exchanger has a predetermined temperature.

7. The flow-type water tempering device according to any one of claims 1 to 6, further comprising

- an output temperature sensor determining the temperature of the water exiting the first heat exchanger, wherein the output temperature sensor is connected with the controller and wherein the controller is adapted to at least one of:
- control the supply of power to the connector of the Peltier element such that water exiting the first heat exchanger has a predetermined temperature;
- control the flow velocity of water by the flow controller such that water exiting the first heat exchanger has the predetermined temperature.

8. The flow-type water tempering device according to any one of claims 1 to 7, further comprising

- an input temperature sensor determining the temperature of the water entering the first heat exchanger, wherein the input temperature sensor is connected with the controller and wherein the controller is adapted to at least one of:
- controlling the supply of current to the connector of the Peltier element such that water exiting the first heat exchanger has a predetermined temperature;
- controlling the flow velocity of water such that water exiting the first heat exchanger has the predetermined temperature.

9. The flow-type water tempering device according to any one of claims 1 to 8, wherein at least one Peltier element is sandwiched between the first heat exchanger and the second heat exchanger.

10. The flow-type water tempering device according to any one of claims 1 to 9, wherein the flow-type water tempering device is adapted to store heat generated by the Peltier element, preferably by at least one of the following:

- at least one buffer reservoir adapted to store the heat exchange fluid circulating between the second and third heat exchanger;
- a buffer reservoir adapted to store the circulating heat exchange fluid, wherein the buffer reservoir is located in the third heat exchanger;
- a buffer reservoir adapted to store the circulating heat exchange fluid, wherein the buffer reservoir is located between the third heat exchanger and the second heat exchanger;
- a buffer reservoir adapted to store the circulating heat exchange fluid, wherein the buffer reservoir is located between the second heat exchanger and the third heat exchanger;
- at least one buffer reservoir adapted to store the heat exchange fluid circulating between the second and third heat exchanger wherein the at least one buffer reservoir is thermally insulated.

11. The flow-type water tempering device according to claim 10,
wherein the at least one buffer reservoir comprises at least one of the following features:

- the buffer reservoir volume formed by the at least one buffer reservoir is at least 50 % of the volume of the heat transfer fluid of the flow-type water tempering device;
- the buffer reservoir volume formed by the at least one buffer reservoir is at least 60 % of the volume of the heat transfer fluid of the flow-type water tempering device;
- the buffer reservoir volume formed by the at least one buffer reservoir is at least 70 % of the volume of the heat transfer fluid of the flow-type water tempering device;
- the buffer reservoir volume formed by the at least one buffer reservoir is at least 80 % of the volume of the heat transfer fluid of the flow-type water tempering device;
- the buffer reservoir volume formed by the at least one buffer reservoir is at least 90 % of the volume of the heat transfer fluid of the flow-type water tempering device;
- the at least one buffer reservoir is adapted to store a heat energy of at least 142 kJ;
- the at least one buffer reservoir is adapted to store a heat energy of at least 284 kJ;
- the at least one buffer reservoir is adapted to store a heat energy of at least 568 kJ;
- the at least one buffer reservoir is adapted to store a heat energy of at least 710 kJ;
- the buffer reservoir may store the heat energy for at least 10 min.;
- the buffer reservoir may store the heat energy for at least 20 min.;
- the buffer reservoir may store the heat energy for at least 30 min.

12. The flow-type water tempering device according to any one of claims 1 to 11, further comprising a circulation pump circulating the heat exchange fluid between the second and third heat exchanger, wherein the controller is adapted to control the circulation pump such that the circulation pump circulates the heat exchange fluid if the power is supplied to the at least one Peltier element, and if the power supply to the at least one Peltier element is switched off by the controller, the controller controls the circulation pump such that no heat exchange fluid is circulated by the circulation pump.

13. A beverage dispenser, comprising

- the flow-type water tempering device according to any one of claims 1 to 12.

14. The beverage dispenser according to claim 13, further comprising:

- a filter device having an inlet and an outlet, wherein the inlet of the filter device is coupled with a water source and the outlet of the filter device is coupled the water inlet of the first heat exchanger; and
- a mineralization device having an inlet and an outlet, wherein the inlet of the mineralization device is connected to the water outlet of the first heat exchanger; and
- an output section coupled to the outlet of the mineralization device.

15. The beverage dispenser according to any one of claims 13 to 14, further comprising

- a heating device having an inlet and an outlet, wherein the inlet of the heating device is connected to the outlet of the filter device and the outlet of the heating device is connected to the water inlet of the first heat exchanger;
- wherein the controller is configured in a cleaning mode to apply a current to the heating device that heats the water in the heating device and the heated water flows trough the first heat exchanger, the mineralization device and the output section.

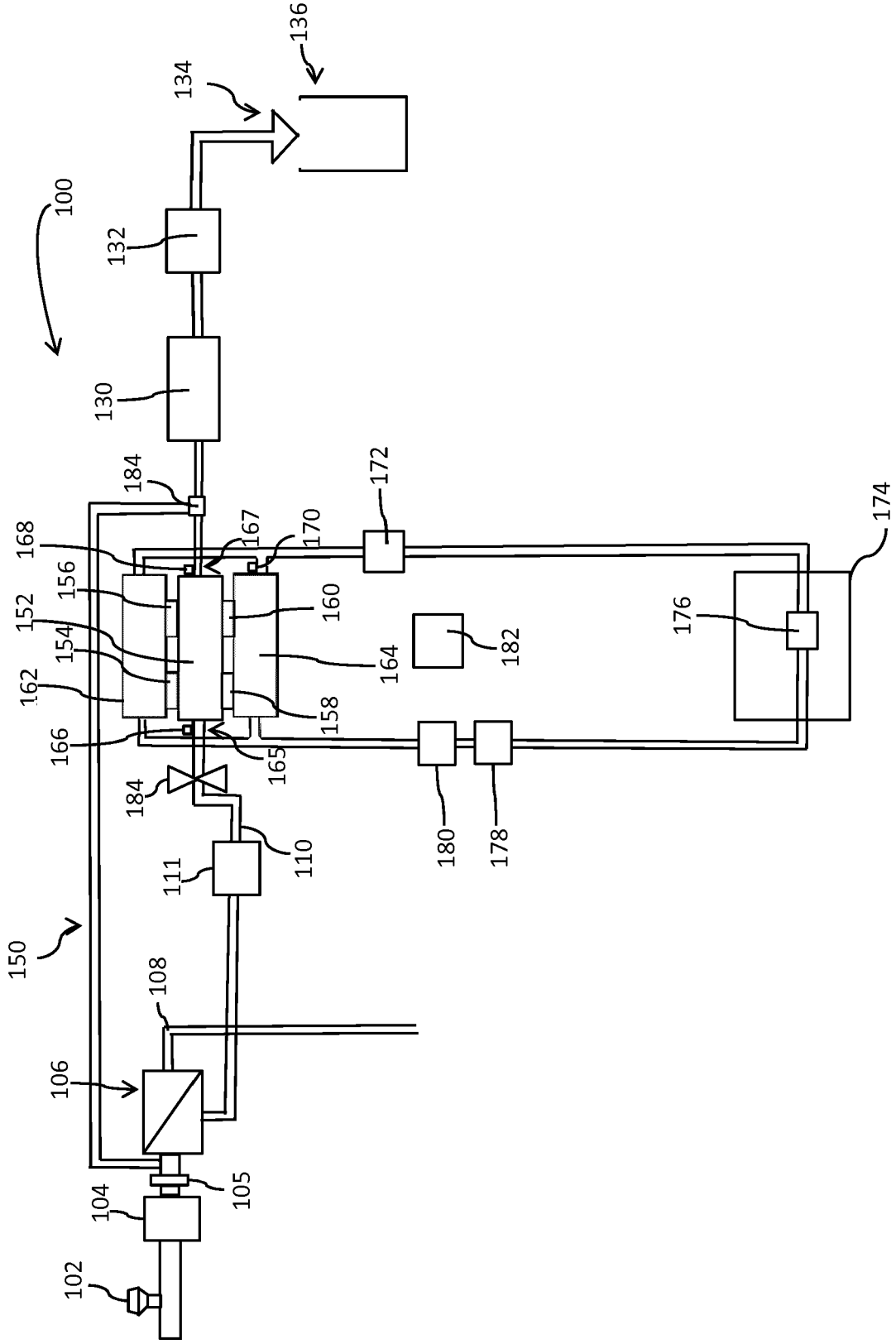
136
134
100
132
130
184
172
174
168
167
170
156
160
152
154
164
182
176
162
158
166
165
184
180
178
110
111
150
108
106
105
104
102

Fig. 1

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 20 3295

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2007/199333 A1 (WINDISCH ROBERT [US]) 30 August 2007 (2007-08-30) * paragraphs [0064] - [0066]; figures 1-3 *	1-15	INV. F25B21/04 F25D31/00
X	US 2016/333561 A1 (CHAN KAI CHI [CN] ET AL) 17 November 2016 (2016-11-17) * paragraph [0037]; figures 1-3,6 *	1-15	
A	DE 10 2012 222635 A1 (BEHR GMBH & CO KG [DE]) 12 June 2014 (2014-06-12) * paragraph [0033] - paragraph [0042]; figures 1-6 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F25B
F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 February 2018	Amous, Moez

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 20 3295

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-02-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007199333 A1	30-08-2007	US 2007199333 A1	30-08-2007
		WO 2007101197 A2	07-09-2007
US 2016333561 A1	17-11-2016	CN 106149836 A	23-11-2016
		JP 2016217125 A	22-12-2016
		KR 20160134578 A	23-11-2016
		US 2016333561 A1	17-11-2016
DE 102012222635 A1	12-06-2014	CN 104838510 A	12-08-2015
		DE 102012222635 A1	12-06-2014
		US 2017018825 A1	19-01-2017
		WO 2014090641 A1	19-06-2014

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 1797382 A1 **[0004]**
- DE 10015869 A1 **[0005]**