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(54) Title: IMPROVED WATER APPARATUS

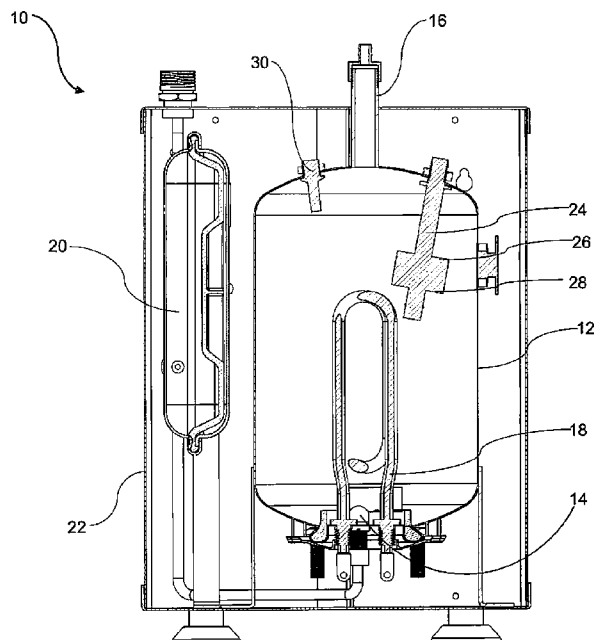


FIG. 1

(57) Abstract: An apparatus for dispensing hot water is described. The apparatus comprises a tank, the tank comprising a water inlet and a water outlet; and a heat source located adjacent to the water inlet within the tank. The apparatus is arranged such that the water inlet is adapted to introduce a water jet into the tank focused towards the heat source.



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Improved water apparatus

Field of the Invention

The present invention relates to the field of hot water systems, in particular, to an apparatus for providing instant hot water. The present invention can be used in residential buildings, at hotel and catering facilities, sporting facilities and wherever there is a need of an instant and constant or continuous supply of hot water, especially where the available space for installing a hot water system is limited.

10 Background to the Invention

There are many situations in which an instant and prolonged supply of hot water is desirable. For example large residential buildings, hotels, catering facilities, changing rooms of sporting facilities, etc.

A common solution adopted to meet this hot water demand is to heat large quantities of water and keep it in large insulated water tanks. Instant demand of hot water is then met by supplying it from the tank.

This solution requires a large space for installing a large water container to be dedicated to this purpose and significant quantities of energy might be lost due to the fact that hot water in the tank cools down if it is not used in short time after it has been heated. To overcome this problem, there are thermostatic water tanks that keep water hot at all times, even when it is not needed. This amounts to a waste of energy due to heat loss through the tank walls and still requires a large space for the tank. However, if the water is heated on demand, there can be a substantial delay from when that demand arises until the water is actually supplied at the required temperature.

In order to solve these problems, instant hot water dispensers have been developed. Instant hot water dispensers might keep a smaller amount of water in a smaller tank and heat water after a certain amount of hot water in the tank has been used, or if the temperature of the water in the tank falls below a certain level. These instant hot water dispensers usually require less space than the traditional hot water systems described above but are more energy intensive, that is, they require a more intense energy input. One of the problems of instant hot water dispensers is that they

are not able to constantly supply a hot water flow at the desired temperature, and the water temperature falls substantially after the dispenser has been a few seconds supplying water at the desired temperature.

Another problem found is that sometimes, the water level within the tank might fall so much that part of the heating element within the tank is left above the water level and then there is a risk that the heating element overheats itself and burns (this is what is called dry-burn), which can damage the heating element and other parts of the hot water dispenser and amounts to an unnecessary excess of energy consumption.

Summary of the Invention

According to a first aspect of the invention there is provided an apparatus for dispensing hot water, the apparatus comprising:

a tank, the tank comprising a water inlet and a water outlet; and

a heat source located adjacent to the water inlet within the tank

wherein the water inlet is adapted to introduce a water jet into the tank focused towards the heat source.

In at least an embodiment of the present invention, by introducing a water jet in the tank focused towards the heat source, it is ensured that the heat provided by the heat source is mainly used to heat water that has recently entered the tank and still has not reached a desired temperature value. The water jet displaces or propels water that has already been heated towards another area of the tank and new water from the mains is being put in contact with the heat source constantly, therefore creating a greater temperature gradient between the heat source and the water surrounding it, thus improving the heat transfer rate at which heat can pass from the heat source to the water. This accounts for the improved energy efficiency of the present invention.

The heat source may have a vertical axis greater than a horizontal axis.

The heat source may extend to more than 50% of the height of the tank.

The heat source may extend to more than 75% of the height of the tank. The use of vertical heat sources which extend up the tank, provides a better and more efficient heating of the water and keeps the main body of the water at a higher

temperature than conventional apparatus. This allows for particular embodiments of the present invention to be able to dispense a water flow at a desired temperature during a prolonged period of time without causing a significant decrease in water temperature, unlike other instant hot water tank dispensers found in the prior art with similar heating power, which normally exhibit a significant temperature decrease in the dispensed water stream over prolonged periods of time. Such an arrangement, however, is counterintuitive as a vertical heat source increases the possibility of heat source being exposed as the water level in the tank drops. However this arrangement permits water to be introduced at the same rate as water is removed and to be heated more efficiently thereby overcoming this problem.

The heat source may be oriented along a longitudinal axis of the tank. In at least one embodiment of the present invention this disposition of the heat source relative to the tank maximises the heat exchange between the water jet and the heat source because the recently added water flow within the tank is mostly along the heat source. This maximises the contact time between the water recently added to the tank and the heat source.

The heat source vertical axis may be aligned with a tank vertical axis.

The heat source vertical axis and the tank vertical axis may be substantially the same. In at least one embodiment of the present invention this orientation of the tank and heat source produces a secondary flow of heated water by gravity that returns the heated water to the base of the tank and this enhances the heat exchange between the heated water, which has passed along the heat source, and the recently added water. The overall effect is an improved mixing within the tank with the consequent improved heat transfer between heated water and recently added water.

The heat source may be located adjacent the lowest point of the tank.

The heat source may be adapted to heat water located in the lowest point of the tank. Such an arrangement reduces the establishment of dead spots, that is pockets of cold water which remain in the tank without being heated.

The water inlet may be located at or adjacent the heat source vertical axis.

The water jet may be adapted to introduce water into the tank towards the lowest point of the tank.

The water jet may be adapted to introduce water into the tank towards the lowest point of the heat source. In at least one embodiment of the present invention, by introducing a water jet in the tank, and particularly within the region of the heat source and towards the bottom of the heat source, the turbulence of the water in the tank is also increased, thus reducing the thickness of the boundary layer at the heating element surface, and therefore a faster heat transfer occurs among all regions within the tank, more significantly in the region around the heat source. Such an arrangement ensures the coldest water starts at the very bottom of the tank and works its way up as it heats.

In particular embodiments of the present invention, the time required to heat an amount of water to a desired temperature is significantly shorter than the time required to heat the same amount of water to the same temperature using instant hot water tank dispensers found in the prior art with similar heating power.

The water inlet may comprise a narrowing of its cross-sectional area. In at least one embodiment of the present invention by providing a narrowing of the cross-sectional area of the water inlet, an increase in the velocity of the water jet entering the tank towards the heat source is produced and the heat transfer from the heat source to the recently introduced water can be faster.

The water inlet may comprise a nozzle. In at least one embodiment of the present invention by providing a water inlet comprising a nozzle, the introduction of a water jet focused towards the heat source can be implemented more effectively. Especially suitable nozzles are those which focus the water jet towards the heat source and increase the turbulence of the water jet. In some embodiments, a water jet focused towards the heat source with increased turbulence substantially increase the heat transfer rate from the heat source to the water within the tank. This is especially beneficial for obtaining an instant and sustained hot water supply with a state-of-the-art powered heat source.

The heat source may be adapted to be powered by 110 V electrical power. This embodiment is particularly suitable to be used in the US electrical grid.

Alternatively the heat source may be adapted to be powered by 230/240 V electrical power. This embodiment is particularly suitable to be used in the European electrical grid.

Alternatively the heat source may be adapted to be powered by either 110 V electrical power or 230/240 V electrical power. This embodiment can be used in both US and European electrical grids.

5 The apparatus may comprise a liquid level controller, the liquid level controller comprising an upper level limit and a lower level limit. The liquid level controller may be positioned such that the lower level limit is above the heat source such that, in use, the liquid level controller maintains a minimum water level within the tank such that the heat source is completely submerged in water at all times. In at least one embodiment of the present invention, a liquid level controller positioned such that the
10 lower level limit is above the heat source and adapted to maintain the heat source submerged in water at all times prevents that the heat source supplies heat in dry conditions. If the heat source operates in dry conditions, a large amount of heat is wasted and the heat source may be damaged by excessive self-heating in dry conditions, which is typically known as dry-burn. By keeping the heat source
15 submerged at all times, these undesirable effects are prevented from happening.

The apparatus may comprise an expansion bladder in fluid communication with the tank.

The expansion bladder may be made of stainless steel.

Alternatively the expansion bladder may be made of plastic.

20 In at least one embodiment of the present invention an apparatus for instantly dispensing hot water that comprises an expansion bladder maintains a water level within a desired range for longer time, because the expansion bladder compensates for water density changes due to temperature fluctuation. This effect present various benefits. In a first instance, when the water is being heated, the expansion bladder
25 allows that the pressure within the tank does not increase due to the increased water vapour pressure. This, in turn, reduces the risk of leaks from the tank, the mechanical stress on the tank walls and frequent opening of the overpressure safety valve. In a second instance, when the water temperature drops and the water density increases, the expansion bladder gradually restores its original shape and
30 the water level within the tank is kept above a predetermined value for longer, thus delaying the need of cold water entering the tank for refill. This prevents frequent opening of the inlet water valve. This might be beneficial for supplying a hot water

flow for prolonged periods of time. In some embodiments, a stainless steel expansion bladder is more resistant to cracks than conventional plastic expansion bladders and can resist higher pressures.

5 The expansion bladder may have a capacity about 10% or less of the capacity of the tank. In at least one embodiment of the present invention when the apparatus comprises an expansion bladder that is 10% or less the capacity of the tank, then a smooth water dispensing with minimal delays is achieved.

10 The apparatus may comprise a Venturi-type connector that provides fluid communication among a water source, the expansion bladder and the tank. In at least one embodiment of the present invention by providing fluid communication among the tank, the expansion bladder and the water source, the level of the water within the tank is kept more constant due to the volume compensation caused by the hot water flowing from the tank back to the bladder, through the Venturi-type connector. Additionally, when water is introduced within the tank from the water
15 source, through the Venturi-type connector, any hot water remaining in the bladder is sucked by a Venturi effect into the tank. Another advantage is that dripping from the water source connection is avoided by having the water source and the expansion bladder in fluid communication.

20 The Venturi-type connector may be made of plastic.
Alternatively the Venturi-type connector may be made of metal.

The Venturi-type connector may comprise a ramification to the bladder that is double the size of the Venturi-type connector narrowing and half the size of the Venturi-type connector main bore. In at least one embodiment of the present invention by having a Venturi-type connector with these relative dimensions, the flow
25 back to the bladder and the flow from the bladder to the tank is suitably compensated and the dripping for the water source is also avoided.

The Venturi-type connector may comprise a narrowing with at least two different diameters. In at least one embodiment of the present invention a Venturi-type connector with at least two-diameter narrowing is able to suitably distribute or
30 direct the flow from the tank to the bladder without causing dripping from the water source.

The apparatus may comprise a device that allows water to flow to and from the tank and keeps a predetermined constant pressure within the tank. In at least one embodiment of the present invention a device that maintains a constant pressure within the tank is suitable to allow water to be dispensed at a suitable rate, because if the pressure within the tank falls too much, the heating is not as efficient and the water flow dispensed is too low. However, if the pressure within the tank is above a certain value, the heating within the tank is very efficient, but the water flow dispensed is too much and too energetic.

The device may comprise a pressure reducing valve. Alternatively or additionally the device may comprise a backpressure valve. Alternatively or additionally the device may comprise at least one way valve.

The device may be adapted to maintain a pressure in the range of about 2 to about 3 bars within the tank. In at least one embodiment of the present invention when the device is adapted to maintain a pressure in the range of about 2 to about 3 bars, the water heating is efficient and the water flow dispensed is of an adequate speed and strength.

The apparatus may comprise at least one electronic temperature sensor to measure, in use, the temperature of the water within the tank. In at least one embodiment of the present invention, an electronic temperature sensor can measure the water temperature more accurately and reliably than state-of-the-art mechanical temperature sensors. This enhanced accuracy in the temperature measurement is also translated in an increased energy efficiency because the water is never excessively overheated and it is never allowed to cool down too much. In preferred embodiments, the electronic temperature sensor accuracy is ± 0.5 °C.

The apparatus may comprise two electronic temperature sensors, one located at the top of the tank and one located at the bottom of the tank. In at least one embodiment of the present invention by having two electronic temperature sensors arranged as previously described, a more accurate prediction and decision of when the heat source needs to provide heat to the water can be made.

The apparatus may comprise a temperature controller.

The temperature controller may comprise at least one predetermined temperature set-point. In at least one embodiment of the present invention, an

apparatus with a temperature controller with at least one predetermined temperature set-point eliminates the need for introducing a temperature set-point into the temperature controller. The user may select one of the at least one predetermined set-points. This feature increases the user-friendliness of the water tank and its ease
5 of use. In preferred embodiments of the present invention the predetermined temperature set-points are especially suitable for preparing hot beverages or for other specific uses. For example, an embodiment may comprise an apparatus provided with a temperature controller with four predetermined temperature set points, one at 99 °C especially suitable for preparing coffee drinks, another at 90 °C,
10 especially suitable for preparing tea drinks, another at 75 °C, especially suitable for preparing instant soups and one at 65 °C, especially suitable for washing up dishes.

The temperature controller may comprise a temperature set-point which is adjustable. The temperature set-point may be adjustable by a rotating knob, a press button or a touch screen button or selector.

15 The apparatus may comprise an electronic or capacitive touch control panel. In at least one embodiment of the present invention, an apparatus provided with an electronic or capacitive touch control panel is more user-friendly and can provide enhanced interactivity when entering temperature set-points and other parameters for the temperature controller of the apparatus. An electronic or capacitive touch
20 control panel is particularly suitable to be used by elderly and/or disabled people.

The apparatus may comprise a display screen. In at least one embodiment of the present invention, the display screen enhances the user-friendliness of the apparatus and its interactivity. In some embodiments the display screen shows actual temperature values, temperature control set point values and/or it indicates
25 when the heat source is supplying heat to the water or when a certain pre-set temperature has been reached.

The apparatus may comprise a device for wireless data transfer and communication. The device for wireless data transfer and communication may function with Wi-Fi™ technology. Alternatively, the device for wireless data transfer
30 and communication may function with Bluetooth™ technology. Other wireless data transfer and communication technologies and protocols may be used without departing from the principles of the invention, such as NFC technology.

The device for wireless data transfer and communication may be adapted to exchange information with a portable device, such as a mobile phone or tablet. In at least one embodiment of the present invention, an apparatus fitted with a wireless data transfer and communication adapted to exchange information with a portable device is more user-friendly and interactive and can provide real-time information about actual water temperature, temperature set-points and other parameters to the user, wherever he/she may be. Additionally, the user can modify set-points or other settings of the apparatus from a remote location.

The device for wireless data transfer and communication may be adapted to exchange information with a remote console. In at least one embodiment of the present invention this feature allows that the control of the apparatus can be implemented in the remote console.

The apparatus may be adapted to exchange information via an internet connection. In at least one embodiment of the present invention by exchanging information via an internet connection it is possible to send a diagnostic of the apparatus functional state to the user or technical service so that appropriate action can be taken in case of faulty operation or maintenance requirements. The internet connection may be used to register the apparatus in a regular maintenance or service programme.

The apparatus may be adapted to be controlled by human voice. In at least one embodiment of the present invention when the apparatus is controlled by human voice there is no need to move the hands to control the operation of the apparatus and therefore it is very suitable for disabled people. The human voice reception may be implemented in the apparatus, in the portable device and/or in the remote control.

The apparatus may comprise a central control unit. In at least one embodiment of the present invention the central control unit coordinates, integrates and centralises the operation of the different controls and communication options implemented in the apparatus.

The tank may be made of stainless steel. In at least one embodiment of the present invention an apparatus comprising a stainless steel tank is more durable because a stainless steel tank is more resistant to corrosion by hot water and air.

The tank may be laser welded. In at least one embodiment of the present invention, a tank that has been laser welded presents a more uniform strength at its welded junctions and it is less likely that pores or other stress points in the welded junctions occur. This feature accounts for a reduced risk of leaks and mechanical failure of the tank.

The tank may comprise formations in the interior of the tank arranged to promote, in use, turbulence and mixing of the water contained in the tank. The formations may comprise baffles. In at least one embodiment of the present invention the addition of formations within the tank to promote turbulence and mixing of the water contained in the tank improves the heat transfer from the heat source and the hot water towards the cold water recently introduced in the tank and therefore the apparatus energy efficiency increases.

The apparatus may comprise an integral tap for dispensing water from the tank, in use.

The apparatus may comprise a tap coupled to the apparatus for dispensing water from the tank, in use.

In at least one embodiment of the present invention when the apparatus comprises a tap, integrated with the apparatus or coupled to it, there is no need to use the services of a plumber to install a tap for dispensing water.

The apparatus may comprise at least one water treatment unit.

The at least one water treatment unit may comprise a filter.

Alternatively or additionally the at least one water treatment unit may comprise an ion-exchange unit.

The at least one water treatment unit may perform, in use, additional or alternative water treatments, selected from the group of water disinfection, chlorination, desalinisation, micro and/or nano-filtration.

Preferably, the at least one water treatment unit may be located upstream of the water tank, so that, in use, the water is treated before entering the tank.

Alternatively or additionally, the at least one water treatment unit may be located downstream of the water tank, so that, in use, the water is treated after exiting the water tank.

In at least one embodiment of the present invention, the water treatment unit prevents or minimises the formation of scale deposits on the heat source by removing salts and other precipitable matter from the water before entering the water tank.

- 5 The at least one water treatment unit may be adapted to exchange information with the central control unit.

According to a second aspect of the invention there is provided an apparatus for dispensing hot water, the apparatus comprising:

- a tank, the tank comprising a water inlet and a water outlet;
10 a heat source located within the tank;
 a liquid level controller comprising an upper level limit and a lower level limit, the liquid level controller being positioned such that the lower level limit is above the heat source .

- In at least one embodiment of the present invention, a liquid level controller
15 being positioned such that the lower level limit is above the heat source is adapted to maintain the heat source submerged in water at all times and prevents that the heat source supplies heat in dry conditions. If the heat source operates in dry conditions, a large amount of heat is wasted and the heat source may be damaged by excessive self-heating in dry conditions, which is typically known as being dry-burnt. By
20 keeping the heat source submerged at all times, these undesirable effects are prevented from happening.

According to a first aspect of the invention there is provided an apparatus for dispensing hot water, the apparatus comprising:

- a tank, the tank comprising a water inlet and a water outlet; and
25 a heat source located adjacent to the lowest point of the tank
 wherein the water inlet is adapted to introduce in the tank a water jet focused towards the lowest point of the tank.

According to a fourth aspect of the invention there is provided an apparatus for dispensing hot water, the apparatus comprising:

- 30 a tank, the tank comprising a water inlet and a water outlet; and
 a heat source located adjacent to the water inlet within the tank

wherein the water inlet is adapted to introduce in the tank a water jet focused towards the heat source.

The second, third, or fourth aspects of the invention or its embodiments may comprise one or more features of the first aspect of the invention or its embodiments,
5 and vice versa.

Brief Description of the Drawings

Embodiments of the invention and some performance results of these embodiments will now be described making reference to the following figures, in
10 which:

Figure 1 shows a sectioned view of an embodiment of the present invention.

Figure 1a shows an enlarged view of the water inlet of the embodiment of figure 1.

Figure 2 shows an exploded view of another embodiment of the present
15 invention.

Figure 3 shows a different embodiment of the present invention without the housing and top cover.

Figure 4 shows a front view and a sectional view of a Venturi-type connector like the one used in the embodiment of Figure 3.

Figure 5 shows a graphical representation of the temperature decrease observed after supply of heat water commences as observed in an embodiment of
20 the present invention and compared with two prior art devices.

Detailed Description of the Drawings

Referring to figure 1 an embodiment of the present invention will be described.
25

Figure 1 shows an apparatus 10 for dispensing hot water. The apparatus comprises a tank 12 made of stainless steel by laser welding and has a capacity of 2.6 litres. The tank 12 comprises a water inlet 14 and a water outlet 16. The apparatus 10 also comprises a heat source 18 located within the tank 12, along its
30 longitudinal axis and in a vertical position. The heat source 18 is a coiled resistance made of 304 grade stainless steel and can deliver 1500 W of heat. The heat source 18 works under a 200 V voltage.

The water inlet 14 is located adjacent to the heat source 18 and is adapted to introduce in the tank 12 a water jet (shown in Fig 1a) focused towards the heat source 18. Particularly the water inlet 14 comprises a series of nozzles 15 adapted to direct the incoming water towards the base of the heat source 18 such that water is directed to the lowest point of the tank 12. The water inlet 14 is made of nickel plated brass.

The apparatus 10 also comprises a stainless steel expansion bladder 20 in fluid communication with the tank 12 and a metallic housing 22 that contains the tank 12 and the expansion bladder 20. The housing 22 is 31 cm high, 22 cm deep and 20 cm wide.

The apparatus 10 also comprises cotton insulation material (not shown) surrounding the tank 12 so that heat loss towards the outside of the apparatus 10 is minimised.

The apparatus 10 comprises a liquid level controller 24 of the float type. The liquid level controller comprises an upper level limit 26 and a lower level limit 28. The liquid level controller 24 is positioned within the tank 12 such that the lower level 28 limit is above the heat source 18 such that, in use, maintains a minimum water level within the tank 12 such that the heat source 18 is completely submerged in water at all times. In other embodiments, the liquid level controller may be located outside the tank but in fluid communication with the tank.

Additionally, the apparatus 10 comprises an electronic temperature sensor 30 for measuring the temperature of the water inside the tank 12.

Referring now to figure 2 the components of another embodiment of the present invention will be described. Figure 2 shows an exploded view of an apparatus 110 for dispensing hot water.

The apparatus comprises a tank 112 made of stainless steel by laser welding. The tank 112 comprises a water inlet 114 and a water outlet 116. The apparatus 110 also comprises a heat source 118. The heat source 118 is a coiled resistance made of 304 grade stainless steel.

The water inlet 114 is adapted to introduce in the tank 112 a water jet (not visible) focused towards the base of the heat source 118.

The apparatus 110 also comprises a stainless steel expansion bladder 120 and a metallic housing 122.

The apparatus 110 also comprises cotton insulation material 123 so that heat loss towards the outside of the apparatus 110 is minimised.

5 Additional elements of the apparatus 110 which are visible in figure 2 are:

- a top cover 124 and a bottom cover 126 made of cold rolled metal,
- a printed circuit board 128 for the temperature control,
- a temperature indicator 130,
- a flange 132 and a silicon flange seal 134 provided to seal the hole 136
- 10 in the tank for mounting the heat source 118 within the tank 112,
- an electronic display and touch control pad 138 and a printed circuit board 140 for the electronic display and touch control pad 138,
- four silicone pads 144 that support the apparatus 110,
- a thermostat temperature controller 146,
- 15 • an inlet tube 148 made of brass that fluidly connects the apparatus 110 water inlet with the expansion bladder 120,
- a connecting tube 150 made of silicone that fluidly connects the expansion bladder 120 with the tank 112; and
- two coloured silicone rings 152 to differentiate the water inlet from the
- 20 water outlet.

Referring now to Figure 3 the internal arrangement of a different embodiment of the present invention will be described.

Figure 3 shows an apparatus 210 for dispensing hot water according to an embodiment of the present invention without the housing and top cover. The

25 apparatus 210 comprises a stainless steel laser welded tank 212 and a plastic expansion bladder 220.

The water source (not shown) is connected to an apparatus inlet tube 254. The apparatus 210 also comprises a tank inlet tube 248 and a tank outlet tube 256. The inlet tube 254, the tank 212 and the expansion bladder 220 are in fluid

30 communication through a Venturi-type connector 258. The Venturi-type connector 258 is made of plastic. When the water within the tank 212 is overheated and therefore expanded, the Venturi-type connector 258 directs the water flow from the

tank 212 towards the expansion bladder 220, and therefore the water level within the tank 212 is kept constant and there is no dripping at the water source connection with the apparatus inlet tube 254. Similarly, when the water in the tank 212 cools down and therefore contracts, the Venturi-type connector 258 directs water from the expansion bladder 220 towards the tank 212, thus keeping a constant level within the tank 212. When the water source supplies fresh water towards the tank 212, the Venturi effect at the Venturi-type connector 258 withdraws any hot water remaining in the expansion bladder 220 and feeds it into the tank 212.

Referring now to Figure 4, the constructional principles of a Venturi-type connector 258 like the one shown in Figure 3 will be described.

Figure 4 shows a front and sectional views of a Venturi-type connector 258 like the one shown in Figure 3. The Venturi-type connector 258 comprises a main bore 260 along the connector body 262. The main bore 260 comprises two main sections: an inlet section 264 and an outlet section 266 and a narrowing 268. In use, the inlet section 264 is connected to the apparatus inlet tube 254 and the outlet section 266 is connected to the tank inlet tube 248. The connector 258 also comprises a lateral ramification 270 that, in use, provides fluid communication between the main bore 260 and the expansion bladder 220.

In order to guarantee an optimal operation of the apparatus, it has been observed that the narrowing 268 should be about half the size of the lateral ramification 270 and the lateral ramification 270 should be about half the size of the main bore 260. This relative dimensions cause that the Venturi-type connector 258 acts as described above. It may be of additional benefit to have a narrowing 268 with different diameters, as shown in Figure 4.

Referring now to figure 5 the performance of an embodiment of the present invention will be compared with the performance of other hot water dispensers found in the prior art.

Figure 5 shows a graphical representation of the temperature of the water dispensed from a hot water dispensing apparatus versus the time passed after the apparatus has commenced to dispense water. The initial temperature is set up to the maximum temperature that each apparatus can supply water. All three apparatus

have similar heating power, around 1500 W and the supplied water flow is also very similar.

The lines representing the prior art apparatus performance (circle and triangle markers) show a marked decrease in supplied water temperature which reaches 65 °C and 42 °C after 60 seconds from the start of water supply. In contrast, the present invention (X markers) is able to supply water at a substantially constant temperature of around 95 °C for the same period of time. This substantial improvement could be due to the fact that the water from the mains that enters the tank is focused onto the heat source and a rapid heat transfer to the recently added water takes place.

Claims:

1. An apparatus for dispensing hot water, the apparatus comprising:
 - a tank, the tank comprising a water inlet and a water outlet; and
 - 5 a heat source located adjacent to the water inlet within the tankwherein the water inlet is adapted to introduce a water jet into the tank focused towards the heat source.
2. An apparatus according to claim 1 wherein the water inlet comprises a narrowing of its cross-sectional area.
- 10 3. An apparatus according to any of claims 1 or 2 wherein the water inlet comprises a nozzle.
4. An apparatus according to any preceding claim wherein the heat source is oriented along a longitudinal axis of the tank.
5. An apparatus according to claim 4 wherein the heat source and the tank are
- 15 positioned so that their longitudinal axes remain vertical.
6. An apparatus according to any preceding claim wherein the water jet is directed towards a base of the heat source.
7. An apparatus according to any preceding claim wherein the water jet is directed towards a base of the tank.
- 20 8. An apparatus according to any preceding claim wherein the water jet is directed to the lowest point of the tank.
9. An apparatus according to any preceding claim comprising a liquid level controller, the liquid level controller comprising an upper level limit and a lower level limit.
- 25 10. An apparatus according to claim 9 wherein the liquid level controller is positioned such that the lower level limit is above the heat source such that, in

use, the liquid level controller maintains a minimum water level within the tank such that the heat source is completely submerged in water at all times.

11. An apparatus according to any preceding claim comprising an expansion bladder in fluid communication with the tank.

5 12. An apparatus according to claim 11 wherein the expansion bladder is made of stainless steel.

13. An apparatus according to claim 11 wherein the expansion bladder is made of plastic.

10 14. An apparatus according to any of claims 11 to 13 wherein the expansion bladder has a capacity about 10% or less of the capacity of the tank.

15. An apparatus according to any of claims 11 to 14 wherein comprising a Venturi-type connector that provides fluid communication among a water source, the expansion bladder and the tank.

15 16. An apparatus according to claim 13 wherein the Venturi-type connector is made of plastic.

17. An apparatus according to claim 13 wherein the Venturi-type connector is made of metal.

20 18. An apparatus according to any of claims 15 to 17 wherein the Venturi-type connector comprises a ramification to the bladder that is double the size of the Venturi-type connector narrowing and half the size of the Venturi-type connector main bore.

19. An apparatus according to any of claims 15 to 18 wherein the Venturi-type connector comprises a narrowing with at least two different diameters.

25 20. An apparatus according to any preceding claim comprising a device that allows water to flow to and from the tank and keeps a predetermined constant pressure within the tank.

21. An apparatus according to claim 20 wherein the device comprises a pressure reducing valve.
22. An apparatus according to claim 20 or claim 21 wherein the device comprises a backpressure valve.
- 5 23. An apparatus according to any of claims 20 to 22 wherein the device comprises at least one way valve.
24. An apparatus according to any of claims 20 to 23 wherein the device is adapted to maintain a pressure in the range of about 2 to about 3 bars within the tank. An apparatus according to any preceding claim comprising at least
10 one electronic temperature sensor to measure, in use, the temperature of the water within the tank.
25. An apparatus according to claim 24 comprising two electronic temperature sensors, one located at the top of the tank and one located at the bottom of the tank.
- 15 26. An apparatus according to any preceding claim comprising a temperature controller.
27. An apparatus according to claim 26 wherein the temperature controller comprises at least one predetermined temperature set-point.
28. An apparatus according to claim 26 or claim 27 wherein the temperature
20 controller comprises a temperature set-point which is adjustable.
29. An apparatus according to any preceding claim comprising an electronic or capacitive touch control panel.
30. An apparatus according to any preceding claim comprising a display screen.
31. An apparatus according to any preceding claim comprising a device for
25 wireless data transfer and communication.

32. An apparatus according to claim 31 wherein the device for wireless data transfer and communication is adapted to exchange information with a portable device.

5 33. An apparatus according to claim 31 or claim 32 wherein the device for wireless data transfer and communication is adapted to exchange information with a remote console.

34. An apparatus according to any preceding claim adapted to exchange information via an internet connection.

10 35. An apparatus according to any preceding claim adapted to be controlled by human voice. .

36. An apparatus according to any preceding claim comprising a central control unit.

37. An apparatus according to any preceding claim wherein the tank is made of stainless steel.

15 38. An apparatus according to any preceding claim wherein the tank is laser welded.

39. An apparatus according to any preceding claim wherein the tank comprises formations in the interior of the tank arranged to promote, in use, turbulence and mixing of the water contained in the tank.

20 40. An apparatus according to claim 39 wherein the formations comprise baffles.

41. An apparatus according to any preceding claim comprising an integral tap for dispensing water from the tank, in use.

42. An apparatus according to any preceding claim comprising a tap coupled to the apparatus for dispensing water from the tank, in use.

25 43. An apparatus according to any preceding claim comprising at least one water treatment unit.

44. An apparatus according to claim 43 wherein the at least one water treatment unit comprises a filter.
45. An apparatus according to claim 43 or claim 44 wherein the at least one water treatment unit comprises an ion-exchange unit.
- 5 46. An apparatus according to any of claims 43 to 45 wherein the at least one water treatment unit performs, in use, additional or alternative water treatments, selected from the group of water disinfection, chlorination, desalinisation, micro and/or nano-filtration.
- 10 47. An apparatus according to any of claims 43 to 46 wherein the at least one water treatment unit is located upstream of the water tank, so that, in use, the water is treated before entering the tank.
48. An apparatus according to any of claims 43 to 47 wherein the at least one water treatment unit is located downstream of the water tank, so that, in use, the water is treated after exiting the water tank.
- 15 49. An apparatus according to any of claims 43 to 48 wherein the at least one water treatment unit is adapted to exchange information with the central control unit.
50. An apparatus according to any preceding claim wherein the heat source extends to more the 50% of the height of the tank.
- 20 51. An apparatus according to any preceding claim wherein the heat source extends to more the 75% of the height of the tank.
52. An apparatus for dispensing hot water, the apparatus comprising:
- a tank, the tank comprising a water inlet and a water outlet;
- a heat source located within the tank;
- 25 a liquid level controller comprising an upper level limit and a lower level limit, the liquid level controller being positioned such that the lower level limit is above the heat source .

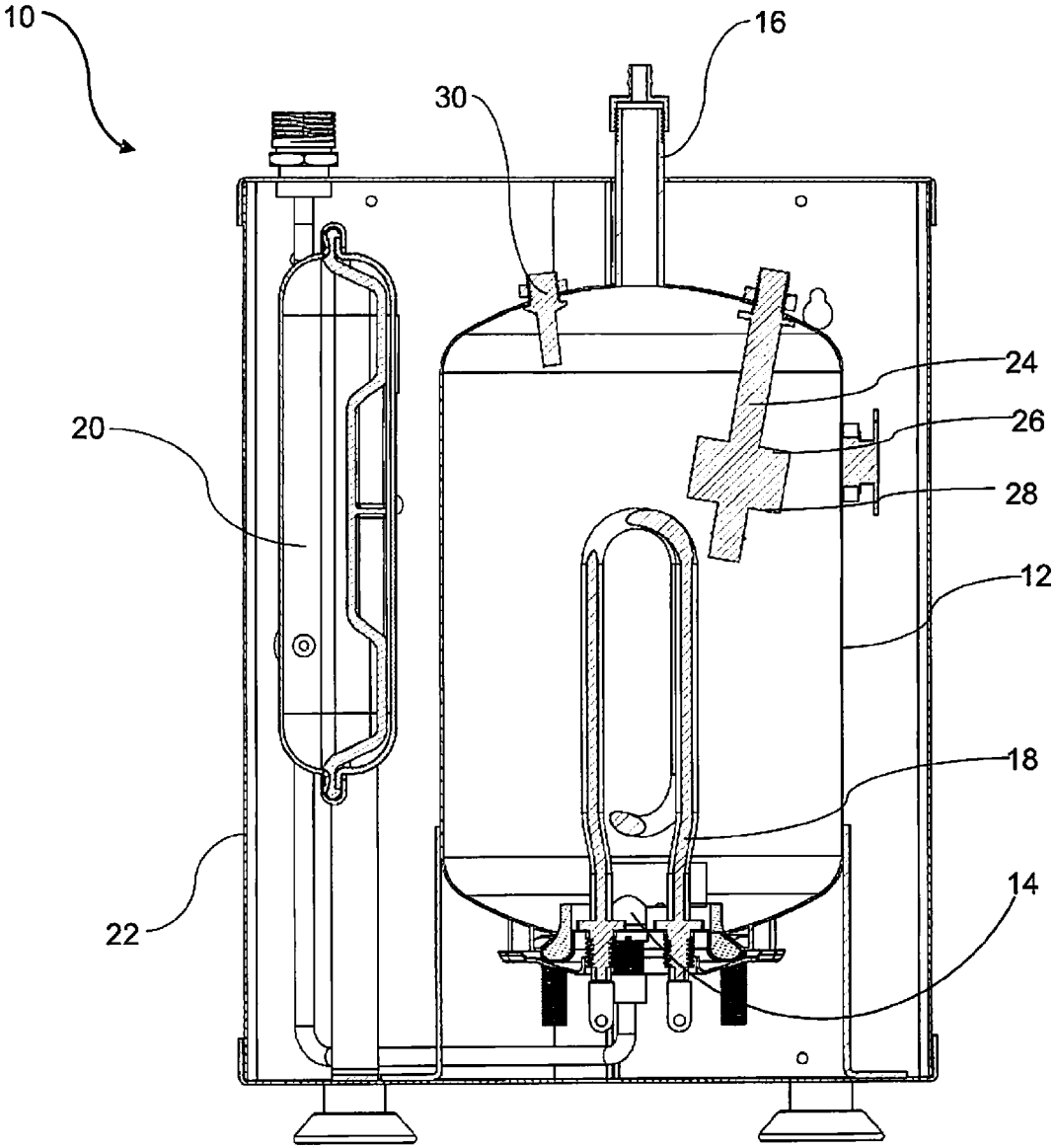


FIG. 1

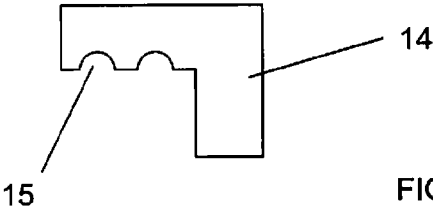


FIG. 1a

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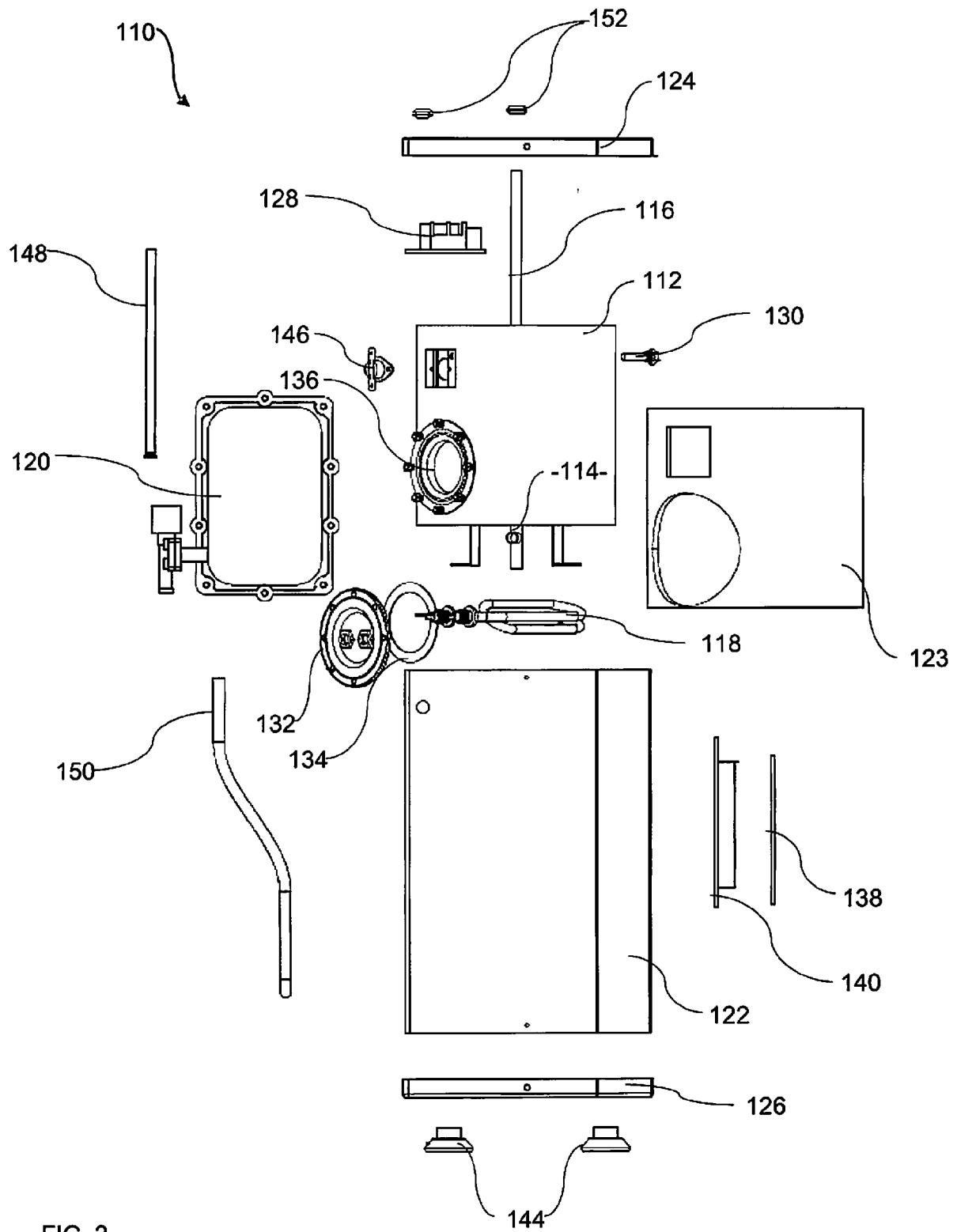


FIG. 2

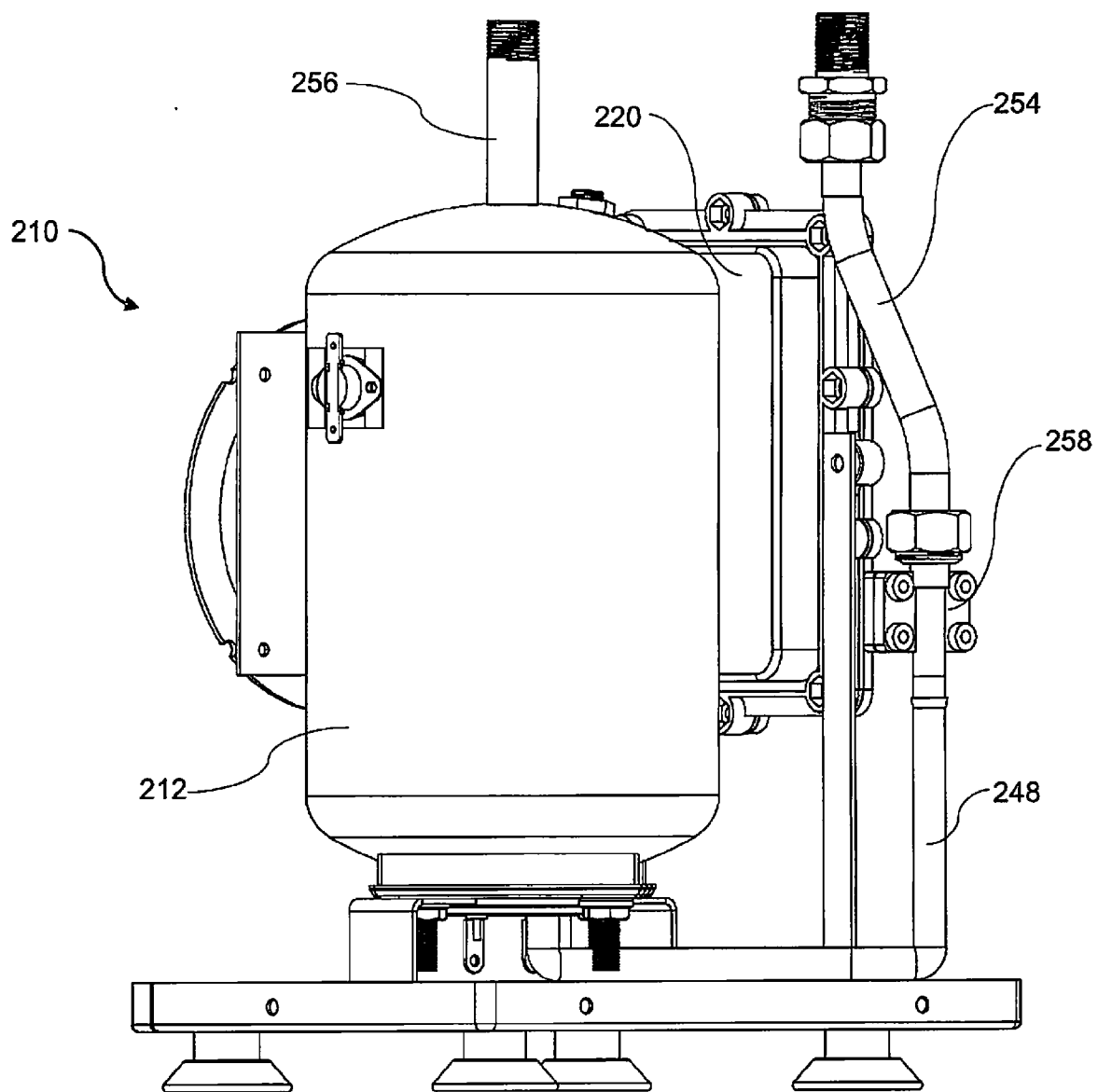


FIG. 3

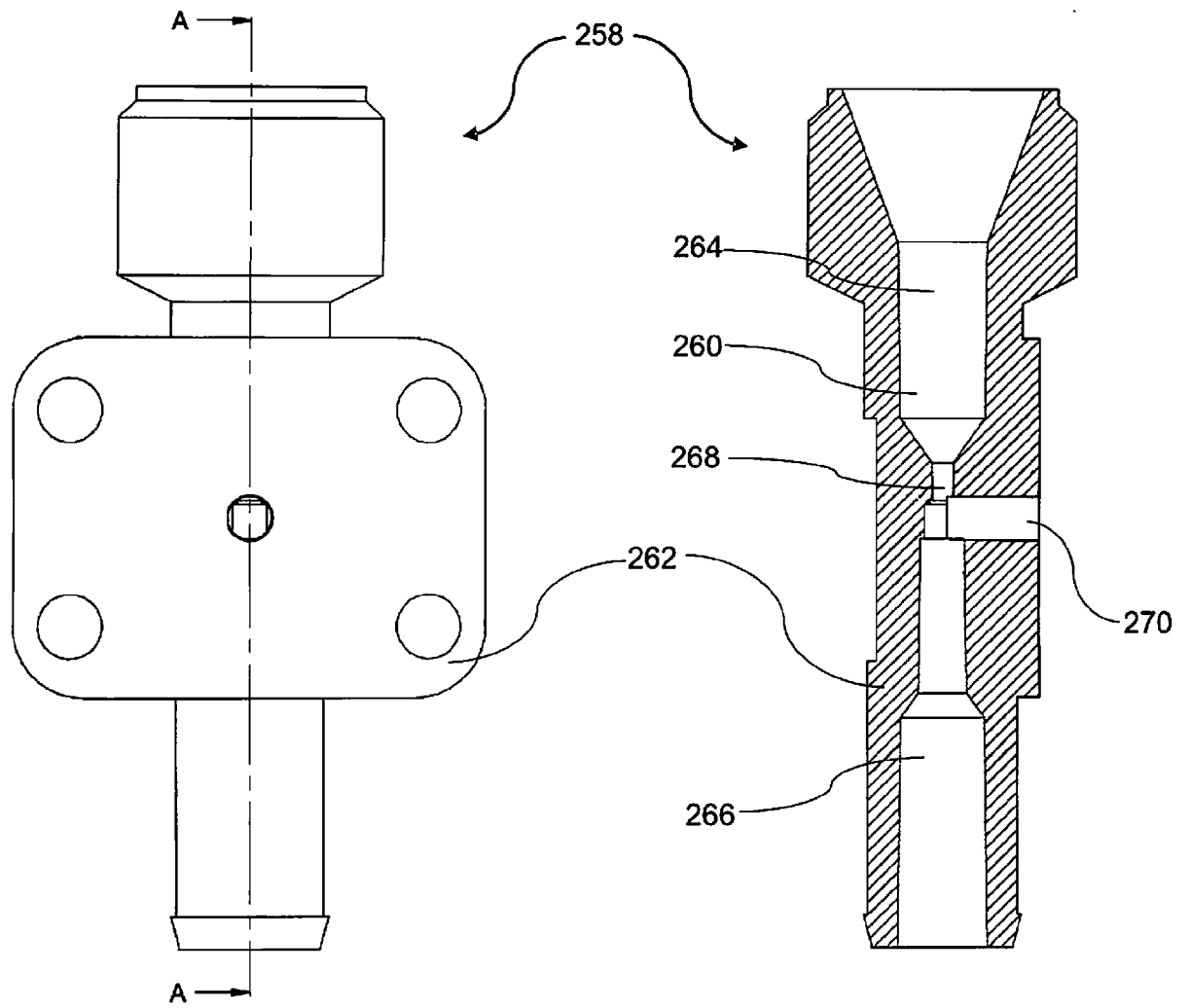


FIG. 4

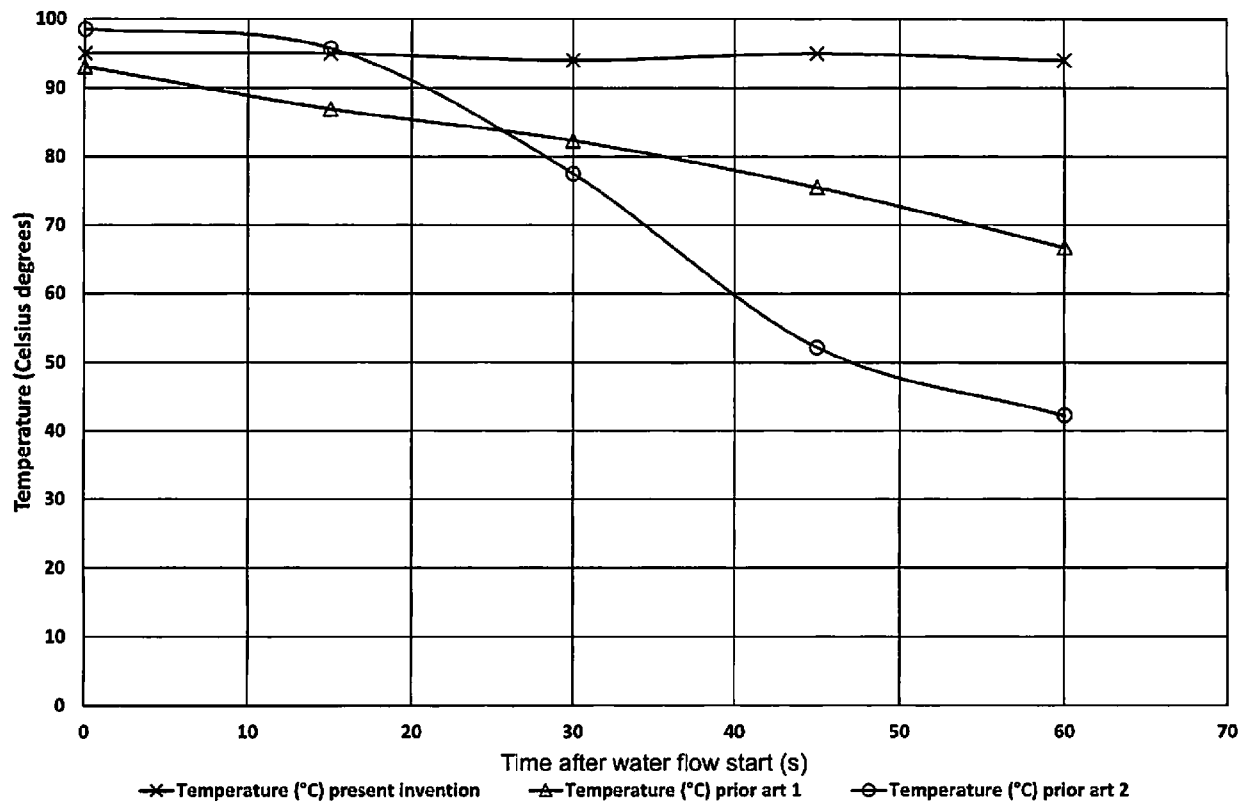


FIG. 5