DEVICE COMPRISING A BOILER FOR CONTAINING AND HEATING A LIQUID AND A SYSTEM FOR CONTAINING THE LIQUID AT A LOWER TEMPERATURE

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ABSTRACT
A device comprises a boiler for containing and heating a liquid; and a cool liquid system that is in liquid communication with the boiler, and that is intended to contain relatively cold liquid. During operation of the device, the boiler is activated such as to heat a quantity of liquid that is received from the cool liquid system. In order to avoid heating up of the liquid that is present inside the cool liquid system and cooling down of the liquid that is present inside the boiler, measures are taken in order to prevent a backflow of the liquid. These measures involve an application of some kind of component (9) to be positioned upstream of the boiler, and in order to avoid heat transfer through this component (9), additional measures are taken to realize a heat insulating effect at a position upstream of the boiler.
FIG. 1

FIG. 2
DEVICE COMPRISING A BOILER FOR CONTAINING AND HEATING A LIQUID AND A SYSTEM FOR CONTAINING THE LIQUID AT A LOWER TEMPERATURE

FIELD OF THE INVENTION

[0001] The present invention relates to a device, comprising:
[0002] a boiler for containing and heating a liquid such as water; and
[0003] a cool liquid system that is in liquid communication with the boiler, and that is intended to contain liquid that is at a lower temperature than hot liquid from the boiler.

BACKGROUND OF THE INVENTION

[0004] A device as mentioned in the opening paragraph is well-known in practice. For example, the device may be a water purifying device. In many cases, such a device is a gravity-based device in which the water flows through the device and a filter that is part of the device only under the influence of gravity, without the use of a pump or the like. Hence, in such a device, the boiler is arranged at a lower level than the cool liquid system, which comprises a storage tank in many practical cases. Furthermore, in such a device, a conduit system is provided for interconnecting the storage tank and the boiler. The functioning of the various elements of the device is adapted to the fact that there are only very low pressures in the device, as only the pressure due to a height of a water column extending between the storage tank and the boiler can be applied.

[0005] Conventional gravity-based water purifying devices involve the problem that when the boiler is activated to heat a quantity of water, water that is present in the storage tank is heated as well. The storage tank is supposed to contain water at ambient temperature, but due to the presence of a connection between the storage tank and the boiler, the temperature of the water in the storage tank increases when the boiler is activated. In this respect, it is noted that there is always a heat flow between quantities of water having different temperatures, irrespective of the shape or size of conduits and other elements for containing and/or conveying water. Due to the fact that only low pressures are prevailing in the device, it is not possible to apply complex valves, for example, spring-loaded valves or valves comprising moving parts, to disconnect the hot water in the boiler from the much cooler water in the storage tank.

[0006] The hot water in the boiler has a lower density than the water in the storage tank and the conduit system interconnecting the storage tank and the boiler. Due to the density difference, the hot water has a tendency to rise to a higher level in the device, and moves towards the storage tank, whereas the cold water has a tendency to go down in the device. Consequently, the water in the storage tank gets warmer over time, whereas the boiler needs to use energy to heat the cold water that goes down.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide a solution to the above-sketched problem of the undesirable increase of the temperature of the water in the storage tank due to a flow of relatively hot water from the boiler to the storage tank. It is also an object of the present invention to provide a solution to the above-sketched problem of the undesirable increase of the energy that is needed to heat the water in the boiler due to a flow of relatively cold water from the storage tank to the boiler.

[0008] According to the present invention, a device comprising a boiler and a cool liquid system as described in the foregoing is provided, wherein the device is further equipped with means for preventing a backflow from the boiler to the cool liquid system, and for realizing heat insulation at a position upstream of the boiler.

[0009] It is noted that the means for preventing a backflow from the boiler to the cool liquid system, and for realizing heat insulation at a position upstream of the boiler comprise a single construction in which both functions as mentioned are united. For example, for the purpose of preventing a backflow, the device according to the present invention may comprise a one-way valve for allowing liquid to flow in the direction from the cool liquid system to the boiler and for blocking a flow in the other direction. In a gravity-based device, the valve may be a low pressure operated valve such as an umbrella valve or a duckbill valve. However, such a valve is usually very thin, as a result of which there is a considerable transfer of heat through such a valve. Therefore, in the case of the application of a thin valve as mentioned, although the direct flow of liquid can be blocked by the valve, a construction for realizing a heat insulating function is provided as well in order to avoid cooling of the hot liquid under the influence of the presence of the cold liquid, and heating of the cold liquid under the influence of the presence of the hot liquid. For example, a space for entrapping air may be provided in the vicinity of the valve.

[0010] In any case, when the present invention is applied, it is achieved that a flow of liquid in the direction from the boiler to the cool liquid system cannot occur, and that the hot liquid is insulated from the cold liquid. As an advantageous consequence, the nuisance of a user of the device who expects a liquid at ambient temperature in the cool liquid system, but finds a quantity of warm liquid there, no longer occurs. Furthermore, the energy consumption by the boiler is reduced, as the temperature at the boiler side of the device is no longer continually decreased under the influence of interaction with liquid from the cool liquid system. Another advantageous consequence of having an improved partition of hot liquid and cold liquid is that a phenomenon known as bio fouling is not likely to occur in the cool liquid system, or is at least slowed down to such an extent that no health-threatening situations occur in normal use of the device according to the present invention.

[0011] In respect of the possibility of having a one-way valve in the device for preventing a backflow, it is noted that such valve may be of the type that is adapted to be opened under the influence of liquid pressure. This option is especially advantageous in case it is required to let the design of the device according to the present invention be as simple as possible, wherein there is no need for a valve having moving parts that need to be actively put in an opened position or a closed position by means of a micro-controller or the like.

[0012] It is advantageous for the device according to the present invention to comprise an air entrapment space that is located at a position upstream of the boiler. In this way, an airlock is created that may be situated such as to insulate the hot liquid in the boiler from the cold liquid in the cool liquid system. Preferably, the design of the air entrapment space is such that air is automatically entrapped when the device is filled with a liquid. In such a case, a quantity of air will remain
inside the device as long as the device is filled with the liquid. Furthermore, the airlock is recreated every time the device including the boiler is drained and refilled.

[0013] Within the scope of the present invention, the cool liquid system and the boiler may be directly connected to each other, but it is also possible for the device according to the present invention to comprise a conduit system interconnecting the cool liquid system and the boiler, which comprises a conduit extending between the cool liquid system and the boiler, wherein the air entrapment space is present in a portion of the conduit having a larger cross-sectional area than adjacent portions. In such a configuration, various sorts of practical measures can be taken to ensure that air remains in the defined portion of the conduit, wherein it is possible to make use of the fact that barriers are present at the positions where the portion of the conduit having the larger cross-sectional area is connected to the portions having the smaller cross-sectional areas.

[0014] In a practical embodiment, the device may comprise means for preventing liquid from filling the air entrapment space from the side of the cool liquid system in the form of a wall blocking the access to the air entrapment space. Having a physical barrier for delimiting at least a portion of the air entrapment space in the device is a suitable way of ensuring that air is retained in the air entrapment space on the basis of the fact that the space cannot be reached by the liquid.

[0015] According to a first possibility, a conduit system comprising a conduit extending between the cool liquid system and the boiler is present in the device, wherein a tube member is arranged inside the conduit, and wherein the cross-sectional area of at least an end portion of the tube member, in particular an end portion that is located at the side of the boiler, is smaller than the cross-sectional area of the conduit at the position where the end portion of the tube member is present. In that case, the wall of the end portion of the tube member constitutes a physical barrier between the area where a flow of liquid is present during operation, namely the interior of the tube member, and an area that cannot be reached by the liquid, including the air entrapment space that is present between the wall of the end portion of the tube member and the wall of the conduit.

[0016] Preferably, the wall of the tube member is a thin wall and comprises a flexible material, so that the end portion of the tube member can be used as a one-way valve that can be opened and closed under the influence of very low pressures, for example, pressures prevailing in a gravity-based device. The embodiment comprising the tube member extending inside the conduit has the advantage of a compact and simple design, and has a useful valve function and air entrapment function at the same time, so that a backflow of liquid from the boiler to the cool liquid system is prevented, and a transfer of heat through the valve is prevented as well.

[0017] According to a second possibility existing within the concept of having a wall for blocking the access to the air entrapment space, the air entrapment space is defined by the interior space of a hollow member for containing air. In that case, the wall of the hollow member constitutes the wall that prevents the liquid from filling the air entrapment space. The hollow member may be freely arranged inside a portion of the conduit of the conduit system having a larger cross-sectional area than adjacent portions, wherein the cross-sectional area of the hollow member is larger than the cross-sectional area of the adjacent portions of the conduit. On the basis of the differences of the sizes of the cross-sectional areas, it is impossible for the hollow member and air contained therein to escape from the defined portion of the conduit. Furthermore, due to the free arrangement of the hollow member, the hollow member may perform a valve function. In particular, a backflow from the boiler to the cool liquid system is prevented when the hollow member blocks an opening that is present between the portion of the conduit having the larger cross-sectional area and a portion of the conduit having a smaller cross-sectional area, whereas the hollow member may float at a position inside the portion of the conduit having the larger cross-sectional area under the influence of the pressure of a flow of liquid from the cool liquid system from the boiler, such that the opening as mentioned is no longer blocked.

[0018] The hollow member may have any suitable shape for retaining a quantity of air. For example, the hollow member may be ball-shaped and fully closed, or may be dome-shaped, wherein one side of the hollow member, especially a side at the bottom of the hollow member, is open.

[0019] According to another option, which is applicable when the device comprises a separate valve besides the hollow member, the hollow member may be connected to the valve. In this configuration, heat transfer through the valve is minimized, as the insulating effect of the presence of air takes place right at the position of the valve.

[0020] It is noted that when a hollow member is applied, it may be so that this member is filled with another suitable heat insulating material than air, especially in case the hollow member is fully closed.

[0021] When the device has an air entrapment space, another advantageous possibility for creating a one-way valve function and enhancing the heat insulating function of the space is applying means for transforming a flow of liquid from the cool liquid system to the boiler in a shower of droplets. In particular, with the means as mentioned, it is achieved that there is never physical contact between liquid on one side of the air entrapment space and liquid on another side of the air entrapment space, so that heat insulation takes place to a maximum extent. Furthermore, a flow of liquid from the boiler to the cool liquid system cannot occur, as the air blocks the way back for the liquid.

[0022] The application of the means for transforming a flow of liquid in a shower of droplets is especially useful in a configuration in which the cool liquid system is arranged at a higher level than the boiler, and in which the means are arranged above the air entrapment space. The droplets may then simply fall from the means towards a conduit leading to the boiler, crossing the air entrapment space. In a practical embodiment, the means for transforming a flow of liquid in a shower of droplets comprise a number of lamellae, straws, fibers, or the like, which are extending next to each other with little space in between. An advantage of an application of fibers is that the means may also have a function in purifying the liquid.

[0023] For practical reasons, it is advantageous for the device to be equipped with a pipe which is arranged between the cool liquid system and the boiler, and which is intended to be used for de-airing the liquid-filled portions of the device. Normally, a de-airing pipe as mentioned has a relatively small diameter. When an air entrapment space is present inside the device according to the present invention, it is possible for this space to be present in the cool liquid system, wherein an end portion of the de-airing pipe extends inside the air entrapment space. Furthermore, in such a case, the device may comprise
two one-way valves, wherein one way-valve is arranged at a position inside the conduit, and serves for allowing liquid to flow in the direction from the cool liquid system to the boiler through the conduit, and for blocking a flow in the other direction, and wherein another one-way valve is arranged at an end of the de-airing pipe that is present inside the cool liquid system, and serves for allowing liquid to flow in the direction from the boiler to the cool liquid system through the de-airing pipe, and for blocking a flow in the other direction. In this arrangement, an interface between hot and cool liquid is present at the end of the de-airing pipe. Among other things, this offers the advantage that a user of the device is not allowed to have a clear view on the section of the device where the hot and cool liquid are separated from each other, which may contribute to the user’s appreciation of the device as far as hygiene is concerned, as contaminations like fungus, limescale etc. may be expected to be mainly present in that very section.

In the device according to the present invention, at least a portion of the boiler may be positioned at a lower level than the cool liquid system. In this respect, it is noted that the device may be a gravity-based device in which a displacement of liquid only takes place under the influence of gravity. A specific aspect of the gravity-based device is that such a device can do without a pump or the like, so that energy and space may be saved, which may be advantageous in various intended applications of the device. In the gravity-based device, in case a one-way valve is present in a conduit of the conduit system, it is advantageous if the air entrainment space is located between the valve and the boiler. When the air entrainment space is present at the boiler side of the valve, the liquid inside the boiler is kept at the highest possible temperature, as a heat transfer process to the valve and the elements of the device arranged beyond the valve is hindered on the basis of the insulating effect of the air entrainment space.

The above-described and other aspects of the present invention will be apparent from and elucidated with reference to the following detailed description of a number of embodiments of a device according to the present invention, focusing on a portion of the device where an air entrainment space is present.

A water heating and dispensing system is disclosed in WO 98/51970. The system includes a dispenser body having a water reservoir which can be replenished by an inverted water bottle. The bottle is mounted on top of the dispenser body. The system further includes a cold water tank, a hot water tank and a non-return valve which is located in a pipe. The pipe feeds water from the water reservoir to the hot water tank and prevents return of heated water in the hot water tank to the cold water tank. An expansion chamber is connected to the hot water tank to allow expansion of the heated water. The cold water tank is thermally insulated from the expansion chamber and the hot water tank.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be explained in greater detail with reference to the figures, in which equal or similar parts are indicated by the same reference signs, and in which:

FIG. 1 diagrammatically shows a number of components of a first embodiment of a device according to the present invention, including a storage tank, a boiler, and a conduit extending from the storage tank to the boiler;

FIG. 2 diagrammatically shows a portion of the conduit where an air entrainment space is present;

FIGS. 3-9 illustrate a number of alternative options existing within the scope of the present invention for the design of portion of the conduit where the air entrainment space is present;

FIG. 10 diagrammatically shows a number of components of a second embodiment of the device according to the present invention, including cool water conduits and a boiler; and

FIG. 11 diagrammatically shows a number of components of a third embodiment of the device according to the present invention.

In the figures, a direction of flow of water is indicated by means of arrows.

DETAILED DESCRIPTION OF EMBODIMENTS

FIG. 1 diagrammatically shows a number of components of a first embodiment of a device 1 according to the present invention. In this example, the device 1 is a device for purifying water, but that does not alter the fact that the present invention is also applicable in the field of other types of devices.

The device 1 comprises a storage tank 2 for containing water and a boiler 3 for containing and heating water. FIG. 1 illustrates the positioning of the storage tank 2 and the boiler 3 that is related to a normal orientation of the device 1, and shows that the boiler 3 is positioned at a lower level than the storage tank 2. The storage tank 2 and the boiler 3 are in communication through a conduit 4 that is extending from the storage tank 2 to the boiler 3, and that has a substantially vertical orientation in the shown example. Furthermore, in the shown example, a de-airing pipe 5 is arranged between the storage tank 2 and the boiler 3.

A filling process of the boiler 3 takes place under the influence of gravity, wherein water flows from the storage tank 2 to the boiler 3 through the conduit 4. The boiler 3 has suitable heating means for heating the water and/or boiling the water.

The device 1 has two water taps 6, 7, namely a water tap 6 that is connected to the storage tank 2 and serves for supplying water from the storage tank 2, and a water tap 7 that is connected to the boiler 3 and serves for supplying water from the boiler 3. A user of the device 1 uses the first water tap 6 in case it is desired to take water at ambient temperature from the device 1, whereas the user uses the second water tap 7 in case it is desired to take hot water from the device 1.

The present invention relates to measures which are aimed at avoiding an undesirable displacement of hot water to the storage tank 2 and an undesirable displacement of cold water to the boiler 3 through the conduit 4, which would take place if the conduit 4 would simply be open under all circumstances. In particular, according to the present invention, measures are taken in order to avoid a backflow of water through the conduit 4, i.e. a flow from the boiler 3 back to the storage tank 2, and in order to create heat insulation at a position between the storage tank 2 and the boiler 3.

FIG. 2 shows a detail of FIG. 1, namely a portion 8 of the conduit 4 having a larger cross-sectional area than adjacent portions, and thereby illustrates a first example of a way of realizing the functions of avoiding a backflow of water and insulating hot water from cool (ambient) water as mentioned in the preceding paragraph. In the shown example, a thin, flexible tube member 9 is arranged inside the portion 8 of
the conduit having the relatively large cross-sectional area, which will hereinafter be referred to as enlarged conduit portion. One end of the tube member 9 is located at the storage tank side of the enlarged conduit portion, and another end of the tube member 9 is located at the boiler side of the enlarged conduit portion. At the boiler side, the tube member 9 has a tapering shape, wherein the end 10 of the tube member 9 is normally closed. Only under the influence of a pressure difference between one side of the normally closed end 10 and the other side, the tube member 9 opens, and water is allowed to pass through.

[0040] In the device for purifying water, pressure is exerted from the side of the storage tank, under the influence of gravity. When the tube member 9 is opened under the influence of this pressure, water flows from the storage tank to the boiler. As soon as the pressure is relived, the tube member 9 is closed again under the influence of an inclination of the material of the tube member 9 to assume the originally closed position and/or pressure exerted on the end 10 of the tube member 9 by a quantity of air which has a function in surrounding this end 10, as will be explained later. In any case, in the closed state of the tube member 9, a backflow of water from the boiler to the storage tank cannot occur. Hence, the tube member 9 acts like a one-way valve, which is adapted to only allow for a flow of water from the storage tank to the boiler, while blocking the passage in the opposite direction. In particular, the tube member 9 acts like a so-called duckbill valve.

[0041] Furthermore, due to the tapering shape of the tube member 9, an air entrainment space 11 is obtained in the enlarged conduit portion, namely at the position where there is space between the outer wall of the tube member 9 and the inner wall of the conduit. The air entrainment space 11 cannot be filled with water flowing from the storage tank to the boiler, as it is guided through the enlarged conduit portion by the tube member 9, and the air that remains inside the enlarged conduit portion once the device is filled is trapped inside the air entrainment space 11, wherein it is enclosed by the wall of the conduit, the wall of the tube member 9, and the water at the boiler side, and cannot escape.

[0042] On the basis of the presence of air in the air entrainment space 11, a heat insulating effect is created, wherein the insulation is present between the relatively cold water at the storage tank side and the relatively hot water at the boiler side. In this way, it is achieved that the temperature of the water in the storage tank 2 is practically not influenced by the temperature of the water in the boiler 3, and that the temperature of the water in the boiler 3 is practically not influenced by the temperature of the water in the storage tank 2.

[0043] All in all, the device according to the present invention is capable of offering the same water purifying function and water storage function as a conventional device for purifying water. As the tube member 9 can be opened at low pressure, the flow of water from the storage tank to the boiler 3 is practically not influenced. Advantageous effects of the design with the tube member 9 involve a valve function in which backflow of water is prevented, and a heat insulating function in which a transfer of heat between water at the storage tank side and water at the boiler side is minimized.

[0044] Within the scope of the present invention, many alternatives for realizing the valve function and the heat insulating function as described in the foregoing exist. FIGS. 3-9 serve to illustrate a number of those alternatives.

[0045] In FIG. 3, a first alternative is shown. According to this alternative, the tube member 9 is rigid and does not have a tapering shape, and is not capable of performing a valve function. Therefore, a separate valve 13 is provided at the storage tank side of the tube member 9, which valve 13 may be a relatively simply valve that can open under the influence of low pressures, such as an umbrella valve. As is the case with the embodiment described on the basis of FIG. 2, an air entrainment space 11 is present between the outer wall of the tube member 9 and the inner wall of the conduit 4 for realizing a heat insulating function at the position of the enlarged conduit portion.

[0046] In FIG. 4, a second alternative is shown. According to this alternative, there is no tube member 9, but the air entrainment space 11 is simply constituted by an upper portion of the enlarged conduit portion. At the position of the connection from the enlarged conduit portion to the adjacent conduit portion 12 at the storage tank side, a valve 13 is provided, which is capable of allowing water to pass from the storage tank to the boiler, through the air entrainment space 11, and which is capable of blocking the way in the opposite direction, so that it is not possible for the air to escape from the air entrainment space 11. For example, the valve 13 is a solenoid valve that is operated electrically. In that case, the functioning of the valve 13 does not directly depend on pressures prevailing at the two sides of the valve 13, and proper operation of the valve 13 is also guaranteed in situations in which pressures are higher than in a gravity-based device.

[0047] In FIG. 5, a third alternative is shown. According to this alternative, a umbrella valve 13 is arranged at the storage tank side of the enlarged conduit portion, and an air entrainment space 11 is located right underneath the valve 13 when going from the storage tank side to the boiler side.

[0048] In FIG. 6, a fourth alternative is shown. According to this alternative, there is an umbrella valve 13 as in the third alternative. However, the air entrainment space 11 is provided in the form of a hollow member 14 containing air or another heat insulating material, which is connected to the valve 13.

[0049] In FIG. 7, a fifth alternative is shown. According to this alternative, a device 15 for transforming a flow of water into droplets of water is applied. In the shown example, this device 15 comprises a number of lamellae, straws, fibers, or the like, which are extending at a relatively small distance with respect to each other. An application of fibers in the droplet device 15 is advantageous, as on the basis of such an application, it is possible to also use the droplet device 15 for purifying the water.

[0050] The droplet device 15 is arranged near the storage tank side of the enlarged conduit portion, wherein an air entrainment space 11 is present at a top portion of the enlarged conduit portion. Under the influence of pressure that is exerted from the side of the storage tank, a flow of water is supplied to the droplet device, and droplets of water are generated as the water passes through the device, which droplets fall towards the boiler side of the enlarged conduit portion. By supplying water to the boiler 3 in the form of droplets, it is achieved that there is no direct contact between the water at the storage tank side and the water at the boiler side, so that the heat insulating function of the air entrainment space 11 is enhanced even further. On the basis of the fact that the droplet device 15 offers a certain flow resistance, the droplet device 15 has a valve function. However, if so desired, it is possible to have an additional valve 13 such as an umbrella valve as shown in FIG. 7.
In FIG. 8, a sixth alternative is shown. According to this alternative, a hollow member 14 containing air or another heat insulating material is arranged inside the enlarged conduit portion 8, and this hollow member 14 is free to float inside the enlarged conduit portion 8. In the shown example, the hollow member 14 is ball-shaped, wherein the cross-sectional area of the hollow member 14 is smaller than the cross-sectional area of the enlarged conduit portion 8, and larger than the cross-sectional area of adjacent conduit portions 12, 16. In this way, it is ensured that the hollow member 14 cannot escape from the enlarged conduit portion 8. At the storage tank side of the enlarged conduit portion 8, the conduit 4 tapers, so that the hollow member 14 smoothly led to a position for blocking a passage from the enlarged conduit portion 8 to the adjacent conduit portion 12 at the storage tank side when no pressure is exerted. However, when pressure is exerted, the hollow member 14 is displaced a little bit, such that water is allowed to pass between the hollow member 14 and the inner wall of the conduit 4. It follows from the foregoing description that the hollow member 14 has a valve function. However, if so desired, it is possible to have an additional valve 13 such as an umbrella valve as shown in FIG. 8.

In FIG. 9, a seventh alternative is shown. According to this alternative, another type of hollow member is applied, namely a dome-shaped hollow member 17 that is open at a bottom side. As air rises in water, there is no risk of the air escaping from the hollow member 17, even though there is an open side.

Although the above-described alternatives differ from each other, there are two important things they have in common, namely the fact that there are means for preventing a backflow of water, and the fact that there are means for realizing a heat insulating function at a position between the storage tank 2 and the boiler 3. These means may be realized on the basis of a single construction, such as a thin, flexible tube member 9 that is arranged inside a portion of the conduit 4, as shown in FIG. 2, or a hollow member 14, 17 as shown in FIGS. 8 and 9. It is also possible that a construction having more elements is applied, such as the combination of a rigid tube member 9 and an umbrella valve 13, as shown in FIG. 3. In any case, a very practical manner of realizing the heat insulating function is having a quantity of air at a position for separating water at the storage tank side from water at the boiler side.

By only allowing a flow of water from the storage tank 2 to the boiler 3, and preventing a backflow, and by providing a heat insulating function, it is achieved that water that is present inside the storage tank 2 remains at ambient temperature, whereas the relatively high temperature of water that is present inside the boiler 3 is practically not influenced by the much lower temperature of the water that is present inside the storage tank 2.

It will be clear to a person skilled in the art that the scope of the present invention is not limited to the examples discussed in the foregoing, but that several amendments and modifications thereof are possible without deviating from the scope of the present invention as defined in the attached claims. While the present invention has been illustrated and described in detail in the figures and the description, such illustration and description are to be considered illustrative or exemplary only, and not restrictive. The present invention is not limited to the disclosed embodiments.

Variations to the disclosed embodiments can be understood and effected by a person skilled in the art in practicing the claimed invention, from a study of the figures, the description and the attached claims. In the claims, the word “comprising” does not exclude other steps or elements, and the indefinite article “a” or “an” does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope of the present invention.

It is not necessary for the device 1 according to the present invention to comprise a storage tank 2 for containing cold water and supplying cold water at the request of a user. In general, the device 1 according to the present invention comprises a system for containing liquid outside of the boiler 3, wherein this system may as well be shaped like a conduit system, for example. For sake of illustration of this statement, an embodiment of the device 18 according to the present invention, which does not comprise a storage tank 2, but only comprises cool water conduits 19 that are in liquid communication with the boiler 3, is diagrammatically shown in FIG. 10.

Furthermore, in case the device 1, 18 according to the present invention comprises an air entrainment space 11, it is not necessary for this space 11 to be present in the conduit 4. FIG. 11 shows an embodiment of the device 20 in which the air entrainment space 11 has another position. In particular, the alternative position is a position inside a bottom portion 21 of the storage tank 2, wherein an end portion of the de-airing pipe 5 is extending inside the bottom portion 21 of the storage tank 2 as mentioned, and wherein the air entrainment space 11 is located such as to surround this end portion.

For the purpose of defining the air entrainment space 11 to such an extent that only a bottom portion is left open, a wall part 22 is arranged inside the storage tank 2.

In the embodiment as shown in FIG. 11, for the purpose of preventing a backflow from the boiler 3 to the storage tank 2, a suitable one-way valve 13 is arranged at a position inside the conduit 4. Furthermore, another one-way valve 23 is provided, which is positioned in the bottom portion 21 of the storage tank 2, in the air entrainment space 11, at an end of the de-airing pipe 5.

When air is present inside the air entrainment space 11, it is achieved that hot water is separated from cold water at the position of the end of the de-airing pipe 5. The air can also serve as a back-up in case the valve 23 has some leakage.

An important advantage of the construction of the embodiment shown in FIG. 11 is recognized when the fact that the de-airing pipe 5 has a relatively small diameter is taken into account. The fact is that if any contaminations are present in the water, these contaminations normally tend to be present at the interface between the hot water and the cold water. In this case, the interface as mentioned is small, so that it is difficult or even impossible for a user to see any contaminations, which will contribute to consumer's trust in the device 20.

For sake of completeness, it is noted that the present invention is applicable in any situation in which there is a cool liquid system 2, 19 and a boiler 3, wherein the cool liquid system 2, 19 and the boiler 3 are in liquid communication with each other, and wherein it is desired to keep the heat at the boiler side, and to keep the cold at the cool liquid system side. Hence, the device 1, 18, 20 according to the present invention does not necessarily need to be a gravity-based device, but may comprise additional components for realizing a desired displacement of a liquid through the device, especially a pump. Furthermore, the present invention is applicable in the field of any type of liquid, wherein water is just one practical example. In respect of the boiler 3, it is noted that this component of the device 1, 18, 20 according to the present invention may be of any suitable type. It is assured
that the construction of a boiler 3 with heating means for heating a content of the boiler 3 is well-known and does not need any further explanation here.

[0062] The present invention can be summarized as follows. A device 1, 18, 20 comprises a boiler 3 for containing and heating a liquid such as water; and a cool liquid system 2, 19 that is in liquid communication with the boiler 3, and that is intended to contain liquid that is at a lower temperature than hot liquid from the boiler 3, i.e. relatively cold liquid. During operation of the device 1, 18, 20, the boiler 3 is activated such as to heat a quantity of liquid that is received from the cool liquid system 2, 19. In order to avoid heating up of the liquid that is present inside the cool liquid system 2, 19 and cooling down of the liquid that is present inside the boiler 3 under the influence of a natural displacement of relatively cold liquid and relatively hot liquid in the device 1, 18, 20, measures are taken in order to prevent a backflow of the liquid. These measures involve an application of some kind of component to be positioned upstream of the boiler 3, and in order to avoid heat transfer through this component, additional measures are taken to realize a heat insulating effect at a position upstream of the boiler 3, which may be a position in the vicinity of the component. A practical way of realizing the heat insulating effect is providing an air entrapment space 11 at a suitable position.

1. Device (1, 18, 20), comprising:
   a) a boiler (3) for containing and heating a liquid such as water;
   b) a cool liquid system (2, 19) that is in liquid communication with the boiler (3), and that is intended to contain liquid that is at a lower temperature than hot liquid from the boiler (3); and
   c) means for preventing a backflow from the boiler (3) to the cool liquid system (2, 19), and for realizing heat insulation at a position upstream of the boiler (3), characterized in that the means for preventing a backflow from the boiler to the cool liquid system, and for realizing heat insulation at a position upstream of the boiler comprise a single construction in which both functions as mentioned are united.

2. Device (1, 18, 20) according to claim 1, comprising a space (11) for entrapping air in the device (1, 18, 20), which is located at a position upstream of the boiler (3).

3. Device (1, 18) according to claim 2, comprising a conduit system interconnecting the cool liquid system (2) and the boiler (3), which comprises a conduit (4) extending between the cool liquid system (2) and the boiler (3), wherein the air entrapment space (11) is present at a position (8) of the conduit (4) having a larger cross-sectional area than adjacent portions (12, 16).

4. Device (1, 18, 20) according to claim 2, comprising means for preventing liquid from filling the air entrapment space (11) from the side of the cool liquid system (2, 19) in the form of a wall blocking the access to the air entrapment space (11).

5. Device (1) according to claim 4, comprising a conduit system interconnecting the cool liquid system (2) and the boiler (3), which comprises a conduit (4) extending between the cool liquid system (2) and the boiler (3), wherein a tube member (9) is arranged inside the conduit (4), and wherein the cross-sectional area of at least an end portion of the tube member (9) is smaller than the cross-sectional area of the conduit (4) at the position where the end portion of the tube member (9) is present.

6. Device (1) according to claim 5, wherein the wall of the tube member (9) is a thin wall and comprises a flexible material.

7. Device (1) according to claim 2, comprising a hollow member (14, 17) for containing a heat insulating material.

8. Device (1) according to claim 7, comprising a conduit system interconnecting the cool liquid system (2) and the boiler (3), which comprises a conduit (4) extending between the cool liquid system (2) and the boiler (3), wherein the hollow member (14, 17) is freely arranged inside a portion (8) of the conduit (4) having a larger cross-sectional area than adjacent portions (12, 16), wherein the cross-sectional area of the hollow member (14, 17) is larger than the cross-sectional area of the adjacent portions (12, 16) of the conduit (4).

9. Device (1) according to claim 7, wherein the hollow member (17) is shaped like a dome having an open side.

10. Device (1) according to claim 7, comprising a valve (13) for allowing liquid to flow in the direction from the cool liquid system (2, 19) to the boiler (3) and for blocking a flow in the other direction, wherein the hollow member (14) is connected to the valve (13).

11. Device (1) according to claim 2, comprising means (15) like a number of lamellae, straws, or fibers, which are extending next to each other with little space in between, for transforming a flow of liquid from the cool liquid system (2, 19) to the boiler (3) in a shower of droplets.

12. Device (20) according to claim 2, comprising a conduit system interconnecting the cool liquid system (2) and the boiler (3), which comprises a conduit (4) extending between the cool liquid system (2) and the boiler (3), and a de-airing pipe (5) having a relatively small diameter, which is arranged between the cool liquid system (2) and the boiler (3), wherein the air entrapment space (11) is present in the cool liquid system (2), and wherein an end portion of the de-airing pipe (5) extends inside the air entrapment space (11).

13. Device (20) according to claim 12, comprising two one-way valves (13, 23), wherein one way-valve (13) is arranged at a position inside the conduit (4), and serves for allowing liquid to flow in the direction from the cool liquid system (2) to the boiler (3) through the conduit (4), and for blocking a flow in the other direction, and wherein another one-way valve (23) is arranged at an end of the de-airing pipe (5) that is present inside the cool liquid system (2), and serves for allowing liquid to flow in the direction from the boiler (3) to the cool liquid system (2) through the de-airing pipe (5), and for blocking a flow in the other direction.

14. Device (1, 18, 20) according to claim 14, being a gravity-based device in which a displacement of liquid only takes place under the influence of gravity, wherein at least a portion of the boiler (3) is positioned at a lower level than the cool liquid system (2, 19).

15. Device (1) according to claim 14, comprising a valve (13) for allowing liquid to flow in the direction from the cool liquid system (2) to the boiler (3) and for blocking a flow in the other direction, and a space (11) for entrapping air in the device (1), wherein the air entrapment space (11) is located at a position between the valve (13) and the boiler (3).