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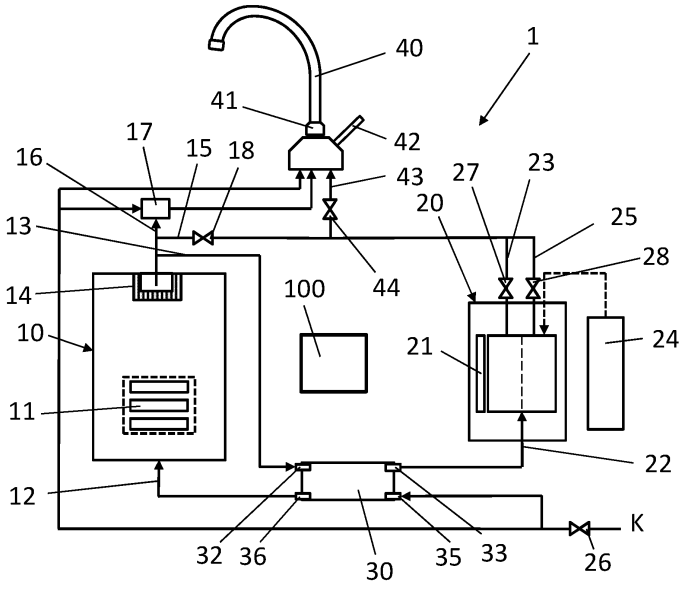
(54) **WATER DISPENSING DEVICE**

(57) The invention relates to a water dispensing device (1) for dispensing water for consumption, comprising
- a duct for conveying water with a temperature below 65°C ,
- a hot water tank (10) arranged for keeping hot water at a temperature of at least 100°C, comprising:
- a hot water tank feed (12) for feeding fresh water to the hot water tank,
- a hot water tank discharge (13) for discharging the hot water from the hot water tank (10), wherein the hot water tank discharge (13) is in fluid communication with the duct for conveying water with a temperature below 65°C,
wherein the water dispensing device comprises:
- a control device (100) for controlling the water dispensing device (1),
- an inlet valve (26), to be controlled by the control device (100), which is arranged to allow or to block inflow of fresh water into the hot water tank feed (12),
wherein the control device (100) is arranged for controlling the water dispensing device (1) in various operating modes, wherein the operating modes comprise:
a steam sterilization mode, in which the inlet valve (26) is placed in a closed state in order to block the inflow of fresh water into the hot water tank (10) via the hot water tank feed (12).

Figuur 1



EP 3 933 125 A1

Description

[0001] The invention relates to a water dispensing device for dispensing water for consumption.

[0002] Various water dispensing devices are known, which are arranged for dispensing water for consumption. It is desired that such water is supplied via ducts that are free from bacteria.

[0003] On commissioning, bacteria may already be present in the various ducts or may end up in the duct via fresh water that is supplied from a general water supply network. It is also possible that bacteria enter the water duct from a dispensing point for dispensing the water, for example a tap installed in a kitchen.

[0004] One aim of the invention is to provide a water dispensing device for dispensing water for consumption, wherein the water may have a temperature below 65°C, and wherein the chance of bacteria being present in the duct for conveying water with a temperature below 65°C is considerably lower or can be made so.

[0005] For this purpose, the invention provides a water dispensing device for dispensing water for consumption, comprising

- a duct for conveying water with a temperature below 65°C,
- a hot water tank arranged for keeping hot water at a temperature of at least 100°C, comprising:
    - a hot water tank feed for feeding fresh water to the hot water tank,
    - a hot water tank discharge for discharging hot water from the hot water tank, wherein the hot water tank discharge is in fluid communication with the duct for conveying water with a temperature below 65°C,

characterized in that the water dispensing device comprises:

- a control device for controlling the water dispensing device,
- an inlet valve, to be controlled by the control device, which is arranged to allow or to block inflow of fresh water into the hot water tank feed,

wherein the control device is arranged for controlling the water dispensing device in various operating modes, wherein the operating modes comprise:
a steam sterilization mode, in which the inlet valve is placed in a closed state in order to block the inflow of fresh water into the hot water tank via the hot water tank feed.

[0006] The water dispensing device according to the invention comprises a hot water tank arranged for keeping hot water at a temperature of at least 100°C. Such a hot water tank for dispensing water for consumption is known. The hot water tank is for example used for dispensing boiling water at a temperature of 100°C as it leaves the tap.

[0007] The hot water may also be used for mixing with cold water in order to supply warm water. This prevents warm water, at for example 40°C, being held in a tank for a long time at this temperature, which is disadvantageous because it is precisely such a temperature that allows good growth of bacteria.

[0008] It is possible to cool the water from the hot water tank to supply it as cooled water. This water is suppliable directly after cooling or can first be stored in a cold water tank.

[0009] In both cases use is made of water at above 100°C, for example at above 105°C, which is cooled by cooling or mixing in a duct for conveying water with a temperature below 65°C.

[0010] The water dispensing device then has a standby mode in which no water is supplied via the duct for conveying water with a temperature below 65°C and a dispensing mode for, for example, cooled water, cooled-down water or mixed water that is derived at least partially from the hot water tank with a temperature below 65°C supplied via the duct for conveying water with a temperature below 65°C.

[0011] According to the invention, a third operating mode of the water dispensing device is provided for sterilizing the duct for conveying water with a temperature below 65°C. In this mode, the steam sterilization mode, the inlet valve is placed in a closed state in order to block the inflow of fresh water into the hot water tank via the hot water tank feed, whereas the outlet valve is opened. By closing the inlet valve in combination with opening the outlet valve, the overpressure no longer exists in both the hot water tank and the duct for conveying water with a temperature of less than 65°C. As a result, the superheated water in the hot water tank will boil instantaneously. The steam that is released thereby will then expel the water from the duct for conveying water with a temperature below 65°C. If the water in this duct has been fully expelled, in addition steam will continue to flow through the duct for conveying water with a temperature below 65°C, so that the interior of the duct becomes boiling hot, so that any bacteria that may be present in this duct are killed. After the inlet valve is opened again, the steam that remains in the duct can be expelled by the hot water from the hot water tank, after which the outlet valve can be closed. This completes the sterilization process.

[0012] Moreover, the amount of hot water that is required for sterilizing the water dispensing device in this way by using steam for the sterilization is relatively limited. For example, in the case of a 3-litre cold water tank, it may be that less than 1 litre of superheated water evaporates.

[0013] In an embodiment, the water dispensing device further comprises an outlet valve, controllable by the control device, which is arranged for allowing or blocking outflow of hot water from the hot water tank, wherein in

the steam sterilization mode the outlet valve is placed in an open state to allow outflow of hot water from the hot water tank via the hot water tank discharge.

[0014] By also allowing the outlet valve of the duct for conveying water with a temperature below 65°C to be controlled by the control device, the sterilization mode can be started and stopped by the control device. The outlet valve may be the same valve that is used for dispensing water through the duct in question, but also an additional valve. For steam sterilization of a duct, it is necessary for all valves after the hot water tank in the duct in question to be opened. Manually operated outlet valves must be opened by the user.

[0015] In an embodiment, the operating modes to be controlled by the control device further comprise:

a standby mode, in which the outlet valve is placed in a closed state to block the outflow of hot water from the hot water tank via the hot water tank discharge, and
a dispensing mode, in which the outlet valve is placed in an open state to allow outflow of hot water from the hot water tank via the hot water tank discharge and in which the inlet valve is placed in an open state to allow inflow of fresh water into the hot water tank via the hot water tank feed.

[0016] The control device may be arranged for carrying out the steam sterilization mode periodically and/or on request, for example on commissioning or after the water dispensing device has not been used for a long time.

[0017] In an embodiment, the water dispensing device comprises:

- a heat exchanger comprising:
  - a first heat exchange duct with a first inlet and a first outlet, and
  - a second heat exchange duct with a second inlet and a second outlet,

  wherein the first heat exchange duct and the second heat exchange duct are arranged for exchanging heat with one another,
  wherein the first inlet is connected to the hot water tank discharge and the first outlet is connected to the duct for conveying water with a temperature below 65°C, and wherein the second inlet is to be connected to a fresh water main and the second outlet is connected to the hot water tank feed,
  so that the hot water from the hot water tank is feedable via the first heat exchange duct to the duct for conveying water with a temperature below 65°C.

[0018] In this embodiment, the hot water from the hot water tank is cooled by means of a heat exchanger to cooled-down water which is then fed to the duct for conveying water with a temperature below 65°C. The water cooled down by the heat exchanger is for example tepid water with a temperature between 20°C and 30°C. The duct for conveying water with a temperature below 65°C is for example connected to a tap where the cooled-down water is suppliable as cooled-down water for consumption.

[0019] A water dispensing device of this kind may also be provided in a configuration without a steam sterilization mode, i.e. a water dispensing device for dispensing water for consumption, comprising:

- a duct for conveying water with a temperature below 65°C,
- a hot water tank arranged for maintaining hot water at a temperature of at least 90°C, for example at least 100°C, comprising:
  - a hot water tank feed for feeding fresh water to the hot water tank,
  - a hot water tank discharge for discharging the hot water from the hot water tank, and
- a heat exchanger comprising:
  - a first heat exchange duct with a first inlet and a first outlet, and
  - a second heat exchange duct with a second inlet and a second outlet,

  wherein the first heat exchange duct and the second heat exchange duct are arranged for exchanging heat with one another,
  wherein the first inlet is connected to the hot water tank discharge and the first outlet is connected to the duct for conveying water with a temperature below 65°C, and wherein the second inlet is to be connected to a fresh water main and the second outlet is connected to the hot water tank feed,
  so that the hot water from the hot water tank is feedable via the first heat exchange duct to the duct for conveying water with a temperature below 65°C,
  wherein the duct for conveying water with a temperature below 65°C is connected to a tap in order to be supplied as cooled-down water for consumption.
  Moreover, the cooled-down water may be mixed in a mixing device with hot water received from the hot water tank to supply mixed water, and hot water may be supplied directly from the hot water tank as hot or boiling water. In a water dispensing device of this kind, all the water to be supplied, such as cooled-down water, mixed water and hot or boiling water, is obtained from the hot water tank. This has the advantage that all the water is kept above a temperature of at least 90 degrees until it is supplied.

[0020] In an embodiment, the heat exchanger is a plate heat exchanger. A plate heat exchanger is a heat exchanger that employs heat exchange by means of a

number of plates stacked on one another with passages provided therein for forming the first and the second heat exchange duct. A plate heat exchanger of this kind can be used effectively for exchanging heat. With a heat exchanger of this kind it is possible to transfer a large part of the heat from the hot water to the fresh water.

[0021] In an embodiment, the water dispensing device comprises:

- a cold water tank arranged for keeping cooled water at a temperature of at most 20°C, comprising:
  - a cold water tank feed for feeding water to the cold water tank,
  - a cold water tank discharge for dispensing cooled water from the cold water tank,
- a heat exchanger comprising:
  - a first heat exchange duct with a first inlet and a first outlet, and
  - a second heat exchange duct with a second inlet and a second outlet,

  wherein the first heat exchange duct and the second heat exchange duct are arranged for exchanging heat with one another,
  wherein the first inlet is connected to the hot water tank discharge and the first outlet is connected to the cold water tank feed, and wherein the second inlet is to be connected to a fresh water main and the second outlet is connected to the hot water tank feed,
  so that the hot water from the hot water tank may be fed via the first heat exchange duct to the cold water tank, then to be discharged as cooled-down water for consumption.

[0022] In this embodiment, the hot water from the hot water tank is cooled by means of a heat exchanger to cooled-down water and is fed to a cold water tank where the cooled-down water is optionally cooled further and is held at a temperature of at most 20°C.

[0023] The cold water tank may comprise a cooling device in order to keep the cooled, filtered water at a desired temperature. The cooling device may be any suitable device for keeping the cooled water at the desired temperature.

[0024] The cooled water may then be supplied as cooled water via a tap. In this embodiment, the cold water tank may also be viewed as a duct for conveying water with a temperature below 65°C, which can be sterilized effectively by means of the steam sterilization mode.

[0025] In an embodiment, the hot water tank comprises a second hot water tank discharge for dispensing hot or boiling water, wherein the water dispensing device comprises a second outlet valve, to be controlled by the control device, which is arranged to allow or to block outflow of hot water from the hot water tank via the second hot water tank discharge,
wherein the control device is further arranged for controlling a dispensing mode for hot or boiling water, in which the second outlet valve is placed in an open state to allow outflow of hot water from the hot water tank via the second hot water tank discharge and in which the inlet valve is placed in an open state to allow inflow of fresh water into the hot water tank via the hot water tank feed.

[0026] In an embodiment, the water dispensing device comprises a CO_2 container for supplying CO_2, wherein the cold water tank is arranged for dissolving CO_2 in the cooled water to supply carbonated cooled, filtered water.

[0027] In an embodiment, the cold water tank discharge is arranged for dispensing cooled water from the cold water tank and the cold water tank comprises a second cold water tank discharge for dispensing carbonated cooled water. In this embodiment it is possible to use the cold water tank to supply both cooled water and carbonated cooled water. For this purpose the cold water tank may have a first container for holding cooled water in which carbon dioxide has not been dissolved and a second container for holding carbonated cooled water, wherein the CO_2 container is connected to the second container for dissolving CO_2 in the cooled water.

[0028] In an embodiment, the water dispensing device comprises a filter for filtering the hot water, wherein the filter is fitted in the hot water tank or in the hot water tank discharge, so that the hot water discharged via the hot water tank discharge is filtered by the filter. By fitting the filter for filtering the water used for consumption in the hot water tank or the hot water tank discharge, owing to the high temperature of the water of at least 100°C, no growth or barely any growth of bacteria will occur in the filter.

[0029] In an embodiment, the filter is an activated carbon filter. An activated carbon filter can be used for filtering water that is used as water for consumption. In particular, an activated carbon filter is sensitive to bacterial growth. It is therefore advantageous to fit said activated carbon filter in the hot water tank, where, owing to the high temperature, the activated carbon filter will be subject to very little if any bacterial growth.

[0030] In an embodiment, the filter is fitted in or near the hot water tank discharge in order to filter hot water that is discharged via the hot water tank discharge. By providing the filter in or near the hot water tank discharge, the hot water is only filtered as it leaves the hot water tank. Here, the hot water in the hot water tank will have the desired temperature of at least 100°C for as long as possible and there will be no or barely any contamination of the filter with bacteria. When the filter is for example placed near the hot water tank feed, cooler water will regularly flow through the filter, so that there is a greater chance of bacterial growth or the like.

[0031] The cold water tank will in consequence only be fed with filtered water. It is therefore no longer necessary to provide a filter in the cold water tank in order to

supply cooled, filtered water for consumption.

[0032] The invention further provides a method for sterilizing a duct for conveying water with a temperature below 65°C which is in fluid communication with a hot water tank discharge of a hot water tank of a water dispensing device, wherein the hot water tank is arranged for keeping hot water at a temperature of at least 100°C and comprises a hot water tank feed for feeding fresh water to the hot water tank,

wherein an inlet valve is provided that is arranged to allow or to block inflow of fresh water into the hot water tank via the hot water tank feed, and an outlet valve that is arranged to allow or to block outflow of hot water from the hot water tank via the hot water tank feed,
with the distinctive feature that the method comprises sterilizing the duct for conveying water with a temperature below 65°C, wherein the inlet valve is placed in a closed state to block inflow of fresh water into the hot water tank and wherein the outlet valve is placed in an open state to allow outflow of hot water from the hot water tank, so that the hot water in the tank forms steam owing to the decrease in pressure, which flows out into the duct for conveying water with a temperature below 65°C for effective sterilization of this duct.

[0033] In an embodiment of the method, wherein the water dispensing device comprises:

- a control device for controlling the water dispensing device,
- an inlet valve, to be controlled by the control device, which is arranged to allow or to block inflow of fresh water into the hot water tank feed,
- an outlet valve, controllable by the control device, which is arranged to allow or to block outflow of hot water from the duct for conveying water with a temperature below 65°C, the method comprises control, with the control device, of the water dispensing device in different operating modes, wherein the operating modes comprise:
- a steam sterilization mode, in which the inlet valve is placed in a closed state in order to block the inflow of fresh water into the hot water tank via the hot water tank feed, and wherein the outlet valve is placed in an open state to allow outflow of hot water and/or steam from the hot water tank via the hot water tank discharge to the duct for conveying water with a temperature below 65°C, wherein the method comprises selecting the steam sterilization mode for the control device.

[0034] In an embodiment, the operating modes further comprise:

- a standby mode, in which the outlet valve is placed in a closed state to block the outflow of hot water from the hot water tank via the hot water tank discharge, and
- a dispensing mode, in which the outlet valve is placed in an open state to allow outflow of hot water from the hot water tank via the hot water tank discharge and in which the inlet valve is placed in an open state to allow inflow of fresh water into the hot water tank via the hot water tank feed.

[0035] In an embodiment of the method, wherein the water dispensing device comprises:

- a heat exchanger comprising:
  - a first heat exchange duct with a first inlet and a first outlet, and
  - a second heat exchange duct with a second inlet and a second outlet,

wherein the first heat exchange duct and the second heat exchange duct are arranged for exchanging heat with one another,
wherein the first inlet is connected to the hot water tank discharge and the first outlet is connected to the duct for conveying water with a temperature below 65°C, and wherein the second inlet is connected to a fresh water main and the second outlet is connected to the hot water tank feed,
the method comprises, if desired, dispensing hot water from the hot water tank via the first heat exchange duct to the duct for conveying water with a temperature below 65°C.

[0036] Moreover, the duct for conveying water with a temperature below 65°C may be connected to a tap in order to be supplied as cooled-down water for consumption.

[0037] In an embodiment of the method, wherein the water dispensing device comprises:

- a cold water tank arranged for keeping cooled water at a temperature of at most 20°C, comprising:
  - a cold water tank feed for feeding water to the cold water tank,
  - a cold water tank discharge for dispensing cooled water from the cold water tank,
- a heat exchanger comprising:
  - a first heat exchange duct with a first inlet and a first outlet, and
  - a second heat exchange duct with a second inlet and a second outlet,

wherein the first heat exchange duct and the second heat exchange duct are arranged for exchanging

heat with one another,
wherein the first inlet is connected to the hot water tank discharge and the first outlet is connected to the cold water tank feed, and wherein the second inlet is to be connected to a fresh water main and the second outlet is connected to the hot water tank feed,
the method comprises, if desired, feeding hot water from the hot water tank via the first heat exchange duct to the cold water tank, then to be discharged as cooled-down water for consumption.

[0038] In an embodiment of the method, the water dispensing device is arranged for executing the steam sterilization mode periodically and/or on request.

[0039] It should be noted that various types of water are mentioned in this patent application. They are:

hot water, water with a temperature of at least 65°C, for example at least 95°C; at a temperature of at least 100°C, also called boiling water
warm water, water with a temperature in the range from 35°C to 65°C;
fresh water, water that is supplied through a water main from the central water supply network or some other source of fresh water;
tepid water, water with a temperature from 20°C to 35°C
cooled water, water that is cooled in the cold water tank to a temperature of at most 20°C, for example at most 10°C;
carbonated cooled water, cooled water in which carbon dioxide (CO_2) has been dissolved under pressure; and
filtered water, water that is filtered with a filter, for example (carbonated) cooled, filtered water.

[0040] An embodiment of a water dispensing device according to the invention will be described in more detail hereunder, wherein reference is made to the figures, in which:

Fig. 1 shows schematically a first embodiment of a water dispensing device according to the invention;
Fig. 2 shows schematically a cross-section of a plate exchanger that may be employed in the embodiment in Fig. 1; and
Fig. 3 shows schematically a second embodiment of a water dispensing device according to the invention.

[0041] Fig. 1 shows an embodiment of a water dispensing device for at least dispensing cooled, filtered water for consumption. The water dispensing device is indicated in general with the reference number 1. The water dispensing device 1 comprises a hot water tank 10, a cold water tank 20, a heat exchanger 30, and a tap 40.

[0042] The hot water tank 10 is arranged for keeping hot water at a temperature of for example 108°C. A heating device 11 with temperature control is fitted in the hot water tank 10 to heat the water in the hot water tank 10 to the desired temperature and maintain it at this temperature. The hot water tank 10 comprises a hot water tank feed 12 for feeding fresh water to the hot water tank 10 and a hot water tank discharge 13 for discharging hot water from the hot water tank 10. In the hot water tank 10, near the start of the hot water tank discharge 13, a filter 14 is fitted for filtering the hot water that is led away via the hot water tank discharge 13. The filter 14 is an activated carbon filter that is arranged to adsorb certain constituents from water by means of activated carbon. The filter 14 is fitted in the hot water tank 10 because the temperature of the hot water is relatively high. Owing to this high temperature, the filter 14 will remain free of bacterial growth. In particular for water for consumption, it is desirable that no bacteria are present in the water.

[0043] The hot water tank 10 comprises a second hot water tank discharge 15 and a third hot water tank discharge 16. The first hot water tank discharge 13, the second hot water tank discharge 15 and the third hot water tank discharge 16 may be provided as three separate channels from the hot water tank 10 or as a combined channel from the hot water tank 10 that is split into the separate discharges as shown in Fig. 1.

[0044] The second hot water tank discharge 15 is connected directly to the tap 40 for dispensing hot water. An operating element 41 is provided for activating supply of the hot water. On flowing out of the hot water tank 10, the hot water will go through the filter 14 and thus be discharged as filtered hot water that is suitable for consumption. In the hot water tank 10 there is an above-atmospheric water pressure as a result of the pressure of the water of a water supply network K at which fresh water is supplied and also because the water expands during heating of the water through the supply of heat from the heating device 11. Owing to the overpressure, the hot water at for example 108°C will not boil in the hot water tank 10. On opening the tap 40, the pressure of the hot water will decrease to atmospheric pressure. In consequence, the hot water will be boiling as it leaves the tap. In this embodiment the hot water is thus discharged as boiling water.

[0045] The operating element 41 is arranged to supply an electrical signal to a control device 100 that can be used for controlling one or more valves. In an alternative embodiment, the operating element 41 may be arranged for operating a mechanical valve.

[0046] The third hot water tank discharge 16 is connected to a mixing device 17 for mixing the hot water from the hot water tank 10 in a defined mixing ratio with fresh water from a water supply network K in order to supply warm water. This warm water is then fed to the tap 40. In the tap 40, a second mixing device (not shown) is provided, which is to be operated by means of operating element 42. The second mixing device is arranged for mixing fresh water from the water supply network K

with a mixing ratio to be set manually by the operating element 42 with the warm water in order to supply mixed water from the tap 40 in the temperature range between the temperature of the fresh water and the temperature of the warm water.

[0047] The cold water tank 20 is arranged for keeping cooled water at a temperature of at most 20°C, for example 10°C. A cooling device 21 with temperature control is fitted in the cold water tank 20 in order to cool the water in the cold water tank 20 to the desired temperature and maintain it at this temperature. The cold water tank 20 comprises a cold water tank feed 22 for feeding water to the cold water tank 20 and a cold water tank discharge 23 for discharging cooled water from the cold water tank 20.

[0048] The water dispensing device 1 comprises a CO_2 container 24 for supplying CO_2 under pressure. The cold water tank 20 is arranged for dissolving CO_2 in the cooled water that is held in the cold water tank 20. In order to dissolve the CO_2 in the cooled water, a pressure is required that is usually higher than the water pressure supplied by the water supply network K. The cold water tank 20 may comprise a pump to allow the water to flow through the cold water tank feed 22 into the cold water tank 20 against the higher pressure of the carbon dioxide from the CO_2 container 24. This pump thus supplies a water pressure that is higher than the pressure that is exerted via the CO_2 container 24 in the cold water tank 20.

[0049] By dissolving carbon dioxide in the cooled water, the cooled water is suppliable as carbonated cooled water for consumption. The cold water tank 20 comprises a second cold water tank discharge 25 for dispensing carbonated cooled water. The cold water tank discharge 23 and the second cold water tank discharge 25 are connected to the tap 40, which has an operating element 41, with which the supply of cooled water may be activated. The cold water tank 20 may moreover be configured to supply carbonated cooled water or cooled water in which carbon dioxide has not been dissolved, as desired, depending on the operation of the operating element 41. For this purpose, the cold water tank may comprise two holders, one for cooled, filtered water and one for carbonated cooled and filtered water.

[0050] In the cold water tank discharge 23 and the second cold water tank discharge 25, a first outlet valve 27 and a second outlet valve 28 are provided for dispensing cooled and carbonated cooled water, respectively. Said first outlet valve 27 and said second outlet valve 28 are thus controllable via the control device 100 with the operating element 41.

[0051] One and the same dispensing duct 43 is used for dispensing the hot water and the cooled water. The same operating element 41 is also used for controlling, by means of the control device 100 whether boiling water or cooled water is supplied as a function of the operation of the operating element 41.

[0052] In the dispensing duct 43, a valve 44 is fitted, which may be placed in an open state during supply of hot water from the hot water tank 10 or supply of cooled water from the cold water tank discharge 23, and a closed state when no water is supplied through the dispensing duct 43. By means of this valve 44, it is possible to prevent bacteria being displaced from the tap 40 to the cold water tank discharge 23. Placement of the valve 44 in the shared dispensing duct 43 offers the further advantage that this valve 44 and the part of the dispensing duct 43 downstream relative to the valve 44 during the supply of hot water are flushed with hot water, so that bacteria present in the dispensing duct 43 are killed.

[0053] The valve 44 may optionally also be fitted in an unshared part of the supply channel of the cold water tank 20.

[0054] The valve 44 may be any suitable valve that is adapted to be placed in an open state and a closed state. The valve 44 may be an actively operated valve, for example a magnetic valve, or a valve that is operated by the water pressure, for example a non-return valve.

[0055] In alternative embodiments, different supply channels and/or different operating buttons may be used for dispensing hot water, cooled water and/or carbonated cooled water. It is also possible to provide separate taps, for example a separate tap for the mixed water and a separate tap for the hot water and a separate tap for the cooled water.

[0056] The heat exchanger 30 is a plate heat exchanger. A cross-section of this heat exchanger 30 is shown schematically in Fig. 2. The heat exchanger 30 comprises a first heat exchange duct 31 with a first inlet 32 and a first outlet 33 and a second heat exchange duct 34 with a second inlet 35 and a second outlet 36. The first heat exchange duct 31 and the second heat exchange duct 34 are arranged for exchanging heat with one another via plates 37 that are placed between the first heat exchange duct 31 and the second heat exchange duct 34.

[0057] As shown in Fig. 1, the first inlet 32 of the heat exchanger 30 is connected to the hot water tank discharge 13 and the first outlet 33 is connected to the cold water tank feed 22, so that cooled-down hot water from the hot water tank 10 can be fed via the heat exchanger 30 to the cold water tank 20.

[0058] The second inlet 35 of the heat exchanger 30 is connected to a water supply network K with which fresh water is suppliable. The second inlet 35 may also be connected to any other suitable source for the supply of fresh water, for example a fresh water tank. The second outlet 36 is connected to the hot water tank feed 12.

[0059] The internal volume of the heat exchanger 30 may have a small volume relative to the volume of the cold water tank 20. The internal volume of the heat exchanger 30 is for example at most 20% of the internal volume of the cold water tank 20, such as at most 10% of the internal volume of the cold water tank 20.

[0060] When supply of cooled water is activated through operation of the operating element 41 of the tap 40, cooled water will be supplied from the cold water tank 20 by opening the outlet valve 27 or outlet valve 28. Owing

to the cold water flowing out of the cold water tank 20, the water pressure in the cold water tank 20 will decrease. As a result, hot water from the hot water tank 10 will flow through the first hot water tank discharge 13 via the first heat exchange duct 31 of the heat exchanger 30 and the cold water tank feed 22 to the cold water tank 20 to replace the discharged cooled water. At the same time the hot water flowing from the hot water tank 10 will be replaced by fresh water that will flow via the second heat exchange duct 34 from the water supply network K to the hot water tank feed 12 of the hot water tank 10.

[0061] The cooled water that is supplied from the cold water tank 20 is thus obtained from the hot water tank 10. As this water flows from the hot water tank 10 to the cold water tank 20, the water will go through filter 14 and thus be filtered. The cooled water discharged from the tap 40 is therefore filtered water that is suitable for consumption. Moreover, it is advantageous for the filter 14 to be placed in the hot water tank 10, so that the filter 14 will have no or hardly any burden of bacterial growth.

[0062] Because the fresh water and the hot water flow in opposite directions through the heat exchanger 30, the heat of the hot water in the first heat exchange duct 31 will effectively be transferred to the fresh water in the second heat exchange duct 34. The temperature of the hot water will thus decrease in the heat exchanger 30 and conversely the temperature of the fresh water will increase. This means that in the hot water tank 10, a limited amount of energy is required for heating the fresh water to the desired temperature of for example 108°C, whereas in the cold water tank 20 also a limited amount of extra energy is required, in comparison with direct cooling of fresh supply water, to cool the hot water cooled-down in the heat exchanger further, to the desired temperature of the cold water of for example 10°C.

[0063] In a plate heat exchanger such as shown schematically in Fig. 2, it is for example possible to cool down the hot water at 108°C to 22°C-30°C, whereas the fresh water with a temperature of for example 15°C can be heated to for example 80°C-100°C.

[0064] In the embodiment in Fig. 1, a valve 26 is provided in the supply duct for the fresh water, i.e. between the water supply network K and the hot water tank 10. In the embodiment shown, the inlet valve 26 is placed in the duct from the water supply network K to the second inlet 35 of the heat exchanger 30. As an alternative, the inlet valve 26 may also be placed in the hot water tank feed 12 of the hot water tank 10.

[0065] The inlet valve 26 may be placed in an open state and a closed state. During normal use of the water dispensing device 1, the inlet valve 26 will be placed in the open state, so that water that is supplied via the tap 40 is supplemented with water from the water supply network K. The water pressure of the water supply network K is then also used for dispensing water, unless the water is carbonated water that is supplied from the cold water tank 20. When dispensing carbonated water, use is in fact made of a pump that supplies a higher water pressure than the back pressure of the carbon dioxide received from the CO_2 container 24, which is connected to the container for carbonated cooled water of cold water tank 20.

[0066] For effective disinfection of the water dispensing device 1, for example on commissioning, the inlet valve 26 may be placed in the closed state. When, in this closed state of the inlet valve 26, cooled water is discharged from the cold water tank 20, by opening the first outlet valve 27 and/or the second outlet valve 28, owing to the decreasing pressure in the hot water tank 10, the superheated water will be boiled instantaneously so that the steam formed forces the cooled water from the cold water tank 20 to the tap 40 via the associated ducts, such as the cold water tank discharge 23, the second cold water tank discharge 25 and the supply channel. The overpressure of the steam formed in the hot water tank at for example 108°C may be 0.3 bar, which is ample to force the cooled water out of the cold water tank. As the cooled water is expelled, steam will flow through the cold water tank 20 and the associated ducts until the interior of the cold water tank 20 and the associated ducts are boiling hot. All bacteria are killed thereby. Then the inlet valve 26 may be opened so that the empty, boiled cold water tank 20 is refilled with cooled water, after which the first outlet valve 27 and/or the second outlet valve 28 may be closed again. The amount of hot water that is required for disinfecting the water dispensing device 1 in this way is relatively limited through the use of steam for disinfection. For the disinfection of a cold water tank with a cubic capacity of 2 litres, In an embodiment less than 1 litre of superheated water is required.

[0067] After the water dispensing device 1 has been disinfected in this way, all the water in the cold water tank 20 has been received from the hot water tank 10. So long as the temperature in the hot water tank 10 is above 100°C, for example 108°C, this water is sterile and there are no new bacteria in the cold water tank 20.

[0068] It was also evident that little if any contamination occurs from the tap. Moreover, it is possible, as already described above, to fit a valve 44 in the supply channel for further limiting the contamination risk.

[0069] It was found that with this water dispensing device 1, sterile cooled and hot water is suppliable for a longer time. If desired, the water dispensing device can be disinfected periodically, for example once every three or six months, or after a certain period without use of the water dispensing device 1.

[0070] By means of the control device 100, the water dispensing device 1 may, as described above, be controlled in at least three, for example five, operating modes:

- a standby mode, in which the first outlet valve 27 and the second outlet valve 28 are closed so that no cooled water is discharged from the cold water tank 20. In this standby mode the inlet valve 26 may be open or closed,

- a dispensing mode for cooled water, in which the first outlet valve 27 or the second outlet valve 28 is opened for dispensing cooled water or carbonated cooled water, wherein the inlet valve 26 is opened to allow inflow of fresh water into the hot water tank 10 through the hot water tank feed 12,
- a steam sterilization mode, in which the first outlet valve 27 and/or the second outlet valve 28 is/are placed in an open state, and wherein the inlet valve 26 is closed to block the inflow of fresh water into the hot water tank via the hot water tank feed. In this steam sterilization mode, steam sterilization of the cold water tank and the associated ducts is in consequence carried out, and
- a dispensing mode for hot or boiling water, in which hot water of at least 65°C, for example 108°C, is suppliable, by means of the hot water tank discharge 15 and the third outlet valve 18, as hot or boiling water for consumption, and
- a dispensing mode for mixed water, in which water with a temperature from the fresh supply water to warm water is suppliable, by mixing fresh supply water with the hot water from the hot water tank 10 in the mixing valve 17 and wherein by means of operating element 42 the desired temperature of the water supplied can be regulated,

[0071] The control device 100 may be arranged to carry out steam sterilization periodically, for example once every 3, 6 or 12 months. Moreover, or as an alternative, the control device 100 may be configured to carry out steam sterilization on request. For example, the control device 100 may be activated to carry out steam sterilization on commissioning or during maintenance of the water dispensing device 1.

[0072] The control device 100 may be configured for controlling further valves of the water dispensing device 1, such as the third outlet valve 18 for dispensing boiling water via the second hot water tank discharge 15 or the valve 44 in the dispensing duct 43.

[0073] Fig. 3 shows an alternative embodiment of a water dispensing device according to the invention. Components with the same reference numbers have the same function and will not be discussed separately here.

[0074] The water dispensing device 1 comprises a hot water tank 10, a heat exchanger 30 and a tap 40.

[0075] The hot water tank 10, the heat exchanger 30 and the tap 40 are of substantially the same configuration as the corresponding components of the water dispensing device 1 in Fig. 1.

[0076] A difference from the hot water tank 10 in Fig. 1 is that the filter in Fig. 3 is fitted in the hot water tank discharge 13 instead of in the tank itself.

[0077] Furthermore, the first outlet 33 of the first heat exchange duct 31 of the heat exchanger 30 is connected via the duct 50 directly to the tap 40. The water that is cooled down in the heat exchanger 30 to for example 20°C may then be discharged without further cooling or optionally with a through-flow cooling device via the tap 40.

[0078] Another duct 51, which partially runs in common with the duct 50, is connected to the mixing device 17 for conveying relatively cold water to the mixing device 17. In the mixing device 17, the water cooled down in the first heat exchange duct 31 of the heat exchanger 30 is mixed at a certain mixing ratio with the hot water that is supplied via the third hot water tank discharge 16 from the hot water tank 10. The mixing ratio is usually set so that the water coming from the mixing device 17 is warm water.

[0079] In the tap 40, a second mixing device is provided, which is to be operated by means of operating element 42. By operating the mixing tap, the water from the duct 50 and/or water received from the mixing device 17 can be discharged in any desired mixing ratio. It is thus also possible to discharge only water from duct 50 or only water from the mixing device 17. By providing a second mixing device instead of a manual device operated by operating element 42, valves may be provided, to be controlled by the control device 100, or to be operated in some other way.

[0080] In the common part of the duct 50 and the duct 51, an outlet valve 29 may be provided, which is to be controlled by a signal emitted by the control device 100, to make it possible optionally for water cooled down in the heat exchanger 30 to be supplied through the duct 50 and the duct 51.

[0081] The ducts 50 and 51 are arranged for conveying water that has been cooled down in the heat exchanger 30 and are in consequence used as ducts for conveying water with a temperature below 65°C. Advantageously, the water dispensing device 1 offers the possibility of sterilizing these ducts, if desired.

[0082] The advantage of the water dispensing device in Fig. 3 is that all the water that is supplied via the tap 40, thus also the mixed water, has been obtained from the hot water tank 20, and consequently is suitable for consumption. This is in particular of advantage in an environment where the fresh water that comes from the water supply network K is not, at least not directly, suitable for consumption on account of the presence of bacteria or other contaminants in the fresh water. The water dispensing device 1 thus offers the possibility of dispensing mixed warm and/or tepid water via the second mixing device (not shown) by means of operating element 42 and boiling water via the second hot water tank discharge 15 by means of operating element 41 and the third outlet valve 18.

[0083] Precisely because the water dispensing device 1 is suitable for an environment where the fresh water that comes from the water supply network K is not directly suitable for consumption, it is advantageous that the control device 100 is arranged for controlling a steam sterilization mode.

[0084] This steam sterilization mode may for example be used during commissioning, during maintenance or

periodically for sterilizing the ducts 50, 51, the mixing device 17 and the tap 40.

[0085] In the steam sterilization mode, the inlet valve 26 operated by the control device 100 is provided with a signal, with which the supply of fresh water from the water supply network K to the hot water tank 10 can be shut off.

[0086] In the case of steam sterilization, it is necessary for the (optionally) manually operated second mixing device to be opened. For this purpose, on activation of the steam sterilization mode in the control device 100, first the outlet valve 29 is closed, after which the user is asked to open the manually operated second mixing device, for example in a mixing state in which normal operating state, water is discharged both from the duct 50 and the duct 51. When opening of the manual second mixing device is confirmed, for example by operating an operating element 101 connected to the control device 100, the control device 100 can close the inlet valve 26 and open the outlet valve 29 again.

[0087] When the inlet valve 26 is closed and the second mixing device and the outlet valve 29 are open, owing to the decreasing pressure in the hot water tank 10, the superheated water will boil instantaneously, so that the steam formed will expel the water present in the duct 50 and/or the duct 51, after which this water leaves the tap via supply channel 40. As the cooled water is expelled, steam will flow through the ducts 50 and/or 51 and the supply channel, so that these ducts are boiling hot. All bacteria are then killed. After a certain time, the control device 100 can close the outlet valve 29 and open the inlet valve 26, so that the hot water tank 10 is again made up with fresh water and the ducts 50 and/or 51 are filled again with water cooled via the heat exchanger 30. After the water pressure is restored, the control device 100 may optionally open the outlet valve 29 again temporarily to ensure that any steam that there may still be between the hot water tank 10 and the outlet valve 29 is forced out of the water dispensing device 1 via the tap 40. The user may then receive a signal that the steam sterilization has ended, or he may perceive this because steam and/or water are no longer coming out of the tap. The user is then asked to close the second mixing device. After the user has confirmed this to the control device 100, for example by means of operating element 101 connected to the control device 100, the steam sterilization mode has ended, and water dispensing device 1 can be used again for dispensing water for consumption.

[0088] In this water dispensing device 1, the outlet valve 29 controlled by the control device 100 is thus used for a number of extra steps for safe starting and stopping of the steam sterilization mode in a water dispensing device 1 with a manually operated mixing device for mixing and supplying water from several ducts or a manually operated valve for dispensing water from a single duct.

[0089] In an alternative embodiment with only manually operated valves in the duct in question, the user may be asked to operate the inlet valve and/or the respective outlet valve or outlet valves manually for carrying out a steam sterilization procedure.

[0090] It is also possible to select the provision, in all ducts to be sterilized by means of steam sterilization, of only valves that are to be controlled by the control device for carrying out steam sterilization automatically by the control device 100.

Claims

1. Water dispensing device for dispensing water for consumption, comprising

   - a duct for conveying water with a temperature below 65°C,
   - a hot water tank arranged for keeping hot water at a temperature of at least 100°C, comprising:

     - a hot water tank feed for feeding fresh water to the hot water tank,
     - a hot water tank discharge for discharging the hot water from the hot water tank, wherein the hot water tank discharge is in fluid communication with the duct for conveying water with a temperature below 65°C,

   characterized in that the water dispensing device comprises:

   - a control device for controlling the water dispensing device,
   - an inlet valve, to be controlled by the control device, which is arranged to allow or to block inflow of fresh water into the hot water tank feed, wherein the control device is arranged for controlling the water dispensing device in various operating modes, wherein the operating modes comprise a steam sterilization mode, in which the inlet valve is placed in a closed state in order to block the inflow of fresh water into the hot water tank via the hot water tank feed.

2. Water dispensing device according to claim 1, wherein the water dispensing device comprises an outlet valve, controllable by the control device, which is arranged to allow or to block outflow of hot water from the hot water tank and through the duct for conveying water with a temperature below 65°C, wherein in the steam sterilization mode the outlet valve is placed in an open state to allow outflow of hot water from the hot water tank via the hot water tank discharge.

3. Water dispensing device according to claim 1 or 2, wherein the operating modes to be controlled by the control device further comprise:

a standby mode, in which the outlet valve is placed in a closed state to block the outflow of hot water from the hot water tank via the hot water tank discharge, and
a dispensing mode, in which the outlet valve is placed in an open state to allow outflow of hot water from the hot water tank via the hot water tank discharge and in which the inlet valve is placed in an open state to allow inflow of fresh water into the hot water tank via the hot water tank feed.

4. Water dispensing device according to one of claims 1-3, wherein the water dispensing device comprises:

- a heat exchanger comprising:

  - a first heat exchange duct with a first inlet and a first outlet, and
  - a second heat exchange duct with a second inlet and a second outlet,

wherein the first heat exchange duct and the second heat exchange duct are arranged for exchanging heat with one another,
wherein the first inlet is connected to the hot water tank discharge and the first outlet is connected to the duct for conveying water with a temperature below 65°C, and wherein the second inlet is to be connected to a fresh water main and the second outlet is connected to the hot water tank feed,
so that the hot water from the hot water tank is feedable via the first heat exchange duct to the duct for conveying water with a temperature below 65°C.

5. Water dispensing device according to one of claims 1-4, wherein the duct for conveying water with a temperature below 65°C is connected to a tap in order to be supplied as cooled-down water for consumption.

6. Water dispensing device according to claims 1-3, wherein the water dispensing device further comprises:

- a cold water tank arranged for keeping cooled water at a temperature of at most 20°C, comprising:

  - a cold water tank feed for feeding water to the cold water tank,
  - a cold water tank discharge for dispensing cooled water from the cold water tank,

- a heat exchanger comprising:

  - a first heat exchange duct with a first inlet and a first outlet, and
  - a second heat exchange duct with a second inlet and a second outlet,

wherein the first heat exchange duct and the second heat exchange duct are arranged for exchanging heat with one another,
wherein the first inlet is connected to the hot water tank discharge and the first outlet is connected to the cold water tank feed, and wherein the second inlet is to be connected to a fresh water main and the second outlet is connected to the hot water tank feed,
so that the hot water from the hot water tank is feedable via the first heat exchange duct to the cold water tank, then to be discharged as cooled-down water for consumption.

7. Water dispensing device according to one of the preceding claims, wherein the hot water tank comprises a second hot water tank discharge for dispensing hot or boiling water, wherein the water dispensing device comprises a second outlet valve, to be controlled by the control device, which is arranged to allow or to block outflow of hot water from the second hot water tank discharge,
wherein the control device is further arranged for controlling a dispensing mode for hot water, in which the second outlet valve is placed in an open state to allow outflow of hot water from the hot water tank via the second hot water tank discharge and in which the inlet valve is placed in an open state to allow inflow of fresh water into the hot water tank via the hot water tank feed.

8. Water dispensing device according to one of the preceding claims, wherein the device comprises a CO_2 container for supplying CO_2, and wherein the cold water tank is arranged for dissolving CO_2 in the cooled water to supply carbonated cooled, filtered water.

9. Water dispensing device according to one of the preceding claims, wherein the water dispensing device comprises a filter for filtering the hot water, wherein the filter is fitted in the hot water tank, in the hot water tank discharge or in the hot water tank feed, so that the hot water discharged via the hot water tank discharge is filtered by the filter.

10. Method for sterilizing a duct for conveying water with a temperature below 65°C that is in fluid communication with a hot water tank discharge of a hot water tank of a water dispensing device, wherein the hot water tank is arranged for keeping hot water at a temperature of at least 100°C and comprises a hot water tank feed for feeding fresh water to the hot

water tank,

wherein an inlet valve is provided which is arranged to allow or to block inflow of fresh water into the hot water tank feed, and an outlet valve which is arranged to allow or to block outflow of hot water from the hot water tank feed,
with the distinctive feature that the method comprises sterilizing the duct for conveying water with a temperature below 65°C, wherein the outlet valve is placed in an open state to allow outflow of hot water from the hot water tank and wherein the inlet valve is placed in a closed state to block inflow of fresh water into the hot water tank, so that the hot water in the hot water tank forms steam owing to the decreasing pressure in the duct for conveying water with a temperature below 65°C for effective sterilization of this duct.

11. Method according to claim 10, wherein the water dispensing device comprises:

- a control device for controlling the water dispensing device,
- an inlet valve, to be controlled by the control device, which is arranged to allow or to block inflow of fresh water into the hot water tank feed,
- an outlet valve, controllable by the control device, which is arranged to allow or to block outflow of hot water from the duct for conveying water with a temperature below 65°C,

the method comprises controlling the water dispensing device with the control device in various operating modes, wherein the operating modes comprise: a steam sterilization mode, in which the inlet valve is placed in a closed state in order to block the inflow of fresh water into the hot water tank via the hot water tank feed, and wherein the outlet valve is placed in an open state to allow outflow of hot water and/or steam from the hot water tank via the hot water tank discharge, wherein the method comprises selecting the steam sterilization mode for the control device.

12. Method according to claim 11, wherein the operating modes to be controlled by the control device further comprise:

a standby mode, in which the outlet valve is placed in a closed state to block the outflow of hot water from the hot water tank via the hot water tank discharge, and
a dispensing mode, in which the outlet valve is placed in an open state to allow outflow of hot water from the hot water tank via the hot water tank discharge and in which the inlet valve is placed in an open state to allow inflow of fresh water into the hot water tank via the hot water tank feed.

13. Method according to one of claims 10-12, wherein the water dispensing device comprises:

- a heat exchanger comprising:

  - a first heat exchange duct with a first inlet and a first outlet, and
  - a second heat exchange duct with a second inlet and a second outlet,

wherein the first heat exchange duct and the second heat exchange duct are arranged for exchanging heat with one another,
wherein the first inlet is connected to the hot water tank discharge and the first outlet is connected to the duct for conveying water with a temperature below 65°C, and wherein the second inlet is connected to a fresh water main and the second outlet is connected to the hot water tank feed,
the method comprises, if desired, dispensing hot water from the hot water tank via the first heat exchange duct to the duct for conveying water with a temperature below 65°C.

14. Method according to claim 13, wherein the duct for conveying water with a temperature below 65°C is connected to a tap in order to be supplied as cooled-down water for consumption.

15. Method according to one of claims 10-12, wherein the water dispensing device comprises:

- a cold water tank arranged for keeping cooled water at a temperature of at most 20°C, comprising:

  - a cold water tank feed for feeding water to the cold water tank,
  - a cold water tank discharge for dispensing cooled water from the cold water tank,

- a heat exchanger comprising:

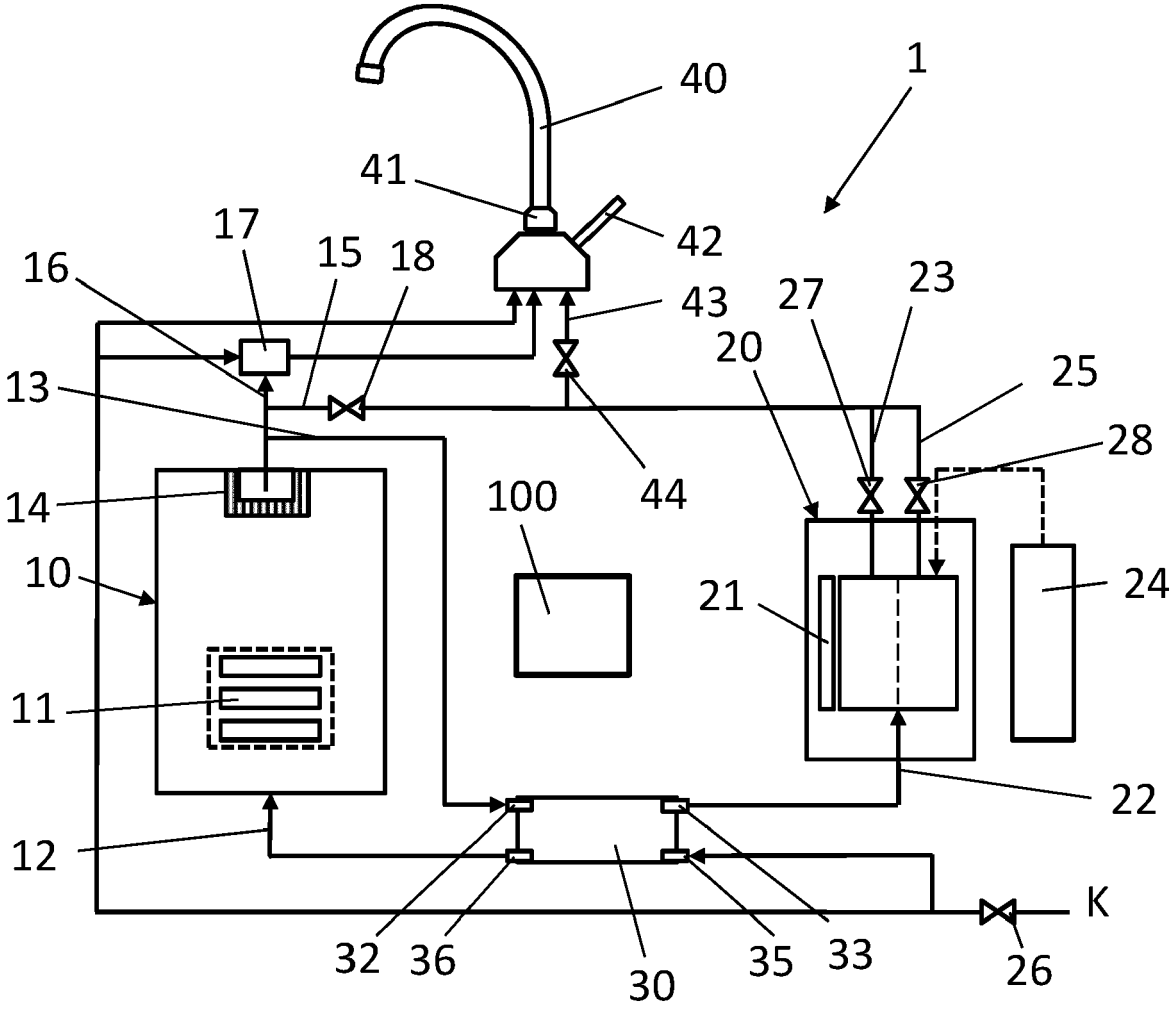
  - a first heat exchange duct with a first inlet and a first outlet, and
  - a second heat exchange duct with a second inlet and a second outlet,

wherein the first heat exchange duct and the second heat exchange duct are arranged for exchanging heat with one another,
wherein the first inlet is connected to the hot water tank discharge and the first outlet is connected to the cold water tank feed, and wherein the

second inlet is to be connected to a fresh water main and the second outlet is connected to the hot water tank feed, and

wherein the method comprises, if desired, dispensing the hot water from the hot water tank via the first heat exchange duct to the cold water tank, then to be discharged as cooled-down water for consumption.

Figuur 1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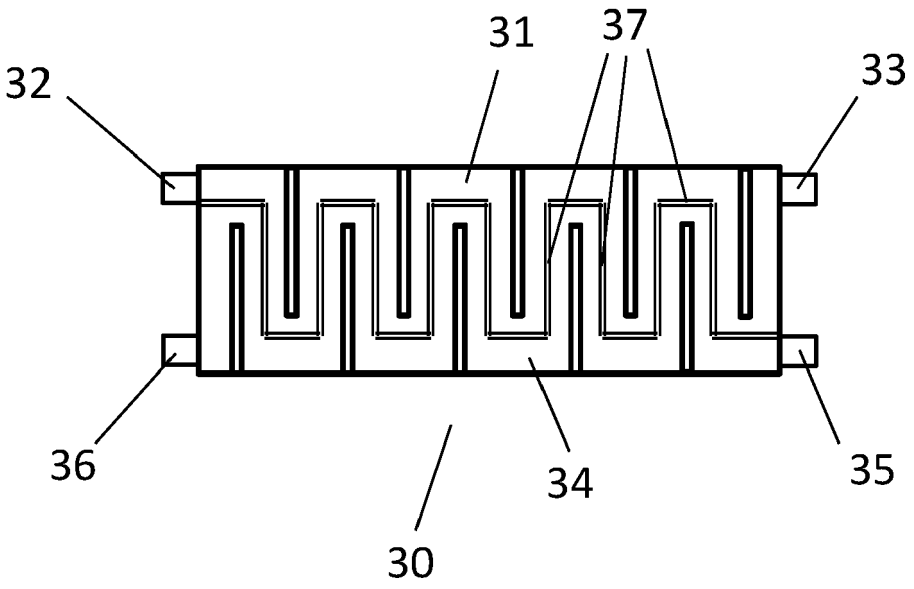
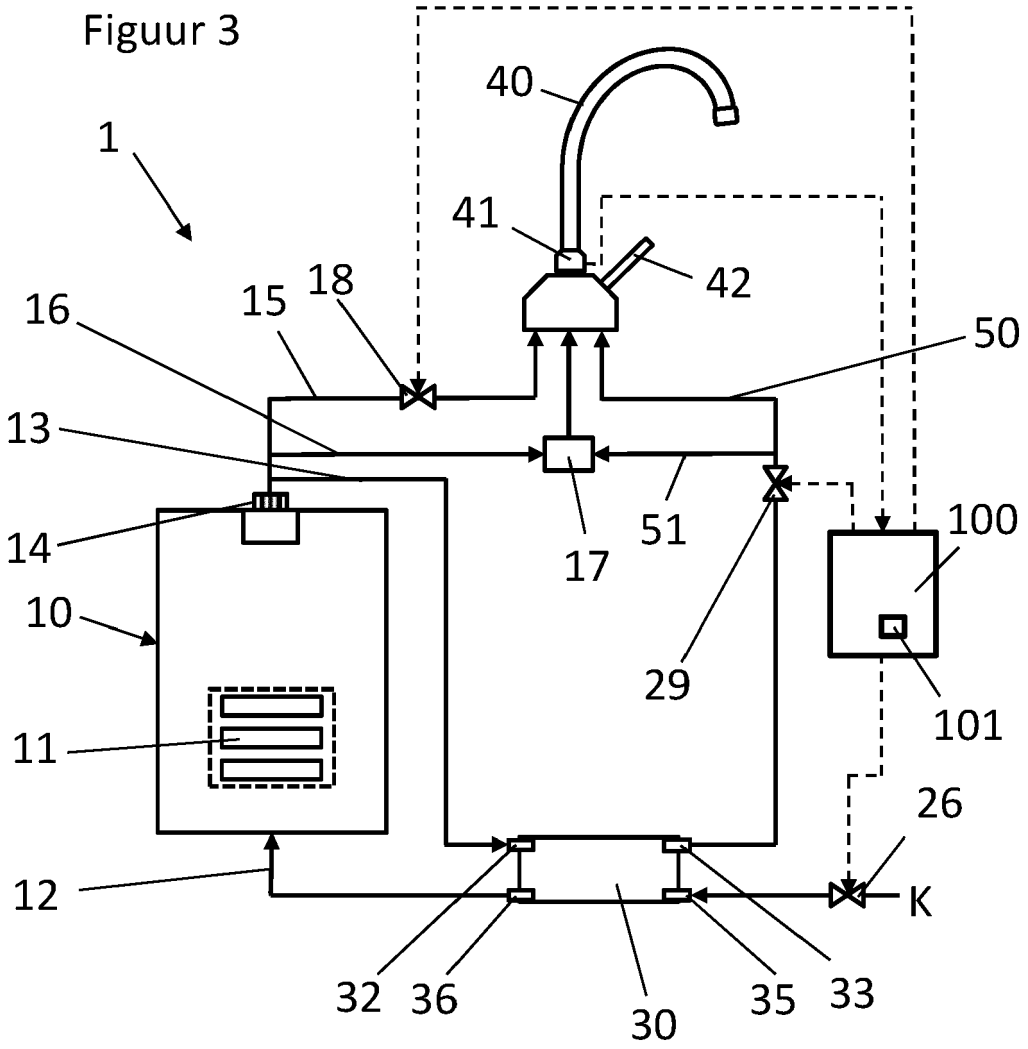
Figuur 2



Figuur 3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EUROPEAN SEARCH REPORT

Application Number
EP 21 17 7617

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 November 2021	Horst, Werner

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