

A Water Purifying Device

Cross-Reference to Related Applications

[0001] The present application claims the benefit of Singapore Provisional Patent Application No. 10201081011X filed on March 6, 2018 which is incorporated by reference herein.

Technical Field

[0002] The present invention relates to a purifying device. For example, a water purifying device, a UV water purifying device, etc.

Background

[0003] Drinkable water, being a necessity for survival, is becoming scarce in some countries due to contamination from urbanisation and increasing population. Water is easily contaminated by bacteria and viruses and becomes harmful to human systems when consumed.

[0004] Diseases like cholera, typhoid fever and hepatitis A are caused by bacteria, and are among the most common diarrheal diseases. The World Health Organization published that every year more than 3.4 million people die from water related diseases, making it the leading cause of disease and death around the world. It is therefore important to have potable water.

[0005] It is known that UV radiation is used to disinfect media in the forms of liquids, gas and solid substances. Bacteria and virus present in these media can be inactivated by exposing them to deep UV radiation, i.e. UV wavelength in the range 250-300 nm. Currently, there are two types of man-made source of deep UV radiation, or UV-C. The first source is from vaporized mercury held inside pressurized UV transparent chambers. The second source is Light Emitting Diodes (LED). Similar to the mercury-based UV light sources, the UV LEDs emit UV radiation that interacts with the bacteria and viruses, making them suitable for media disinfection applications. The latter is preferred the former as it is safer, has a higher power density and is environmentally friendly. Further, the LED does not require any start up time and can be precisely tuned to suit the media condition to provide optimal disinfection and preservation

conditions. Therefore, the LED has a higher efficiency and effectiveness compared to the other source.

[0006] Typically, water may be boiled to be disinfected. However, in certain scenarios, e.g. during hiking, it is not convenient to boil water. Therefore, it is useful to have a portable, effective and easy to use water UV source to obtain potable water.

Summary

[0007] According to various embodiments, a water purifying device is provided. The water purifying device includes an accumulating chamber adapted to accumulate water, the accumulating chamber includes an inlet for receiving water into the accumulating chamber and an outlet for water flow out of the accumulating chamber, a UV source adapted to disinfect the water in the accumulating chamber, such that the accumulating chamber is adapted to accumulate the water entering therein until a pre-determined amount before releasing the water out of the accumulating chamber through the outlet.

[0008] According to various embodiments, the water purifying device may further include an inflow channel in fluid communication with the inlet for directing water into the accumulating chamber, such that the inflow channel is in thermal communication with the UV source, such that the water flowing along the inflow channel is adapted to cool the UV source.

[0009] According to various embodiments, the accumulating chamber may include an internal surface, such that the internal surface may include a UV reflective layer.

[0010] According to various embodiments, the UV reflective layer may include a base layer, wherein the base layer comprises a non-stick and/or self-cleaning layer.

[0011] According to various embodiments, the UV reflective layer may include a catalytic layer above the base layer.

[0012] According to various embodiments, the accumulating chamber may include a bottom portion and a top portion opposite the bottom portion, such that the inlet may be disposed at the bottom portion and the outlet may be disposed at the top portion.

[0013] According to various embodiments, the accumulating chamber may include a bottom side and a top side opposite the bottom side, such that the outlet may be disposed on the bottom side, such that the accumulating chamber further may include a vertical channel therein and in fluid communication with the outlet, such that the channel extends from the outlet to under the top side, such that the water accumulated in the accumulating chamber may exit the accumulating chamber through the channel.

[0014] According to various embodiments, the accumulating chamber further may include a valve therein and adapted to control the water flow out of the accumulating chamber.

[0015] According to various embodiments, the valve may include a floatable member adapted to plug the outlet, such that the floatable member may be adapted to float and unplug the outlet to release the water therethrough when a pre-determined volume of water may be accumulated.

[0016] According to various embodiments, the accumulating chamber further may include a restrictor therein and attached to the inlet, such that the restrictor may be adapted to restrict the flow of water into the accumulating chamber.

[0017] According to various embodiments, the restrictor may include an inner chamber within the accumulating chamber, the inner chamber comprising a proximal opening in fluid communication with the inlet and a distal opening opposite the proximal opening, such that the distal opening may include a slit adapted to restrict the water flowing from the inner chamber into the accumulating chamber due to a water meniscus may be formed across the slit when the water contacts the slit.

[0018] According to various embodiments, the slit may be formed between the distal opening and a plug spaced from the opening.

[0019] According to various embodiments, the plug may be transparent.

[0020] According to various embodiments, the plug may include a UV reflective sphere.

[0021] According to various embodiments, the outlet may include a slot adapted to restrict the water from flowing through the outlet due to a water meniscus formed across the slot when the water contacts the slot.

[0022] According to various embodiments, the slot may be formed between the outlet and a stopper spaced from the outlet.

[0023] According to various embodiments, the stopper may include a UV reflective sphere.

[0024] According to various embodiments, the accumulating chamber may include a cylinder, such that the inlet may be adapted to direct the water flow into the accumulating chamber in a direction away from the centre of the cylinder.

[0025] According to various embodiments, the water purifying device may further include a heating element adapted to heat the water therein.

[0026] According to various embodiments, the heating element may be disposed in the accumulating chamber.

Brief Description of Drawings

[0027] Fig. 1 shows a schematic view of an exemplary example of a water purifying device.

[0028] Fig. 1A show a schematic view of another exemplary example of a water purifying device.

[0029] Fig. 2 shows a schematic view of an exemplary embodiment of the water purifying device.

[0030] Fig. 2A shows a schematic view of another exemplary embodiment of the water purifying device

[0031] Fig. 3A shows a schematic view of an exemplary embodiment of the water purifying device.

[0032] Fig. 3B shows a schematic view of another exemplary embodiment of the water purifying device.

[0033] Fig. 4A shows a schematic view of an exemplary embodiment of the water purifying device.

[0034] Fig. 4B shows a top view of the water purifying device in Fig. 4A.

[0035] Fig. 4C shows another top view of the water purifying device in Fig. 4A.

[0036] Fig. 4D shows a perspective view of an exemplary embodiment of the water purifying device in Fig. 4C.

[0037] Fig. 5A shows a schematic view of an exemplary embodiment of the water purifying device.

[0038] Fig. 5B shows a schematic view of another exemplary embodiment of the water purifying device.

[0039] Fig. 5C shows a top view of the embodiment in Fig. 5A.

[0040] Fig. 5D shows another top view of the embodiment in Fig. 5A.

[0041] Fig. 6A shows a schematic view of an exemplary embodiment of the water purifying device.

[0042] Fig. 6B shows the embodiment of the water purifying device in Fig. 6A with filters.

[0043] Fig. 7 shows a schematic view of an exemplary embodiment of the water purifying device.

[0044] Fig. 8A shows a schematic view of an exemplary embodiment of the water purifying device.

[0045] Fig. 8B shows a sectional view of the water purifying device along line A-A in Fig. 8A.

[0046] Fig. 8C shows an enlarged view of the slit in Fig. 8A.

[0047] Fig. 9A shows a schematic view of an exemplary embodiment of the water purifying device.

[0048] Fig. 9B shows a schematic view of an exemplary embodiment the water purifying device.

[0049] Fig. 9C shows a schematic view of an exemplary embodiment the water purifying device.

[0050] Fig. 10 shows an exemplary embodiment of the UV source.

[0051] Fig. 11 shows a sectional view of an exemplary embodiment of the UV reflective layer.

Detailed Description

[0052] Fig. 1 shows a schematic view of an exemplary example of a water purifying device 100. Water purifying device 100 includes an accumulating chamber 110 adapted to accumulate water. Accumulating chamber 110 includes an inlet 112 for receiving water into the accumulating chamber 110 and an outlet 114 for water flow out of the accumulating chamber 110. Water purifying device 100 has a UV source 130 adapted to disinfect the water in the accumulating chamber 110, such that the accumulating chamber 110 is adapted to accumulate the water entering therein until a pre-determined amount before releasing the water out of the accumulating chamber 110 through the outlet 114. Accumulating chamber 110 has an internal surface, such that the internal surface may include a UV reflective layer 110C.

[0053] Accumulating chamber 110 may have a bottom portion and a top portion opposite the bottom portion, such that the inlet 112 may be disposed at the bottom portion and the outlet 114 may be disposed at the top portion. Alternatively, the inlet 112 and the outlet 114 may be disposed at the top portion where the inlet 112 may be above the outlet 114.

[0054] As the water enters the accumulating chamber 100 via the inlet 112, the water fills the accumulating chamber 100 and is exposed to the UV light from the UV source 130. As shown, the water may be exposed to the UV light for as long as it is in the accumulating chamber 100. When the water reaches the outlet 114, the water is disinfected before leaving the accumulating chamber 100. Accumulating chamber 100 provides a relatively long disinfection period as it is adapted to hold the water therein to allow the water to be exposed to the UV source 130 for a prolonged period of time so that there is sufficient time for the water to be disinfected by the UV light. Water purifying device 100 as shown in Fig. 1 may be made portable as it has a simple design and can thus be made small and light weight. It is also easy to use and has minimal footprint. Accumulating chamber 110 may include a circulating member (not shown in Fig. 1) adapt to circulate the water within the accumulating chamber 110 so that the water may be treated more effectively by the UV light. As a turbulent water flow mixes and increases the time that the water is exposed to the UV light, circulating the water allows the water to be treated for a longer period of time. Circulating member may include rotatable vanes, propellers, etc.

[0055] Fig. 1A show a schematic view of another exemplary example of a water purifying device 100. As shown in Fig. 1A, the accumulating chamber 110 may include a top side 110T,

a bottom side 110B opposite the top side 110T and a perimeter wall 110P extending from the top side 110T to the bottom side 110B. Accumulating chamber 110 may have at least one UV source 130 on at least one of the top side 110T, the bottom side 110B and along the perimeter wall 110P. As shown in Fig. 1 and Fig. 1A, the inlet 112 may be connected to the perimeter wall 110P such that the water flow into the accumulating chamber 110 laterally and across the width thereof.

[0056] Fig. 2 shows a schematic view of an exemplary embodiment of the water purifying device 200. Water purifying device 200 may include the features of the embodiment in Fig. 1 and may include a filter 240 adapted to filter the water before entering the accumulating chamber 210. Filter 240 may be disposed at the inlet 212. Filtered water may be accumulated in the accumulating chamber 210 and exposed to the UV light from the UV source 230 before exiting the accumulating chamber 210 via the outlet 214. Filter 240 may include ceramic water filters, carbon water filters, membrane-type water filter, micropore filters, etc.

[0057] Fig. 2A shows a schematic view of another exemplary embodiment of the water purifying device 200. Accumulating chamber 210 in Fig. 2A is identical to the embodiment in Fig. 1 and Fig. 1A except that the inlet 212 may be connected to the bottom side 210B of the accumulating chamber 210 such that the water flow may be directed upwardly into the accumulating chamber 210. In this way, the water flowing through the inlet 212 may be exposed to the UV light directed into the inlet 212 from the UV source 230 opposite the inlet 212. The present arrangement of the inlet 212 is applicable to any relevant embodiment thereafter.

[0058] Fig. 3A shows a schematic view of an exemplary embodiment of the water purifying device 300. Water purifying device may include a housing 302 adapted to house the accumulating chamber 310 therein. Housing 302 may include a mouth 302M at its top for receiving water thereinto. Housing 302 may include a circumferential wall 302W surrounding and extending above the accumulating chamber 310 such that the housing 302 has an upper portion that forms an inflow channel 350 for channelling water flow to the accumulating chamber 310 and a lower portion that contains the accumulating chamber 310. Accumulating chamber 310 may be spaced from the circumferential wall 302W of the housing 302 to form a

gap therebetween. Water flow into the housing 302 via the mouth 302M may pass through the upper portion and land onto the accumulating chamber 310 before entering it. Water may flow through the gap to enter the accumulating chamber 310. Water purifying device 300 may include one or more UV sources 330 disposed within the accumulating chamber 310 to disinfect the water therein. Accumulating chamber 310 may include a bottom side 310B and a top side 310T opposite the bottom side, such that the inlet 312 and the outlet 314 may be disposed on the bottom side, or at the base of the housing 302. Accumulating chamber 310 may include a vertical channel 314C therein and connected to an outlet 314. Channel 314C may extend from the outlet 314 to under the top side of the accumulating chamber 310 so that water accumulated in the accumulating chamber 310 exits the accumulating chamber 310 through the channel 314C. Inflow channel 350 may be in fluid communication with the inlet 312 for directing water into the accumulating chamber 310, such that the inflow channel 350 may be in thermal communication with the UV source 330, so that the water flowing along the inflow channel 350 may be adapted to cool the UV source 330. Bottom side 310B may be the base of the housing 302. Housing 302 may be a bucket having an opening at the top for receiving water thereinto. As the water enters the accumulating chamber 310 and fills it up, the water may be disinfected by the UV light from the UV source 330. As the water rises to the height of the vertical channel 314C, the water may exit the accumulating chamber 310 via the vertical channel 314C.

[0059] Fig. 3B shows a schematic view of another exemplary embodiment of the water purifying device 300. Accumulating chamber 310 may include a perimeter wall 310W extending from the top side 310T to the bottom side 310B. In addition to the UV source 330 on the top side 310T of the accumulating chamber 310 as shown in Fig. 3A, the accumulating chamber 310 may include at least one UV source 330 on the bottom side, and/or on the inner surface of the perimeter wall 310W. In this way, the exposure of the water within the accumulating chamber 310 to the UV light is improved.

[0060] Fig. 4A shows a schematic view of an exemplary embodiment of the water purifying device 400. Similar to the embodiment in Fig. 3A, the water purifying device 400 may include the accumulating chamber 410 adapted to accumulate water therein. Accumulating chamber 410 may include the inlet 412 for receiving water into the accumulating chamber 410 and the outlet 414 for water flow out of the accumulating chamber 410. Water purifying device 400

may include the UV source 430 adapted to disinfect the water in the accumulating chamber 410. Unlike the embodiment in Fig. 3A, there is no housing in the present embodiment. Instead, the inlet 412 located at the bottom portion of the accumulating chamber 410 and directly receives the water flow thereinto. Accumulating chamber 410 may include the vertical channel 414C connected to the outlet 414 and extends from the bottom side 410B to about the top side 410T to provide a height for the water to rise up to. Accumulating chamber 410 may be adapted to accumulate the water entering thereinto until the height of the vertical channel 414C before releasing the water out of the accumulating chamber 410 through the outlet 414. As shown in Fig. 4A, there may be more than one inlet 412 to receive water into the accumulating chamber 410.

[0061] Fig. 4B shows a top view of the water purifying device 400 in Fig. 4A. As shown in Fig. 4B, the accumulating chamber 410 may be a cylinder, i.e. a circular cylinder. Accumulating chamber 410 may be of any cross-sectional shape, e.g. quadrilateral, pentagonal, etc. Outlet 414 may be disposed at the centre of the accumulating chamber 410. Similarly, the vertical channel 414C may be disposed at the centre of the accumulating chamber 410. Inlet 412 is adapted to direct the water flow into the accumulating chamber 410 in a direction towards the centre of the accumulating chamber 410. As shown in Fig. 4B, the accumulating chamber 410 may include more than one inlet 412 where the inlets 412 may be adapted to direct the water flow towards the centre of the accumulating chamber 410.

[0062] Fig. 4C shows another top view of the water purifying device 400 in Fig. 4A. Alternatively, the inlet 412 is adapted to direct the water flow into the accumulating chamber 410 in a direction away from the centre of the accumulating chamber, i.e. the cylinder. Water flow may be directed in a direction tangential to the perimeter wall 410W of the accumulating chamber 410. In this way, the water flow may create a vortex within the accumulating chamber 410, increasing residence time in chamber 410, as well as allowing the water to be evenly exposed to the UV source (not shown in Fig. 4C). Inlets 412 may direct the water flow in a direction that is tangential to the perimeter wall 410W. As shown in Fig. 4C, the accumulating chamber 410 may include more than one inlet 412 (shown in broken line) where the inlets 412 may be adapted to direct the water flow away from the centre of the accumulating chamber 410. Inlets 412 may be adapted to direct the water flow in the same direction, e.g. clockwise direction.

[0063] Fig. 4D shows a perspective view of an exemplary embodiment of the water purifying device 400 in Fig. 4C. Water may enter the accumulating chamber 410 via the inlet 412 in a direction away from the centre of the accumulating chamber 410, e.g. tangential to the perimeter wall 410W of the accumulating chamber 410. As the water swirls along the perimeter wall 410W, the water level rises towards the UV sources 430 and is sterilized. As the water rises to the height of the vertical channel 414C, the water flows into the vertical channel 414C and exits the accumulating chamber 410 via the outlet 414.

[0064] Fig. 5A shows a schematic view of an exemplary embodiment of the water purifying device 500. Water purifying device 500 is similar to the embodiment in Fig. 4A except that the vertical channel 514C, and the outlet 514, may be disposed off centre of the accumulating chamber 510. For example, the vertical channel 514C and the outlet 514 may be disposed adjacent the perimeter wall 510W of the accumulating chamber 510. Vertical channel 514C and the outlet 514 may be disposed adjacent a perimeter wall portion directly opposite the inlet 512 or at a position furthest away from the inlet 514. In this way, the time taken by the water to travel from the inlet 512 to the outlet 514 is maximised so that the duration for the exposure of the water to the UV source 530 is the longest.

[0065] Fig. 5B shows a schematic view of another exemplary embodiment of the water purifying device 500. Water purifying device 500 in Fig. 5B has the same features as the embodiment in Fig. 5A but has a different arrangement of the UV sources 530. In addition to the top side 510T of the accumulating chamber 510 as shown in Fig. 5A, the accumulating chamber 510 may include UV sources 530 on the bottom side 510B and/or along the perimeter wall 510W of the accumulating chamber 510. In this way, the water within the accumulating chamber 510 may be more thoroughly exposed with in the accumulating chamber 510.

[0066] Fig. 5C shows a top view of the embodiment in Fig. 5A. As shown in Fig. 5C, the inlet 512 may be adapted to direct the water flow in a direction towards the outlet 514 and the vertical channel 514C. Vertical channel 514C may be disposed at a location furthest away from the inlet 512. For example, the vertical channel 514C may be disposed adjacent the perimeter wall 510W of the accumulating chamber 510.

[0067] Fig. 5D shows another top view of the embodiment in Fig. 5A. As shown in Fig. 5D, the inlet 512 may be adapted to direct the water flow in a direction away from the centre of the accumulating chamber 510. Inlet 512 may be directed the water flow in a direction tangential to the perimeter wall 510W of the accumulating chamber 510 so that the water entering the accumulating chamber 510 may create a vortex therein. In this embodiment, the outlet 514 and the vertical channel 514C may be disposed at a location furthest away from the inlet 512. the vertical channel 514C may be disposed adjacent the perimeter wall 510W of the accumulating chamber 510.

[0068] Fig. 6A shows a schematic view of an exemplary embodiment of the water purifying device 600. Water purifying device 600 may include the accumulating chamber 610 adapted to accumulate water. Accumulating chamber 610 may include the inlet 612 for receiving water into the accumulating chamber 610 and an outlet 614 for water flow out of the accumulating chamber 610. Inlet 612 and the outlet 614 may be located at the bottom side 610B of the accumulating chamber 610, which may be the base of the housing 602. Accumulating chamber 610 may include a vertical channel 614C connected to and extending from the outlet 614 upwardly to about the top of the accumulating chamber 610. Water may be accumulated to the height of the vertical channel 614C and exit the accumulating chamber 610 via the vertical channel 614C. Water purifying device 600 may include a funnel 604 adapted to receive water into the water purifying device 600. Funnel 604 may be disposed at the top portion of the water purifying device 600 and the accumulating chamber 610 may be disposed at the bottom portion. Funnel 604 may be in fluid communication with the accumulating chamber 610 such that water from the funnel 604 may flow into the accumulating chamber 610. Funnel 604 may include a cone 604C disposed in the centre of and spaced from the perimeter of the funnel 604 to distribute the incoming water towards the perimeter of the funnel 604. Water purifying device 600 may include a housing 602 adapted to house the accumulating chamber 310 and the funnel 604. Accumulating chamber 610 may be disposed beneath the funnel 604. Water purifying device 600 may include an inflow channel 650 in fluid communication with the funnel 604 and receive water therefrom. Inflow channel 650 in fluid communication with the inlet 612 for directing the water into the accumulating chamber 610. Inflow channel 650 may be disposed beneath the funnel 605. Inflow channel may be disposed above the accumulating chamber 610.

Water purifying device 600 may include the UV source 630 adapted to disinfect the water in the accumulating chamber 610. UV source 630 may be a plurality of lamps as shown in Fig. 6A. While the UV source 630 as shown in Fig. 6A may be disposed at the top side of the accumulating channel 610, the UV source 630 may be disposed along any side or all the sides, e.g. perimeter wall 610W, bottom side 610B, of the accumulating chamber 610. Inflow channel 650 may be in thermal communication with the UV source 630, such that the water flowing along the inflow channel 650 may be adapted to cool the UV source 630. Accumulating chamber 610 may be adapted to accumulate the water entering thereinto until a pre-determined amount before releasing the water out of the accumulating chamber 610 through the outlet 614 via the vertical channel 610C.

[0069] Fig. 6B shows the embodiment of the water purifying device 600 in Fig. 6A with filters. As shown in Fig. 6B, the water purifying device 600 may include filters 640, e.g. membranes, disposed in the funnel 604 for filtering the water before entering the accumulating chamber 610. Filters 640 may be disposed within the funnel 604, e.g. the filters 640 may extend between the housing 602 and the cone 604C, and/or between the floor 604F of the funnel 604.

[0070] Fig. 7 shows a schematic view of an exemplary embodiment of the water purifying device 700. Water purifying device 700 may include an accumulating chamber 710 for accumulating water and a funnel 704 adapted to receive water and direct it into the accumulating chamber 710. Funnel 704 may include a cone 704C disposed in the centre of and spaced from the circumferential wall 704W of funnel 704 to distribute the incoming water towards the perimeter of the funnel 704. Accumulating chamber 710 may include an inlet 712 fluidly connected to the funnel 704 and disposed on the top side 710T of the accumulating chamber 710 and an outlet 714 disposed at the bottom side 710B of the accumulating chamber 710. Accumulating chamber 710 may include one or more UV sources 730 on the top side of the accumulating chamber 710. While the UV source 730 as shown in Fig. 7 may be disposed at the top side of the accumulating channel 710, the UV source 730 may be disposed along any side or all the sides, e.g. perimeter wall 710W, bottom side 710B, of the accumulating chamber 710. Funnel 704 may be in thermal communication with the UV source 730, such that the water flowing along the floor 704F may cool the UV source 730. Accumulating chamber 710 may include a valve 760 therein and adapted to control the water flow out of the accumulating chamber 710. Valve 760 may include a floatable member 760M adapted to plug the outlet 714,

such that the floatable member 760M may be adapted to float and unplug the outlet 714 to release the water therethrough when a pre-determined volume of water is accumulated. Floatable member 760M may be a spherical member, a tubular member, etc. Water purifying device 700 may include a housing (not shown in Fig. 7) to house the funnel 704 and the accumulating chamber 710.

[0071] When the water enters the funnel 704, the water may be distributed to the perimeter of the funnel 704 and enters the inlet 712 of the accumulating chamber 710. As the water is accumulated in the accumulating chamber 710, the water is being sterilized by the UV light from the UV source 730. Water level may continue to rise until the buoyancy force exerted by the water on the floatable member 760M overcomes the weight thereof and lifts the floatable member 760M from the outlet 714 thus unplugging it. During the time when the water is being accumulated, the water in the accumulating chamber 710 is given sufficient time to be sterilized. Once unplugged, the water exits the accumulating chamber 710 via the outlet 714. As the water level resides, the floatable member 760M is lowered. When the water level is sufficiently low, the floatable member 760M may then plug the outlet 714 to stop the water from exiting so that water may be accumulated again. Bottom side 710B of the accumulating chamber 710 may be sloped towards the outlet 714 to allow floatable member 760M to slide towards the outlet 714 to be plugged. Floatable member 760M may include a housing or guide (not shown in Fig. 7) to aid movement.

[0072] Fig. 8A shows a schematic view of an exemplary embodiment of the water purifying device 800. Water purifying device 800 may include the accumulating chamber 810 with an inlet 812 for receiving water therein and an outlet 814 for discharging water therefrom. Accumulating chamber 810 may include a UV source 830 adapted to disinfect the water in the accumulating chamber 810. Similar to the earlier examples, the UV source 830, apart from the top side 810T, may also be disposed on at least one of bottom side 810B and along the perimeter wall 810W. Accumulating chamber 810 may include a restrictor 870 therein and attached to the inlet 812, such that the restrictor 870 may be adapted to restrict the flow of water into the accumulating chamber 810. Restrictor 870 may include an inner chamber 872 within the accumulating chamber 810, the inner chamber 810 may include a proximal opening 872P in fluid communication with the inlet 812 and a distal opening 872D opposite the proximal opening 872P, such that the distal opening 872D may include a slit 872S adapted to restrict the

water flowing from the inner chamber 872 into the accumulating chamber 810 due to a water meniscus that is formed across the slit 872S when the water contacts the slit 872S. As shown in Fig. 8A, the restrictor 870 may include a plug 874 spaced from the distal opening 872D such that the slit 872S may be formed between the distal opening 872D and the plug 874. As shown in Fig. 8A, the inner chamber 872 may be a hollow cylinder and the plug 874 may be a spherical body where the spherical body may be spaced from one end of the hollow cylinder such that the slit 872S may be formed between the edge of the hollow cylinder and the spherical body. Plug 874 may be transparent so that UV light may go through the plug to disinfect the water exiting the inner chamber 872. Plug may be a UV reflective sphere. Reflective sphere may include a UV reflective exterior surface such that the UV light may be reflected into the inner chamber 872 to disinfect the water exiting the slit 872S.

[0073] Referring to Fig. 8A, the outlet 814 may include another restrictor 814R adapted to restrict the water from flowing through the outlet 814. Restrictor 814R may include a stopper 814P spaced from the outlet 814 such that a slot 814S may be formed between the outlet 814 and the stopper 814P spaced from the outlet 814. In this case, the slot 814 may be a circular ring. Water flowing through the outlet 814 may be restricted due to a water meniscus formed across the slot 814S when the water contacts the slot 814. Stopper 814P may include a UV reflective sphere so that the UV light may be reflected onto the water before it passes the slot 814S.

[0074] Fig. 8B shows a sectional view of the water purifying device along line A-A in Fig. 8A. As shown in Fig. 8B, the plug 874 may be spaced from the distal opening 872D of the inner chamber 872 to form the slit 872S. Outlet 814 may include the stopper 814P therein, such that the stopper 814P may be narrower than and spaced from the outlet 814 to form the slot 814S.

[0075] Referring to Fig. 8A, the water may enter the accumulating chamber 810 via the inlet 812. Water may first be accumulated in the inner chamber 872 and rise towards the distal opening 872D and the plug 874. As the water rises and contacts the slit 872S, a water meniscus is formed across the slit 872S between the plug 874 and the distal opening 872D to restrict the water from flowing through the slit 872S. When the water pressure within the inner chamber 872 is high enough to break the meniscus, the water may flow through the slit 872S and into

the accumulating chamber 810. As one would appreciate, the water may surge out of the inner chamber 872 in pulses. Meanwhile, the water being retained within the inner chamber 872 may be sterilized by the UV light passing through or reflected from the plug 874. As the water accumulates in the accumulating chamber 810, the water may flow towards the outlet 814. Similar to the situation at the inner chamber 872, the water at the stopper 814P may form a meniscus at the slot 814S and restricts the water from flowing past the slot 814S. Water that is being retained by the meniscus at the slot 814S may be sterilized by the UV light from the UV source 830 as well as the UV light reflected from the stopper 814P. While the accumulating chamber 810 in Fig. 8A shows the outlet 814 at the lower portion of the accumulating chamber 810, the outlet 814 may be disposed at the upper portion of the accumulating chamber 810.

[0076] Fig. 8C shows an enlarged view of the slit 872S in Fig. 8A. As mentioned, the slit 872S may be formed between the inner chamber 872 and the plug 874. As the water reaches the slit 872S, the meniscus 870M is formed across the slit 872S between the inner chamber 872 and the plug 874 as shown in Fig. 8C.

[0077] Fig. 9A shows a schematic view of an exemplary embodiment of the water purifying device 900. Water purifying device 900 may include the accumulating chamber 910 having an inlet 912 and the vertical channel 914C connected to outlet 914. Accumulating chamber 910 may include the UV sources 930 disposed at the top side 910T of the accumulating chamber 910. Accumulating chamber 910 may include a heating element 980, or other heating methods, adapted to heat the water therein to eliminate bacteria in the water to purify the water. Heating element 980 may be disposed adjacent the inlet 912 and within the accumulating chamber 910 to heat water flow entering the accumulating chamber 910 via the inlet 914. Water purifying device 900 may include a housing 902 adapted to contain the accumulating chamber 910 therein.

[0078] Fig. 9B shows a schematic view of an exemplary embodiment the water purifying device 900. Water purifying device 900 in Fig. 9B has the same features as the embodiment in Fig. 9A except that the heating element 980 may be disposed adjacent the inlet 912 and outside the accumulating chamber 910. Heating element 980 may be disposed between the accumulating chamber 910 and the housing 902.

[0079] Fig. 9C shows a schematic view of an exemplary embodiment the water purifying device 900. Water purifying device 900 may include the accumulating chamber 910 as shown in Fig. 9A and Fig. 9B without the housing 902. Water entering the accumulating chamber 910 via the inlet 914 may first be heated by the heating element 980 before being disinfected by the UV light. As the water accumulates in the accumulating chamber 910, the water is continuously being heated and disinfected before it exits the accumulating chamber 910 via the vertical channel 914C and the outlet 914. In this way, the water is provided sufficient time to be purified.

[0080] Fig. 10 shows an exemplary embodiment of the UV source 130. UV source 130 may include UV LEDs configured to emit UV-A and/or UV-C light. UV source 130 may be a point light source. UV source 130 may emit UV light peaked at two wavelengths, e.g. 275 nm (UV-C) and 375 nm (UV-A). UV LEDs may be mounted on a high humidity resistant PCB to prevent corrosion of the UV source 130. By providing UV light peaked at two wavelengths, the UV-C light is able to deactivate the bacteria and virus and at the same time, the UV-A light is able to penetrate deeper into the water to catalyse the surface of the accumulating chamber. UV source 130 emitting the UV-A light requires a power to at least 50mW. UV-A LEDs (A) may be placed at the outer edge of the plurality of UV LEDs. UV-C LEDs (C) may be placed at about the centre portion of the plurality of LEDs. UV-A light is adapted to activate the reflective coating of the accumulating chamber so that the coating may react with free radicals to improve the disinfection effect on the water. UV source may include UV LEDs, UV emitting optical fibres optically connected to a UV lamp.

[0081] Fig. 11 shows a sectional view of an exemplary embodiment of the UV reflective layer 110C. Accumulating chamber of each of the above embodiments may have an internal surface, such that the internal surface may be lined with the UV reflective layer 110C. UV reflective layer 110C may include a base layer 110CB. Base layer 110CB may include a non-stick layer and/or a self-cleaning layer. UV reflective layer 110C may include a catalytic layer 110CA above the base layer 110CB. Non-stick layer may be a Teflon® coating. Base layer 110CB may have a thickness of 5-15um. Preferably, the base layer 110CB may have a thickness of 10 um. Catalytic layer 110CA may be made from titanium dioxide (TiO₂). Catalytic layer 110CA may have a thickness of 5-15um. Preferably, the catalytic layer 110CA may have a thickness

of 10 μm . Upon exposure to the UV light, the catalytic layer 110CA produces the oxidative OH radicals which aid in the advanced oxidation processes on the surface of the UV reflective layer 110C and in the water thereon.

[0082] Water purifying device as shown in any one of the above examples may be customized to provide a water disinfection module that incorporates engineered light reflection, catalytic surfaces and fluid flow dynamics to improve the water disinfection efficacy. Water purifying device as described provides an improved apparatus for irradiation that can utilize the UV light and combinations of wavelengths effectively. With the incorporation of an adequate thermal management system, the water purifying device provides a point of use water disinfection apparatus for most types of use, e.g. for the global traveller.

[0083] A skilled person would appreciate that the features described in one example may not be restricted to that example and may be combined with any one of the other examples.

[0084] In the following examples, reference will be made to the figures, in which identical features are designated with like numerals.

[0085] The present invention relates to a water purifying device generally as herein described, with reference to and/or illustrated in the accompanying drawings.