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(54) Title: A DEVICE AND METHOD FOR PURIFYING AND ENRICHING WATER WITH AN AGENT, E.G. NUTRIENT

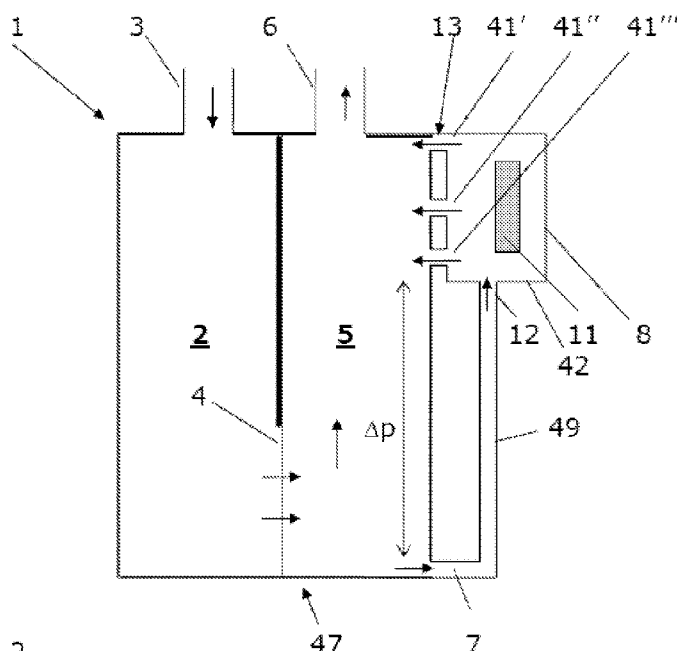


FIG. 2

(57) Abstract: A device and method for
purifying water, wherein a water stream
through a purifying stage (4) is divided into
a main stream and a side stream, wherein
the side stream is enriched with an agent,
for example a nutrient or pharmaceutical
before the streams are merged again. The
agent is supplied in a supply chamber (8),
which has a matrix (11, 30), from which the
agent is dissolved. In order for assuring an
extraction of the agent which is less depen-
dent on a concentration gradient in the
chamber (8), the chamber is provided with
outlet openings (41) at different heights in
the chamber.



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A DEVICE AND METHOD FOR PURIFYING AND ENRICHING WATER WITH AN AGENT, E.G. NUTRIENT

FIELD OF THE INVENTION

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The present invention is related to water purification devices for providing purified water and having means for adding beneficial agents to the purified water.

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BACKGROUND OF THE INVENTION

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Different aspects of portable water filtration devices are disclosed in International patent applications WO2008/067816, WO2008/067817, WO2008/110165, or WO2008/110172. Products on the market include personal water filter straws with the registered trademark LifeStraw (RTM) or gravity feed filter family of the trademark LifeStraw Family marketed by the company Vestergaard-Frandsen with the internet site www.vestergaard-frandsen.com.

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Addition of vitamins to filtered water in a personal drinking straw is discussed in the above mentioned patent application WO2008/067816. Adding nutrition in general to filtered or otherwise purified water is discussed in International patent application WO03/011769 disclosing a water purifier for personal or domestic use, for example in rural areas, containing disinfectants and slow release nutrients; the purifier includes a combination of (i) a primary coagulant, (ii) a microbicidal disinfectant, (iii) an oxidant, and optionally a food additive or nutrient source either as separate compositions in unit dosage form or incorporated directly into the water-purification composition itself.

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US patent application US 2004/0004037 discloses a spirally wound membrane filter with a centrally arranged downstream source adding nutrients to the filtered water; hollow fibre membranes are disclosed as filtration means. US6569329 discloses a bottle with a hollow fibre filter assembly and a downstream nutrient supply.

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Proportional addition of antimicrobials or other chemicals to filtered water by using a slip stream is also known in principle. US6855252 discloses a tubular filter inside which a dispenser is centrally provided, the dispenser containing a solid or granular substance to be dissolved by liquid inside the dispenser. The dispenser has a fluid

intake and a fluid outlet, and fluid flowing through the filter creates a differential pressure between the intake and the outlet, which draws saturated liquid out of fluid dispenser and into the filtered water.

5 Slipstream arrangements by differential pressure or other side-stream arrangements for dispensers with water filters or for swimming pools are further disclosed in GB2200901, US4059522, US5897770, US6485641, WO2010/043940, US2009/095704, FR1289749, and US5976385. Several of these disclose venturi-like arrangements for leading a side stream through a bed of agent. Venturis are
10 generally known in the art for adding a side stream to a main stream and are also disclosed in US40595522 and US2786338.

Release of nutrients in general to animals and in agriculture is known from soluble glasses. Kendall et al published in Animal Science 2001, 73, pp. 163-169 the article
15 "The effect of a zinc, cobalt and selenium soluble glass bolus on the trace element status of extensively grazed sheep over winter" concerning nutritional additives for sheep in sintered soluble glass. A nutrient bolus is also disclosed in GB2164557. British patent application GB2030559 discloses soluble glass with Se and Zn for cattle and sheep. Slow release of Se over years is reported in US5049139. The
20 company Telsol delivers soluble glass with Se and Zn for sheep and cattle, see http://www.telsol.co.uk/sel_def.html.

Glass is also used for release of antimicrobials. For example, US6555491 is concerned with water-soluble glasses, particularly glass fibres, containing small
25 amounts of alkali metal compounds with suggested uses being the sustained release of inorganic metals and anti-corrosion agents. US5792360 concerns water soluble glass with antimicrobial copper, silver, and/or zinc submerged in a water tank in order to prevent fouling, corrosion, and scaling, where zinc is primarily applied to prevent corrosion. US4587267 discloses a sintered glass with active
30 materials incorporated in the voids of the sponge-like glass.

Slow-dissolving glasses, also known as controlled release glasses, include the range of products from Giltech Ltd (Ayr, UK; www.giltech.biz) under the trade name Corglaes. International patent application WO96/24364 by Giltech discloses a
35 soluble glass matrix, preferably for combating infections, the glass matrix including minerals like Zn and Se. Sinter glass is one of the options. Dissolution rates are

given up to 25mg/cm²/hour at 38°C, preferably between 0.01 and 2 mg/cm²/hour. It is generally known that glasses can dissolve in water over years.

5 Other publications include US4419233, US4584106, US5244579, US4404360, US4931078, US7462289, DE10112085, US3929132, US4407322, US5525223, US6511605, US6553894, US6855252, and US7052913.

10 From the above, it appears that there are numerous disclosures concerning enrichment of water by nutrition sources or sources of other agents and disclosures of technical arrangements for release of these sources. However, the addition of the correct concentration of nutrients or other chemicals to filtered water is of general concern when using water filters intermittently, because nutrient or other chemicals may dissolve during storage time when the filter is not used and, then, lead to an undesired overshooting of the targeted concentration of nutrients or other chemicals when the device is going to be used again.

20 US6221416 tries to solve this problem by accumulating filtered rest-water in a channel downstream of the nutrient source, where the channel and the nutrient source are separated by a membrane that only allows water to go through under elevated pressure. The system is integrated in a cap arrangement for a bottle, which arrangement incorporates a tubular filter including a soluble element which in-use dissolves to release nutrients, flavourings, or medicaments. However, in practice, this technical solution of US6221416 has not proven feasible. Especially for water filters of the gravity type and the straw type, the pressure reduction by the membrane is not a good technical solution.

25 Thus, there is a general need for improvement in the art.

30 DESCRIPTION/SUMMARY OF THE INVENTION

It is the objective of the invention to provide an improved combination of a water purifier and a dispenser for dispensing nutrients and/or other agents to the purified water. Especially, it is the purpose to provide a combination of a water purifier with a dispenser that yields better control of dispensed nutrients and/or other agents into water, especially drinking water, even in the case of intermittent use.

During careful study, the inventors have found out that prior art combinations of water purifiers with dispensers for active agents, such as nutrients, do not work satisfactory when used intermittently. Especially, the problem is severe if the dosage of the active agent to be applied to the purified water is very small, which is normally the case in long lasting water purifiers for drinking water. What has been found out is that an important part of the problem is an uneven distribution of the active ingredient inside the dispenser, if the dispenser is not shaken regularly. This seems not to have been recognised as a problem in the prior art. For example, if the dispenser is not shaken or stirred, there tends to be a higher concentration of the active agent at the bottom of the dispenser than at the top, even in the case where the nutrient is provided at different positions inside the dispenser and even in the case where the nutrient is believed to be dissolved. The uneven distribution makes control of the dosage very difficult. This is not a problem for addition of antimicrobial agents in swimming pools, but is a problem if the agent is used in water for human consumption.

This problem is overcome by a device with a medium for water purification and with means for enriching the purified water by an agent according to the following.

The device comprises a fluid inlet into an inlet side upstream of the medium for water purification and a fluid outlet from an outlet side downstream of the medium with a first flow path from the fluid inlet through the inlet side, through the medium, through the outlet side, and to the fluid outlet, from which purified and enriched water can be consumed, for example, as drinking water for human consumption. This arrangement provides a main stream of purified water in the outlet side, which then is enriched by an agent from a supply chamber. The supply chamber has a chamber inlet and a chamber outlet connecting an inner volume of the supply chamber with the outlet side at different locations, which creates a differential pressure between the chamber inlet and the chamber outlet, especially, when the chamber outlet is closer to the fluid outlet than the chamber inlet. This differential pressure draws a side stream of purified water along a second flow path from the outlet side downstream of the medium into the chamber. The water flows through the chamber inlet, through the inner volume, through the chamber outlet, and back to the outlet side for combining the side stream again with the main stream.

The device contains a matrix inside the supply chamber. The matrix comprises a gradually releasable agent for enriching water upon contact with the water in the supply chamber. For example, the matrix is water soluble and releases the agent due to dissolution of the matrix in the water.

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The supply chamber has a bottom and a top and, typically, the concentration of the agent varies in dependence of the height above the bottom, unless the inner volume is shaken or stirred. In order to overcome the drawbacks of a concentration variation inside the inner volume of the supply chamber, the chamber outlet has multiple outlet openings at different distances from a bottom of the supply chamber. These multiple outlet openings extract water from the supply chamber at different positions.

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The terms top and bottom relate to the orientation of the device for proper use and functioning of it. It is understood that the top and bottom of the supply chamber are delimiting features of the inner volume of the supply chamber. Thus, the terms top and bottom of the supply chamber refer to top and bottom of the inner volume of the supply chamber when properly oriented for normal use.

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The term agent covers nutrients, pharmaceuticals, nutraceuticals, nutricosmetics, or flavours, for example. These terms are explained further below in connection with examples.

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The water purifying medium can be a series of chemical and/or physical treatment stages. Advantageously, the purifying medium comprises a filtration membrane, such as microfiltration or ultrafiltration membrane. An example is a plurality of hollow fibre membranes. Useful principles for the water purification part of the device are found in WO 2008/110172, and the fluid inlet, filter, and fluid outlet can advantageously be arranged similar.

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The provision of the first and second flow paths is important, in as far as it allows the rate of flow of water along the matrix to be controlled by providing the chamber inlet and chamber outlet with throughput dimensions adjusted for a desired flow rate of the side stream along the second flow path relatively to the main stream along the first flow path. This facilitates a control of the lifespan of the matrix due to the control of minutes quantities of agent released from it.

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The present inventors have found that even if the inner volume of the supply chamber with the matrix is provided with a chamber inlet at one end and a chamber outlet at the other end, water flowing through the supply chamber results in an inhomogeneous concentration of the agent despite the water flowing along the matrix prior to reaching the chamber outlet. This is especially so when the side stream has a very small flow rate, because the small flow of the side stream through the supply chamber would not result in a homogenising turbulence inside the supply chamber. It has been found in such situations that a concentration gradient for the agent exists between the top and bottom of the supply chamber with the highest concentration at the bottom of the supply chamber. Even, if the chamber inlet is at the bottom of the supply chamber and the chamber outlet at the top, the highest concentration is at the bottom near the inlet and not at the outlet. The gradient may even be so steep that only little of the agent is released to the side stream, if the chamber outlet is only at the top. On the other hand, even in the special case of having the outlet only at the bottom and the inlet at the top, it results in a difficult control of the agent concentration in the side stream at the chamber outlet. In addition, in some cases, it has to be taken into account that is desirable to have an outlet at the top in order to vent air from the supply chamber.

For this reason, it has been found to be a good technical solution if the chamber outlet has multiple outlet openings at different distances from the bottom of the supply chamber in order to extract water from the supply chamber at different positions and thereby counteract the effect from the gradient; because the water at the different positions in the supply chamber has different agent concentration, the multiple outlet openings thereby function as an equalizer of the concentration gradient. Alternatively, the chamber outlet comprises a single elongate outlet opening. With such an elongate outlet opening, if sufficiently narrow, a likewise gradient-equalising effect can be achieved as with the multiple outlet openings. For example, the single chamber outlet has a longitudinal axis, and the single outlet opening has an average length along the longitudinal axis and an average width, wherein the average length is at least ten times larger than the average width, for example 20, 30, 50 or even 100 times larger. For sake of good order, it should be emphasized that the multiple outlet openings can similarly be elongate as well.

Indirectly, the chamber inlet is connected with the chamber outlet through the outlet side. Water extracted from the outlet side flows through the supply chamber and returns to the outlet side. A more direct connection from the chamber inlet to

the chamber outlet is through the inner volume of the supply chamber. Advantageously, for the water flow through the inner volume, the chamber inlet communicates with the chamber outlet only through the multiple outlet openings. In this case, it is ensured that water from the chamber inlet flows into the inner
5 volume and is mixed with the enriched water in the inner volume before leaving the inner volume again through the multiple outlet openings. Thus, no water flows directly from the chamber inlet to the chamber outlet without flowing through the multiple outlet openings and without being mixed with the enriched water in the inner volume of the supply chamber. The advantage is a controlled supplement of
10 enriched water out of the supply chamber.

When comparing to the patent publications FR1289749 and GB2200901, it is recognised that these publications disclose perforated outlet conduits that extend into a granular medium that releases an agent. In both publications, however, a
15 water inlet conduit is provided inside the perforated outlet conduit. Thus, the water coming from the inlet conduit has the possibility to flow from the water inlet to the water outlet without flowing through the multiple outlet openings. This is in sharp contrast to the requirement that the water from the water inlet has to flow through inner volume and through the outlet openings. The disadvantage of the system as
20 disclosed in these two publications is that it is very difficult to achieve a controlled and stable dosage, because the degree of enrichment is not controlled; especially, it is not controlled over time, when the granular agent is gradually reduced in the inner volume of the systems as disclosed in FR1289749 and GB2200901.

The systems in the patent publications FR1289749 and GB2200901 differs from the system as described above in that the multiple outlet openings have a different purpose and function. In these two patent publications, the outlet conduits extend into the granular medium, and the apertures in the outlet conduits have the function of preventing the granular agent from entering the outlet conduit.
30 GB2200901 discloses gauze, for example a fine meshed steel net, which assists in preventing granular material to enter the outlet conduit. An objective of equalizing the concentration of the agent in the water along the outlet conduit is not disclosed in these documents. An equalization of the concentration gradient from bottom to top in the chamber of the agent is not important for the systems in these
35 publications, as the granular agent is directly abutting the tubes and, therefore, a high concentration of the agent is implicit in the water that enters the tube. A long term efficiency with minute amounts of agent supplied to the water is not disclosed.

Possible technical solutions exist in the chamber outlet comprising a tube that is connected to the inner volume of the supply chamber through the single elongate outlet opening or the multiple outlet openings. For example, the tube extends into the inner volume of the supply chamber. The tube has a single elongate outlet opening of multiple outlet openings spaced along its length and communicates with the agent-enriched water in the supply chamber at different distances from the bottom of the supply chamber. For example, the single elongate opening of the tube or that part of the tube that comprises the multiple outlet openings extends into the inner volume of the supply chamber along a distance of at least 50% of the distance between the top and the bottom of the supply chamber, more preferably at least 75%, 80%, 85%, 90% or 95%. For example the single elongate outlet opening extends from the lower quarter of the inner volume of the supply chamber to the upper half of the inner volume of the supply chamber.

Another technical solution exists in the chamber outlet comprising multiple fluid connections between the supply chamber and the outlet side; the multiple fluid connections are connected to the outlet side and the fluid connections communicate with the inner volume of the supply chamber at different distances from a bottom of the supply chamber. For example, the fluid connections communicate, on the one hand, individually with the outlet side where the mainstream flows and, on the other hand, communicate individually with the water in the inner volume of the supply chamber at different distance from the bottom of the supply chamber.

For example, at least one of the different positions for extraction of water from the supply chamber is in an upper half of the inner volume of the supply chamber. Optionally, in addition, and at least one of the different positions is in the lower half or lower quarter of the inner volume of the supply chamber. A further option is at least one of the different positions being in an upper half of the inner volume of the supply chamber but a distance remote from the top of the supply chamber. Such a distance is, for example, 10 or 20% of the distance between the top and the bottom of the supply chamber.

Typically, three to five openings are sufficient to obtain a good gradient-equalizing effect, where there should be at least one or two openings in the upper half and at least one or two openings in the lower half or lower quarter of the inner volume of the supply chamber.

Exemplary cross-sections and shapes for the tube include without limitation circular, rectangular, triangular, and crescent. Water passes from the fluid inlet across a part of the matrix and then into the tube via the various openings taking water from various positions at different distances from the bottom.

As outlined above, the gradient between the bottom and the top of the supply chamber has influence on the concentration of the extracted agent-enriched water. However, there may also be a lateral gradient of agent across the supply chamber, depending on the position of the matrix. For this reason, advantageously, the multiple outlet openings or the single elongate outlet opening have/has a distance from the agent such that the agent is dissolved into the water surrounding the matrix, and the water with the dissolved agent enters the outlet opening or openings at a distance from the matrix. For example, the opening or openings are adjacent to a wall of the chamber, whereas the matrix is provided remote from that wall. In this case, the water would have to flow towards the wall and first then enter the multiple outlet openings or the single elongate outlet opening. Optionally, the opening or openings face away from the matrix in order to counteract the influence of a lateral gradient in the supply chamber.

In order to release air or other gases from the supply chamber, it is advantageous, if a vent hole is provided at the top of the supply chamber or at least very near to the top of the supply chamber. In order for the air or gas to accumulate in a controlled manner, the top of the supply chamber, advantageously, has an inclination or concavity. Air or other gases would accumulate in the highest part of the inclination or concavity. For this reason, it is advantageous if the vent hole is in this highest part. Typically, the vent hole will be very close or at the top of the inner volume, for example less than 5 mm from the top of the supply chamber. For example, the vent hole is part of the chamber outlet.

In order to achieve a differential pressure between the chamber inlet and the chamber outlet, the chamber outlet is closer to the fluid outlet than the chamber inlet.

Although the flow through the supply chamber is low, it may still have some small equalizing effect on the gradient, if the chamber inlet is in a lower quarter of the

inner volume of the supply chamber, for example at the bottom of the supply chamber.

5 It has been found as a good technical solution that the water purifying medium is provided in a purifier housing with the fluid inlet and the fluid outlet, and the supply chamber is provided outside the purifier housing. This is an advantageous solution for the case where the supply chamber has multiple outlet openings, but also in general in cases where the above technical solution with the multiple outlet openings from the supply chamber is not used.

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In general terms, there is an independent invention according to the following:

A device for purifying and enriching water, the device comprising: a medium for water purification; a fluid inlet into an inlet side upstream of the medium and a fluid outlet from an outlet side downstream of the medium with a flow path from the fluid inlet through the inlet side, through the medium, through the outlet side, and to the fluid outlet for providing purified water in the outlet side; a supply chamber for supplying an agent to the purified water, the supply chamber having a chamber inlet and a chamber outlet connecting an inner volume of the supply chamber with the outlet side at different locations for drawing purified water from the outlet side through the chamber inlet, through the inner volume, through the chamber outlet, and back to the outlet side by differential pressure between the chamber inlet and the chamber outlet; a matrix inside the inner volume of the supply chamber, the matrix comprising a gradually releasable agent for providing agent-enriched water upon contact with the water in the supply chamber; wherein the water purifying medium is provided in a purifier housing with the fluid inlet and the fluid outlet, and the supply chamber is provided outside the housing. For example, the supply chamber is provided remote from the purifier housing with the inner volume of the supply chamber being fluid-flow-connected by tubing with the outlet side. Optionally, the chamber outlet has multiple outlet openings at different distances from a bottom of the supply chamber for extracting water from the supply chamber at different positions. The special embodiments explained above and below are also applicable in this case.

35 By providing the supply chamber outside the purifier housing, the supply chamber is easily accessible and may be provided with a re-usable port for access to the inner volume of the supply chamber. This allows supply of a new matrix into the inner volume after exhaustion of the agent.

For example, the purifier housing is of the tubular, portable type with a length of less than 50 cm. Optionally, a width is less than 25 cm or 20 cm or 10 cm. Optionally, the purifier housing in combination with the supply chamber are of the portable type. Portable in this respect means portable by a person, at least when not filled with water. For example, the dry weight is less than 50 kg, rather less than 30 kg, less than 20kg, or even less than 10 kg or 5 kg.

In a further embodiment, the device comprises a clean water tank as part of the outlet side for accumulating purified water downstream of the medium. Optionally, the device also comprises a dirt water container above the clean water tank for driving non-purified water through the purifying medium and into the clean water tank by gravity. Such systems are good as table-top systems.

In further embodiments, the device comprises a drain valve having a first connection to the clean water tank for draining water from the clean water tank through the drain valve. The drain valve has a second connection to the chamber outlet of the supply chamber for receiving enriched water from the supply chamber. Advantageously, the drain valve has means for mixing the water from the supply chamber with the water from the clean water tank. Optionally, the drain valve has a closure member that has means for opening and closing for drain of water from the clean water tank simultaneously with opening and blocking the means for mixing the water.

For example, the means for mixing the water comprises a first valve channel flow-connected to the chamber outlet of the supply chamber for receiving enriched water from the supply chamber and comprises a second valve channel flow-connected to the clean water tank for providing enriched water for mixing with the water from the clean water tank. Advantageously, the closure member has means for opening or blocking for flow from the first flow channel to the second flow channel. In this case, it is assured that enriched water is only provided from the supply chamber to the water from the clean water tank when the valve is open.

In some concrete embodiments, the means for mixing the water comprise a venturi with a waist portion for a stream of water from the clean water tank through the venturi when draining the clean water tank through the drain valve, wherein the

second valve channel communicates with the venturi for providing enriched water to the stream of clean water through the venturi.

5 For example, the drain valve comprises a closure member with manual means for holding open the closure member by the hand of a user when draining water from the clean water tank. Advantageously, the drain valve has an automatic closure mechanism for closing the closure member automatically when the user terminates holding the drain valve open by the manual means.

10 The matrix for the release of the agent may be a porous matrix, where the agent is released from the pores. Alternatively, the matrix may be a polymer from which the agent leaches into the side stream. As a further alternative, the matrix is water soluble. An example for a soluble matrix is water soluble glass with an agent dissolved in the glass matrix. A further alternative is sintered, water soluble glass
15 where the nutrient is provided in voids within the sintered glass and released upon dissolution of the glass.

An advantageous matrix, for example soluble glass matrix, is in the form of thin long slabs, because the surface area of the slabs does not change much despite a
20 substantial change of the volume during dissolution. For example, the matrix is provided in form of a slab having a thickness at least a factor of 10 less than a length of the slab.

However, such kind of slabs, especially for soluble glass, may easily break by
25 shock, for example, during transport. To prevent this, optionally, the supply chamber comprises a mount for the matrix, the mount having means for shock absorption. For example, the means for shock absorption comprises resilient fins connecting a holder of the matrix with a chamber wall, such as side wall, top, and/or bottom of the supply chamber.

30 The supply chamber may be provided with a transparent wall in order for the matrix to be seen. If the matrix is glass, the glass advantageously is coloured, for example green. As the matrix, for example glass, dissolves and the agent is gradually exhausted, it can be observed and a decision taken for replacement of the
35 matrix or disposal of the device.

In some embodiments, the device is adapted for dispensing the agent into a plurality of discrete volumes of water, for example least 10, 20, 50, 100, 200, 300, 500, 750 or 1000 discrete volumes of water. By a "discrete volume of water" is meant a portion of water that is dispensed continuously from the water filtration device between intermittent uses. For example, each volume of water is a minimum of 50ml, for example 250ml or 500ml or 1000ml. A suitable maximum for such portions is 3, 5, 10, 20, or 50 litres. For example, the molar quantity of the agent dispensed into the first volume of water is between half and twice that of the molar quantity of the agent dispensed into the final volume, for example, the 10th, 20th, 50th, 100th, 200th, 300th, 500th, 750th or 1000th volume of water, where the first and last volumes of water are of approximately equal size. Advantageously, the device is adapted to dispense the agent into at least 1000 litres, for example, at least 2000, 3000, 4000, 5000, 7500, 10000, 15000, or 20000 litres of water

The water purifying medium is, advantageously, a membrane filter that physically prevents microbes and other particles from traversing the membrane, although, the filtration capability depends on the pore size. For example, the membrane filter comprises a micro-filtration membrane with a porosity of 0.05-0.4 micrometer or 0.05-0.15 micrometer. Alternatively, the membrane filter comprises an ultra-filtration membrane having pores with a pore size adapted to filter viruses. Optionally, the ultra-filtration membrane has a minimum pore size of around or equal to 0.04 micrometer, for example, with a minimum pore size of around or equal to 0.02 micrometer.

Optionally, the microporous filter comprises a solid microporous ceramic wall with a flow path through the wall separating said inlet side from said outlet side. Alternatively, the microporous filter comprises a microporous hydrophilic polymer wall with a flow path through the wall separating said inlet side from said outlet side. An option is stacked microporous polymer sheets or ceramic sheets with a flow conduit between said sheets and a flow path through the microporous walls of the sheets, the sheets separating said inlet side from said outlet side. Another option is at least one hollow, microporous polymer fibre membrane with a flow path through the fibre wall, the fibre wall separating said inlet side from said outlet side. Optionally, the microporous filter comprises a plurality of hollow, microporous polymer fibres, for example, at least one hundred or several hundreds of microporous hollow fibre membranes.

In some embodiments, where a membrane filter is used, the device comprises a second fluid outlet on said fluid inlet side, the second outlet being provided with a valve. Thus, a third fluid flow path is defined between said fluid inlet and said second fluid outlet, said third fluid flow path being from said fluid inlet into said fluid inlet side to said second fluid outlet, thus, being only on the upstream side of the membrane filter. The second fluid outlet can be provided with valves, for example manually operable valve arrangements or magnetic valves. The third fluid flow path does not require fluid to pass across the filter, and this is particularly useful in performing a forward flush of the device, particularly for cleaning the filter; with the valve open, fluid can be flushed from the fluid inlet to the second fluid outlet and flush particulate residues off the membrane filter.

In some embodiments, where a membrane filter is used, the device additionally comprises a flexible, manually-compressible back flush container connected to the fluid outlet side. This is particularly useful in assisting in the unblocking of the filter; the back flush container, for example a resilient bulb/balloon/bellow, can be compressed and decompressed to cause a fluid flow back across the membrane filter from the outlet side to the inlet side in order to assist in dislodging any particulate matter which is accumulated on the upstream side and even inside the filter. A switch between backflush and forward flush is advantageous for removing biofilm and other particulate from the upstream side of the filter. Backflush and forward flush are explained in International patent application WO 2008 110172, which is also mentioned above.

For example, the device is a portable device with dimensions less than 100 cm or 80 cm or 60 cm in all three orthogonal directions. Another example is a portable device being less than 50 cm in one dimension and less than 20 cm in the two orthogonal dimensions.

As options, the agent for enriching the water may comprise nutrients, pharmaceuticals, nutraceuticals, nutricosmetics, flavours, or a combination thereof.

Non limiting examples of nutrients are iodine, zinc, selenium, iron, magnesium, calcium, vitamins, and folic acid, which can also be used in combination. Examples of vitamins are vitamin A, vitamin B1, vitamin B2, vitamin B6, vitamin B12, niacin, pantothenate, biotin, vitamin C, vitamin D, and vitamin K.

The device according to the invention is useful for providing drinking water. However, the device may as well be used to provide purified water for other uses, for example only for use different from drinking water supply. For example, the device may serve as a provider for cleaning agent in medical clinics and hospitals. A possible use is for cleaning external wounds for which the agent may contain corresponding beneficial pharmaceuticals specifically designed for external cleaning of wounds. Optionally, the enriched water from the device may also be used orally for disinfection of the mouth and throat without the water being swallowed. Another use is provision of enriched water for flushing of eyes. An even further use is for administration of pharmaceuticals by water consumption from the device, for example in the form of a steady or intermittent administration of specific medicine from the device to a patient or, rather, a number of patients. For example, the device may be used in rural areas or emergency areas for administration of certain medicine to a plurality of patients in a field hospital; in this way, a large number of patients may be treated quickly through distribution of enriched water from a single device by distributing small amounts of water with specific pharmaceuticals to these patients, while they walk through the field hospital. Such field hospitals, where suffering patients line up in large numbers in front of the field hospital and have to be treated in a quick and rationalised way, are common practice in emergency situations where resources are few. Further use will become apparent in connection with the different types of possible agents presented in the following.

Non limiting pharmaceuticals include orally administrable pharmaceuticals in general; generic drugs, non-generic drugs, for example analgesics, as well as pharmaceuticals that are not regarded as drugs, such as caffeine.

Specific non-limiting examples of pharmaceuticals include:

Antipyretics: reducing fever (pyrexia/pyresis), for example Quinine

Analgesics: reducing pain (painkillers)

Antimalarial drugs: treating malaria, for example Quinine

Antibiotics: inhibiting germ growth

Antiseptics: prevention of germ growth near burns, cuts and wounds

For the gastrointestinal tract (digestive system), useful pharmaceuticals include the following non limiting examples:

Upper digestive tract: antacids, reflux suppressants, antiflatulents, antidopaminergics, proton pump inhibitors (PPIs), H₂-receptor antagonists, cytoprotectants, prostaglandin analogues

5 Lower digestive tract: laxatives, antispasmodics, antidiarrhoeals, bile acid sequestrants, opioid

For the cardiovascular system, useful pharmaceuticals include the following non limiting examples:

10 General: β -receptor blockers ("beta blockers"), calcium channel blockers, diuretics, cardiac glycosides, antiarrhythmics, nitrate, antianginals, vasoconstrictors, vasodilators, peripheral activators

Affecting blood pressure (antihypertensive drugs): ACE inhibitors, angiotensin receptor blockers, α blockers, calcium channel blockers

15 Coagulation: anticoagulants, heparin, antiplatelet drugs, fibrinolytics, anti-hemophilic factors, haemostatic drugs

Atherosclerosis/cholesterol inhibitors: hypolipidaemic agents, statins.

For the central nervous system, useful pharmaceuticals include the following non limiting examples:

20 hypnotics, anaesthetics, antipsychotics, antidepressants (including tricyclic antidepressants, monoamine oxidase inhibitors, lithium salts, and selective serotonin reuptake inhibitors (SSRIs)), antiemetics, anticonvulsants/antiepileptics, anxiolytics, barbiturates, movement disorder (e.g., Parkinson's disease) drugs, stimulants (including amphetamines), benzodiazepines, cyclopyrrolones, dopamine
25 antagonists, antihistamines, cholinergics, anticholinergics, emetics, cannabinoids, and 5-HT (serotonin) antagonists.

For pain & consciousness (analgesic drugs), useful pharmaceuticals include the following non limiting examples: NSAIDs, opioids, and various orphans such as
30 paracetamol, tricyclic antidepressants, and anticonvulsants.

For musculo-skeletal disorders, useful pharmaceuticals include the following non limiting examples: NSAIDs (including COX-2 selective inhibitors), muscle relaxants, neuromuscular drugs, and anticholinesterases.

35

For the eye, useful pharmaceuticals include the following non limiting examples:

General: adrenergic neurone blocker, astringent, ocular lubricant

Diagnostic: topical anesthetics, sympathomimetics, parasympatholytics, mydriatics, cycloplegics

Anti-bacterial: antibiotics, topical antibiotics, sulfa drugs, aminoglycosides, fluoroquinolones

5 Antiviral drugs

Anti-fungal: imidazoles, polyenes

Anti-inflammatory: NSAIDs, corticosteroids

Anti-allergy: mast cell inhibitors

10 Anti-glaucoma: adrenergic agonists, beta-blockers, carbonic anhydrase inhibitors/hyperosmotics, cholinergics, miotics, parasympathomimetics, prostaglandin agonists/prostaglandin inhibitors. nitroglycerin

15 For the ear, nose and oropharynx, useful pharmaceuticals include the following non limiting examples: sympathomimetics, antihistamines, anticholinergics, NSAIDs, steroids, antiseptics, local anesthetics, antifungals, cerumenolyti.

For the respiratory system, useful pharmaceuticals include the following non limiting examples:
20 bronchodilators, NSAIDs, anti-allergics, antitussives, mucolytics, decongestants, corticosteroids, Beta2-adrenergic agonists, anticholinergics, steroids.

For endocrine problems, useful pharmaceuticals include the following non limiting examples:
25 androgens, antiandrogens, gonadotropin, corticosteroids, human growth hormone, insulin, antidiabetics (sulfonylureas, biguanides/metformin, thiazolidinediones, insulin), thyroid hormones, antithyroid drugs, calcitonin, diphosponate, vasopressin analogues.

30 For the reproductive system or urinary system, useful pharmaceuticals include the following non limiting examples:
antifungal, alkalising agents, quinolones, antibiotics, cholinergics, anticholinergics, anticholinesterases, antispasmodics, 5-alpha reductase inhibitor, selective alpha-1 blockers, sildenafil, fertility medications.

35 For contraception, useful pharmaceuticals include the following non limiting examples: Hormonal contraception.

For obstetrics and gynaecology, useful pharmaceuticals include the following non limiting examples:

NSAIDs, anticholinergics, haemostatic drugs, antifibrinolytics, Hormone Replacement Therapy (HRT), bone regulators, beta-receptor agonists, follicle stimulating hormone, luteinising hormone, LHRH, gamolenic acid, gonadotropin release inhibitor, progestogen, dopamine agonists, oestrogen, prostaglandins, gonadorelin, clomiphene, tamoxifen, Diethylstilbestrol.

For the skin, useful pharmaceuticals include the following non limiting examples:

emollients, anti-pruritics, antifungals, disinfectants, scabicides, pediculicides, tar products, vitamin A derivatives, vitamin D analogues, keratolytics, systemic antibiotics, topical antibiotics, hormones, fibrinolytics, proteolytics, corticosteroids.

Against infections and infestations, useful pharmaceuticals include the following non limiting examples: antibiotics, antifungals, antileptotics, antituberculous drugs, antimalarials, anthelmintics, amoebicides, antivirals, antiprotozoals.

For the immune system, useful pharmaceuticals include the following non limiting examples: vaccines, immunoglobulines, immunosuppressants, interferons, monoclonal antibodies

For allergic disorders, useful pharmaceuticals include the following non limiting examples: anti-allergics, antihistamines, NSAIDs

For nutrition, useful pharmaceuticals include the following non limiting examples: tonics, iron preparations, electrolytes, parenteral nutritional supplements, vitamins, anti-obesity drugs, anabolic drugs, haematopoietic drugs, food product drugs

For neoplastic disorders, useful pharmaceuticals include the following non limiting examples: cytotoxic drugs, therapeutic antibodies, sex hormones, aromatase inhibitors, somatostatin inhibitors, recombinant interleukins, G-CSF, erythropoietin

Preferable nutraceuticals include (but are not limited to):

products isolated or purified from foods, and generally sold in medicinal forms not usually associated with food and demonstrated to have a physiological benefit or provide protection against chronic disease. Examples: beta-carotene, lycopene, etc.

food stuff (as a fortified food or a dietary supplement) that provides health benefits

Examples of nutraceutical chemicals include probiotics, antioxidants, and phytochemicals:

5 Antioxidants: resveratrol from red grape products; flavonoids inside citrus, tea, wine, and dark chocolate foods; anthocyanins found in berries

Reducing hypercholesterolemia: soluble dietary fibre products, such as psyllium seed husk

Cancer prevention: broccoli (sulforaphane)

10 Improved arterial health: soy or clover (isoflavonoids)

Lowered risk of cardiovascular disease: alpha-linolenic acid from flax or Chia seeds

Amino acids

Enzymes

Botanical, herbal and spices extracts such as ginseng, garlic oil, etc.

15 Neutraceutical are products which typically claim to prevent chronic diseases, improve health, delay the aging process, and increase life expectancy.

Preferable nutricosmetics include (but are not limited to):

Antioxydants: Vitamin C, Omega-3 fatty acids, Carotenes, Flavonoids

20

The term nutricosmetics refers to nutritional supplements which can support the function and the structure of the skin. Many micronutrients have this effect. Vitamin C, for example, has a well established anti-oxidant effect that reduces the impact of free radicals in the skin. It also has a vital function in the production of collagen in the dermis. Other micronutrients, for example, some omega-3 fatty acids, carotenes, and flavonoids protect the skin from the damaging effects of Ultraviolet (UV) light exposure, which may lead to accelerated skin ageing and wrinkle formation.

25

30 In certain embodiments, the water-soluble glass is also provided with a flavouring agent.

Also provided according to the present invention is a method for filtering water and dispensing an agent into said filtered water, the method comprising passing water through a device according to a device, as described, from said fluid inlet to said fluid outlet. Suitably, the method comprises orienting the device with the top of the device being upwards.

35

The term "advantageously" is to be understood as an advantageous option but not a necessary feature.

5 As it appears from the above, the invention is a device for purifying water, wherein a water stream through a purifying stage is divided into a main stream and a side stream, wherein the side stream is enriched with an agent, for example a nutrient or pharmaceutical before the streams are merged again. The agent is supplied in a chamber, which has a matrix from which the agent is dissolved. In order for
10 assuring an extraction of the agent that is less dependent on a concentration gradient in the chamber, the chamber is advantageously provided with outlet openings at different heights in the chamber.

15

Reference numbers in the claims are exemplary only and not limiting the scope of the claims.

SHORT DESCRIPTION OF THE DRAWINGS

20

The invention will be further apparent from the following description with reference to the several figures of the accompanying drawings which show, by way of example only, forms of suitable devices.

25

Figure 1 is a sketch of the principle;

Figure 2 illustrates a specific embodiment;

Figure 3 is a cross-sectional view of a supply chamber;

Figure 4 is a partly cut-away cross sectional drawing of a table top system in a) a three dimensional perspective and b) a side view;

30

Figure 5 is a three dimensional drawing of the supply chamber of the system as illustrated in Figure 4;

Figure 6 is a partly cut-away drawing of the valve system in Figure 4; Figure 7 illustrates a tube with a single elongate opening for extraction of water from the supply chamber with a) an oval opening and b) a rectangular opening.

35

DETAILED DESCRIPTION

Figure 1 illustrates a first principle of a device 1 for purifying and enriching water. It comprises a fluid inlet side 2, a fluid inlet 3 into the fluid inlet side 2, and a filter 4, for example comprising a plurality of microporous hollow fibre membranes. It comprises a fluid outlet side 5 and a first fluid outlet 6 from the fluid outlet side 5.

5 In addition, it comprises a side-stream outlet 7 from the fluid outlet side 5, the side-stream outlet 7 being in tubular connection to an inlet 12 of a supply chamber 8 in order to provide water from the outlet side 5 to the supply chamber 8. An outlet 13 of the supply chamber 8 is in tubular connection to a side stream return 9 for water flow from the supply chamber 8 to the fluid outlet side 5. As illustrated,
10 the device 1 comprises a separate filtering unit 47 and a remote supply chamber 8, which are mutually connected by tubing 49 from side stream outlet 7 to chamber inlet 12 and by tubing 46 from chamber outlet 13 to side stream return 9.

The device 1 has a first and a second fluid flow paths between the fluid inlet 3 and
15 the first fluid outlet 6. The first fluid flow path is from the fluid inlet 3 into the fluid inlet side 2, through the filter 4 to the fluid outlet side 5 and to the first fluid outlet 6. The second fluid flow path is from the fluid inlet 3 to the fluid inlet side 2, through the filter 4 to the fluid outlet side 5, to the side-stream outlet 7, through the chamber inlet 12, into the inner volume 10 of the supply chamber 8, through
20 the chamber outlet 13 through the side-stream return 9, into the fluid outlet side 5 and through first fluid outlet 6.

The second fluid flow is a side stream relatively to the first flow, the first flow being a main stream. The side stream is much smaller than the main stream and has the
25 purpose to transport minor amounts of agent, for example nutrients, from the supply chamber 8 into the main stream in the fluid outlet side 5. For example, such agent is supplied from a soluble matrix 11 inside the chamber 8 providing the side stream with the agent upon slow solution of the matrix 11. The driving force for the side stream is a differential pressure in the fluid outlet side 5 between the side-
30 stream outlet 7 and the side-stream return 9.

The device 1 further comprises a second fluid outlet 14 out of the fluid inlet side 2 defining a third fluid flow path between the fluid inlet 3 and the second fluid outlet
35 14. The third flow path is from the fluid inlet 3 into the fluid inlet side 2 to the second fluid outlet 14.

The first fluid outlet 6 and the second fluid outlet 14 have valves 16, 15, respectively, for controlling the flow of fluid therein. The valves 16, 15 each have valve fluid outlets 17, 18 for dispensing fluid therefrom.

5 In the specific embodiment of Figure 1, there is a passageway on the fluid inlet side 2 from the fluid inlet 3 to the fluid outlet 14, the passageway being defined by the filter 4. The filter 4 is cylindrical in shape. For example, the filter 4 is an ultra-filtration membrane. In this embodiment there is an annular passageway on the fluid outlet side 5 defined on its inside by the filter 4 and defined on its outside by a
10 wall 19 of the purifier housing 45. The wall 19 is cylindrical in shape but could have many other tubular shapes, if convenient. The filter 4 is provided such that fluid cannot pass from the fluid inlet side 2 to the fluid outlet side 5 without passing through the filter 4, thereby, ensuring that all water dispensed from the valve fluid outlet 18 has been filtered.

15 Valve 15 can be opened allowing water to flow from the fluid inlet 3 along the inner surface of the filter 4 and out of the valve fluid outlet 17. This acts to flush out the filter 4 and remove residue trapped in the filter 4 which then leaves device 1 through valve fluid outlet 17.

20 The device 1 is preferably oriented in use such that the second fluid outlet 14 is disposed below the fluid inlet 3, for example vertically, approximately vertically or inclined to not more than 45 degrees. This allows a good flow-rate of water from the fluid inlet 3 to the valve outlet 17 when flushing out the device. In the same
25 orientation, the first fluid outlet 6 is disposed above the second fluid outlet 14, allowing improved circulation of water through the supply chamber 8.

Initially, valves 15, 16 are closed to prevent water from leaving the device 1 unintentionally. Fluid inlet 3 is connected to a supply of untreated water (not shown),
30 for example a container suitable for storing untreated water and positioned higher than the fluid inlet 3, such that untreated water can flow to the fluid inlet 3 by gravity. This saves a user from the need of pumping water through the device 1. In other embodiments (not shown) the device is arranged to be driven by a pump. The container may have an outlet containing a coarse filter, the outlet being in fluid
35 flow communication with the fluid inlet 3 of the device 1. Valve 16 is to be opened in order to dispense water. Once, air has cleared from the device 1, treated water flows from the valve fluid outlet 18.

Figure 1 has arrows indicating the direction of fluid flow through the device 1. Figure 1 shows the agent dispensed by supply chamber 8 as zinc (Zn^{+}), but the invention is not limited thereto. Although not strictly limited thereto, the term agent covers nutrients, pharmaceuticals, nutraceuticals, nutricosmetics, or flavours, but the principle could as well serve for adding other chemicals, for example biocides.

As illustrated in Figure 1, the supply chamber 8 is provided outside and remote from the purifier housing 45. However, the supply chamber 8 could also be provided outside the purifier housing 45 but abutting the purifier housing 45. As further alternative, the supply chamber could share a common housing with the purification medium, for example a filter 4, although, a separating wall between the fluid outlet side 5 and inner volume 10 of the supply chamber 8 would be needed in order to use the principle. As a further alternative, the supply chamber 8 may be provided outside the purifier housing 45, and also the side stream return 9 is outside the purifier housing 45. Examples thereof are given below in connection with FIG. 4.

If the supply chamber 8 is not shaken regularly, there is a tendency of the agent to accumulated primarily at the bottom 42 of the supply chamber 8, resulting in a gradient of concentration of the agent in the supply chamber 8. This is a problem, if the chamber outlet 13 is at the top 43 of the supply chamber 8. The problem is overcome by a device according to Figure 2, showing a specific embodiment for explanation of the principles.

In Figure 2, the device has a fluid inlet 3 for providing fluid in fluid inlet side 2. The fluid crosses filter 4, which is indicated by two arrows across the filter 4, and is provided as cleaned fluid in fluid outlet side 5 for dispensing through fluid outlet 6. Due to differential pressure Δp , a side stream of fluid is driven from side stream outlet 7 through tubing 49 and chamber inlet 12 into the supply chamber 8. Supply chamber 8 contains a matrix 11 that provides an agent to the side stream. Upon enrichment with the agent, the side stream leaves the supply chamber again through chamber outlet 13. In order to equalize a possible concentration gradient in the supply chamber 8, the agent is extracted at different heights in the supply chamber 8; for this reason, the chamber outlet 13 has multiple openings 41', 41'', 41''' at different heights above the bottom 42. The openings 41', 41'', 41''' are provided as fluid transport channels between the inner volume 10 of the supply

chamber 8 and the fluid outlet side 5. As an alternative, the openings 41', 41'', 41''' may merge in a tube which is then connected to the outlet side. Alternative embodiments with tubes having multiple openings are described below.

5 As an alternative to a filter 4, the fluid inlet side 2 may be provided with a number of chemical stages for purifying the fluid in the fluid inlet side 2 upstream of the fluid outlet side 5. Fluid would then flow from fluid inlet 3 through the chemical stages and as purified fluid into the fluid outlet side 5.

10 Figures 3 shows an alternative embodiment of a supply chamber 8. The supply chamber 8 has a chamber inlet 12 that would be connected for fluid flow communication to side stream outlet 7 of a filtering unit (not shown in Figure 3), and the supply chamber has a chamber outlet 13 that would be connected to a side stream return 9 of the filtering unit, following the principle of Figure 1. For clarity
15 reasons, however, the filtering unit 47 is not shown.

The supply chamber 8 defines a fluid flow path from the chamber inlet 12 to the chamber outlet 13 through the inner volume 10 of the supply chamber 8. The supply chamber 8 comprises a transparent plastics material cylindrical section 33 at
20 least partly delimiting the inner volume 10 of the supply chamber, and bungs 34, 35 seal the ends of the cylindrical section 33. The chamber inlet 12 and the chamber outlet 13 allow passage of fluid through the bungs 34, 35.

The section 33, as shown, constitutes a wall of the supply chamber 8, whereas the
25 bungs 34, 35 seal the top 43 and bottom 42 thereof. The top bung 34 may be provided with a port for exchange and renewing of the matrix.

The supply chamber 8, specifically, the inner volume 10, contains a matrix 30 that is configured to dispense an agent at a low rate. For example, the matrix is soluble
30 and contains the agent as part of the matrix; when the matrix is dissolved slowly, the agent is freed from the matrix and dispensed to fluid in the inner volume 10 of the supply chamber 8. Such a matrix can have various forms and be made of various materials. As a non limiting example, water-soluble glass is illustrated in the form of two elongate water-soluble glass plates 30. The transparent nature of
35 the cylindrical section 33 enables the user to see the state of the water-soluble glass plates 30. The plates 30 are spaced apart from one another and held in parallel position by holders comprising brackets 31 at each end of the plates 30.

The brackets 31 in turn are mounted upon a number of fins 32 that hold the glass plates 30 spaced apart from bungs 34, 35, through which the brackets also are connected to the wall 33. The holders comprising the brackets 30 and the fins 32 are, typically, made of a thermoplastic polymer that is easy to mould into the desired shape, for example polypropylene or polyethylene. The Fins 32 together with brackets 31 act as a shock absorbing mount, thus, protecting the water-soluble glass plates 30 from shocks, for example, resulting from transportation or dropping, which might otherwise cause damage to the water-soluble glass plates 30.

As water follows the flow path from the chamber inlet 12 to the chamber outlet 13 the water flows over the plates 30 dissolving them and is supplemented with nutrients/pharmaceuticals.

Referring to Figure 3, the supply chamber 8 is shown with a dip-tube 40 as part of the chamber outlet 13 and extending into the inner volume 10 of the supply chamber 8. The dip-tube has a plurality of openings 41a, 41b, 41c, 41d, 41e provided at positions extending along its length in order to let the fluid from the supply chamber 8 exit at different heights over the bottom 42 of the supply chamber 8. There is provided an opening 41a adjacent the top 43 and an opening 41e near the bottom 42 of the supply chamber 8, in addition to a further opening 41b in the upper half of the supply chamber 8, an opening 41d in the lower half of the supply chamber, and an opening 41c approximately in the middle of the supply chamber 8. This arrangement provides means to remove water at a plurality of locations. The openings 41a-e face away from the plates 30 in order to avoid receiving water from the region adjacent to the plates 30. In certain embodiments, all openings face away from the plates 30.

A vent hole 44 is provided at the top 43 of the inner volume 10 of the supply chamber 8. This vent hole 44 is used to extract air from the supply chamber 8 in order to prevent accumulation thereof in the supply chamber 8. Once, air is extracted, fluid can be extracted from the supply chamber 8 through this vent hole 44. In order for the air to be guided towards the vent hole 44, the upper bung 34 has an inclination 48 sloping towards the vent hole 44.

FIG. 4a is a three-dimensional perspective cut-away drawing of a device 1 for purifying water, for example as a table-top system. FIG. 4b is a cross sectional side

view. The device 1 has an upper dirt water container 50 and a lower clean water tank 51. Water from the dirt water container 50 is driven by gravity through a filtering unit 47 and into the clean water tank 51. From the clean water tank 51, the purified water can be released through a drain valve 52. In more detail, the water from the dirt water container 50 flows through first tubing 53 and through the fluid inlet 3 of the filtering unit in order to enter the fluid inlet side and further through the internal filter medium for being purified. Typically, the filter medium is a membrane filter, for example a bundle of hollow fibre filter membranes. Having crossed the filter medium, the purified water enters the fluid outlet side and exits the filtering unit 47 through fluid outlet 6 and through second tubing 54 and enters the clean water tank 51 through a distributor 55. The filtering unit 47 also comprises a backwash connector 56 and a second fluid outlet 14.

The distributor 55 releases part of the purified water from the filtering unit 47 into the clean water tank 51 and part of the water through third tubing 57 into a supply chamber 8. In the supply chamber 8, the purified water is enriched with an agent, for example nutrients, from the matrix 11 and leaves the supply chamber 8 again through fourth tubing 58. The fourth tubing 58 crosses the wall 59 of the clean water tank 51 and enters drain valve 52.

In order for the water to flow freely into the clean water tank 51, there is provided a vent opening (not shown) such that air can leave the clean water tank 51 and provide space for the water. This vent opening is not shown in the drawing; it may be provided with a one way check valve in order to prevent back-contamination by dust and microbes. When water enters the nutrient chamber 8 through third tubing 57, air can leave the nutrient chamber 8 through a vent hole 59 in the top ceiling 60 over the nutrient chamber 8. Such a vent hole 59 is advantageously covered by a membrane or one way valve, for example a check valve in order to prevent contamination of the water in the supply chamber 8.

FIG. 5 illustrates the supply chamber 8 of FIG. 4 in greater detail. The supply chamber 8 comprises two matrices 30, for example in form of glass slabs, which are supported in brackets 31. Water leaves the nutrient chamber through tube 40, which has multiple openings 41. The openings 41 are provided at different heights from the bottom of the supply chamber 8. Although, the openings 41 are shown elongate, they could also have other shapes, for example circular. As a further alternative, a single elongate opening in the form of a long, narrow slot could be

provided, where the slot extends over a substantial distance as compared to the height of the supply chamber. Preferably, the term "substantial distance" in this respect means that the elongate opening has a length more than half of the height of the supply chamber; for example the slot extends from the lowest quarter of the supply chamber into the upper quarter of the supply chamber. Such a long slot equalizes the gradient of nutrients in the supply chamber when water is extracted.

It should also be mentioned that a similar effect is achieved with a tube 40 that is not provided inside the supply chamber 8 but at the outer side of the wall 62 of the supply chamber 8 if the wall 62 at the same time has likewise openings connecting the inner volume 10 of the supply chamber 8 with the tube 40

Illustrations of examples of such tubes with a single elongate opening 41' are shown in FIG. 7, with an oval form in FIG. 7a and a rectangular form in FIG. 7b. The forms can be of various other kinds, for example wiggling, spiralling or having a zig-zag shape. The single elongate outlet opening 41 has a longitudinal axis extending in a direction away from the bottom 42 of the supply chamber 8. The single elongate outlet opening 42, for example in the case of an oval form as in FIG. 7a, has an average length along a longitudinal axis 61 and has an average width normal to the longitudinal axis 61. Preferably, the average length is at least ten times larger than the average width. The term "longitudinal axis" must not necessarily be understood as a straight axis; for example, for a spiral form, the longitudinal axis would also spiral in the middle along the spiralling opening. Also, the longitudinal axis need not necessarily be perpendicular to the bottom of the supply chamber but can have some inclination.

FIG. 6 shows the drain valve 52 in greater detail, as part of the valve has been cut away in the drawing to show part of the interior of the drain valve 52. The drain valve 52 has a first water entrance 63 for receiving enriched water from the supply chamber through the fourth tubing 58 as illustrated in FIG. 4b. With reference to FIG. 6, the drain valve 52 has a second water entrance 64 for receiving water from the clean water tank 51. The water from the clean water tank 51 flows through the second water entrance 64, which is part of a venturi 70 and through the drain valve opening 73 for being released through a drain (not shown) in the bottom 67 of the drain valve 52, however, only if a handle 65 of a closure member 66 is turned into an open valve position. Water from the supply chamber 8 enters first water entrance 63 and flows from there into first valve channel 68. Only if the valve

handle 65 is in the open position, enriched water can flow from the first valve channel 68 into the second valve channel 69 through intermediate connector 74 and from the second valve channel 69 further into the waist 71 of the venturi 70. The fact of the drain valve 52 having a venturi 70 results in the water from the clean water tank 51 dragging minute amounts of enriched water along when flowing through the venturi 70. However, in order only to release water from the supply chamber when water is also emptied from the clean water tank 51, the drain valve 52 opens the intermediate connector 74 between the first valve channel 68 and the second valve channel 69 only when the drain valve 52 is opened into a position as shown in FIG. 6. This prevents overdosing and prevents emptying the supply chamber unintentionally. Closing of the intermediate connector 74 between the first valve channel 68 and the second channel 15, when the handle and the closure member 66 is turned, prevents enriched water to flow out of the drain valve 52 and into the clean water tank 51 when the closure member 66 is closed. Differential pressure assisted by gravity is the driving force for the side stream of water through the supply chamber 8 for providing enriched water to the main stream in the drain valve 52.

In order to prevent the closure member 66 of the drain valve 52 from being left open after possible emptying the clean water tank 51, the drain valve 52 has, optionally, an automatic closing mechanism, for example a spring load of the closure member 66. The drain valve 52 is a manual valve in the sense that a manual action is necessary for turning the handle in order to open the drain valve 52 for drainage of water from the clean water tank 51. Due to the automatic closing mechanism, the drain valve 52 will close as soon as the manual holding of the handle by the user is terminated. This is important, as an open valve after emptying of the clean water tank 51 would result in the enriched water from the supply chamber 8 slowly leaking through the venturi waist 71 and leading to a drying out of the supply chamber 8, which should be avoided.

According to the above described principle of the invention, the supply chamber 8 is connected with its entrance as well as exit to the outlet side of the device 1 for using the differential pressure in the outlet side as a driving force. In this connection, it is readily recognised that the term "outlet side" in the embodiment of FIG. 4 comprises the combination of

- the volume in filtering unit 47 downstream of the medium,
- the second tubing 54 between the filtering unit 47 and the distributor 7,

- the distributor 55,
- the clean water tank 51, and
- the first water entrance of drain valve 52.

5 Thus, purified water is provided to the supply chamber 8 from a first connection to the outlet side, namely the connection to the distributor 55; this connection is analogue to the side stream outlet 7 in FIG. 1. The enriched water from the supply chamber 8 is supplied to a second connection to the downstream side, which is the second valve channel 69 ending in the waist 71 of the venturi 70; this corresponds
10 to the side stream return 9 in FIG. 1.

Various modifications will be readily apparent to a person of ordinary skill in the art without departing from the scope of the accompanying claims.

15 The various embodiments above can readily be combined with the embodiments in the co-pending patent application PCT/DK2011/050132 by the same applicant, which is incorporated herein by reference.

Aspects

20 In the following a number of interrelated aspects are given in various terms. The aspects can be combined alone or in groups with above features.

Aspect 1. A device (1) for purifying and enriching water, the device comprising:
a medium (4) for water purification;

25 a fluid inlet (3) into an inlet side (2) upstream of the medium (4) and a fluid outlet (6) from an outlet side (5) downstream of the medium (4) with a flow path from the fluid inlet (3) through the inlet side (2), through the medium (4), through the outlet side (5), and to the fluid outlet (6) for providing purified water in the outlet side (5);

30 a supply chamber (8) for supplying an agent to the purified water, the supply chamber (8) having a chamber inlet (12) and a chamber outlet (13) connecting an inner volume (10) of the supply chamber (8) with the outlet side (5) at different positions for drawing purified water from the outlet side (5) through the chamber inlet (12), through the inner volume (10), through the chamber outlet (13), and
35 back to the outlet side (5) by differential pressure between the chamber inlet (12) and the chamber outlet (13);

a matrix (11, 30) inside the supply chamber (8), the matrix (11, 30) comprising a gradually releasable agent for providing agent-enriched water upon contact with the water in the inner volume (10) of the supply chamber (8);

5 wherein the chamber outlet (13) has multiple outlet openings (41a-e, 41', 41'', 41''') at different distances from a bottom (42) of the supply chamber (8) for extracting water from the inner volume (10) of the supply chamber (8) at different positions.

Aspect 2. A device according to aspect 1, wherein the chamber outlet (13) comprises a tube (40) extending into the inner volume (10) of the supply chamber (8), the tube (40) having a plurality of openings (41a-e) spaced along its length communicating with the agent-enriched water in the supply chamber (8) at different distances from the bottom (42) of the supply chamber (8).

Aspect 3. A device according to aspect 1, wherein the chamber outlet (13) comprises multiple fluid connections (41', 41'', 41''') to the outlet side (5), the fluid connections (41', 41'', 41''') communicating with the inner volume (10) of the supply chamber (8) at different distance from a bottom (42) of the supply chamber (8).

Aspect 4. A device according to any preceding aspect, wherein at least one of the openings (41a, 41b, 41') is provided in an upper half of the inner volume (10) of the supply chamber (8) and at least one of the openings (41d, 41e, 41''') is provided in the lower half of the inner volume (10) of the supply chamber (8).

Aspect 5. A device according to aspect 4, wherein at least one of the openings (41a, 41b) is provided in an upper half of the inner volume (10) of the supply chamber (8) but a distance remote from a top (43) of the inner volume (10) of the supply chamber (8).

Aspect 6. A device according to any preceding aspect, wherein at least one of the openings (41e) is provided in a lower quarter of the inner volume (10) of the supply chamber (8).

Aspect 7. A device according to any preceding aspect, wherein the supply chamber (8) has a vent hole (44) at a top (43) of the inner volume (10) of the supply chamber (8).

Aspect 8. A device according to aspect 7, wherein the top (43) of the inner volume (10) of the supply chamber (8) has an inclination (42) or concavity for accumulating air in a highest part of the inclination (48) or concavity, and wherein the vent hole (44) is in the highest part.

Aspect 9. A device according to aspect 7 or 8, wherein the vent hole (44) is part of the chamber outlet (13).

Aspect 10. A device according to any preceding aspect, wherein the chamber outlet (13) is closer to the fluid outlet (6) than the chamber inlet (12).

Aspect 11. A device according to any preceding aspect, wherein the chamber inlet (12) is in a lower quarter of the inner volume (10) of the supply chamber (8).

5 Aspect 12. A device according to aspect 11, wherein the chamber inlet (12) is at the bottom (42) of the inner volume (10) of the supply chamber (8).

Aspect 13. A device according to any preceding aspect, wherein the water purifying medium (30) is provided in a purifier housing (45) with the fluid inlet (3) and the fluid outlet (6), and the supply chamber (8) is provided outside the purifier housing (45).

Aspect 14. A device according to any preceding aspect, wherein the supply chamber (8) has a reusable port for access to the inner volume (10) of the supply chamber (8) and configured for supply of a new matrix (11, 30) into the inner volume (10) after exhaustion of the agent.

15 Aspect 15. A device according to any preceding aspect, wherein the matrix (11, 30) is water soluble.

Aspect 16. A device according to aspect 15, wherein the matrix (30) is water soluble glass with an agent dissolved in the glass matrix.

20 Aspect 17. A device according to aspect 15, wherein the glass (30) is sintered water soluble glass and the nutrient is provided in voids within the sintered glass.

Aspect 18. A device according to any preceding aspect, wherein the matrix is provided in form of a slab (30) having a thickness at least a factor of 10 less than a length of the slab.

25 Aspect 19. A device according to any preceding aspect, wherein the supply chamber (8) comprises a mount (31, 32) for the matrix (30), the mount having means (32) for shock absorption.

Aspect 20. A device according to aspect 19, wherein the means for shock absorption comprises resilient fins (32) connecting a chamber wall (33) with a holder (31) of the matrix (30).

30 Aspect 21. A device according to any preceding aspect, wherein the water purifying medium is a filtration membrane.

Aspect 22. A device according to aspect 21, wherein the filtration membrane comprises multiple hollow membrane fibers.

35 Aspect 23. A device according to any preceding aspect, wherein the agent comprises nutrients.

Aspect 24. A device according to any preceding aspect, wherein the agent comprises pharmaceuticals.

Aspect 25. A device according to any preceding aspect, wherein the agent comprises nutraceuticals.

Aspect 26. A device according to any preceding aspect, wherein the agent comprises nutricosmetics.

5 Aspect 27. A device according to any preceding aspect, wherein the agent comprises flavours.

Aspect 28. A device according to any preceding aspect, wherein the agent comprises iodine, zinc, selenium, iron, magnesium, calcium, or a combination thereof.

10 Aspect 29. A device according to any preceding aspect, wherein the agent comprises vitamins or folic acid or a combination thereof.

Aspect 30. A device according to aspect 28, wherein the vitamins are selected from the group consisting of: vitamin A, vitamin B1, vitamin B2, vitamin B6, vitamin B12, niacin, pantothenate, biotin, vitamin C, vitamin D, and vitamin K.

15 Aspect 31. A device according to aspect 13, wherein the purifier housing (45) has a maximum dimension of 50 cm.

Aspect 32. A device according to aspect 31, wherein the purifier housing (45) in combination with the supply chamber (8) are of the portable type.

20 Aspect 33. A method for filtering water and dispensing an agent into said filtered water, the method comprising passing water through a device (1) according to any of the preceding aspects, from said fluid inlet (6) to said fluid outlet (6).

Aspect 34. A method according to aspect 33, wherein the method comprises orienting the device (1) with a top (43) of the supply chamber (8) being upwards.

25 Aspect 35. A device (1) for purifying and enriching water, the device comprising:
a medium (4) for water purification;
a fluid inlet (3) into an inlet side (2) upstream of the medium (4) and a fluid outlet (6) from an outlet side (5) downstream of the medium (4) with a flow path from the fluid inlet (3) through the inlet side (2), through the medium (4), through the outlet side (5), and to the fluid outlet (6) for providing purified water in the outlet side (5);
30

a supply chamber (8) for supplying an agent to the purified water, the supply chamber (8) having a chamber inlet (12) and a chamber outlet (13) connecting an inner volume (10) of the supply chamber (8) with the outlet side (5) at different positions for drawing purified water from the outlet side (5) through the chamber inlet (12), through the inner volume (10), through the chamber outlet (13), and
35 back to the outlet side (5) by differential pressure between the chamber inlet (12) and the chamber outlet (13);

a matrix (11) inside the inner volume (10) of the supply chamber (8), the matrix (11, 30) comprising a gradually releasable agent for providing agent-enriched water upon contact with the water in the supply chamber (8);

5 wherein the water purifying medium (4) is provided in a purifier housing (45) with the fluid inlet (3) and the fluid outlet (6), and wherein the supply chamber (8) is provided outside the purifier housing (45).

Aspect 36. A device according to aspect 35, wherein the supply chamber (8) is provided remote from the purifier housing (45) with the inner volume (10) of the supply chamber (8) being fluid-flow-connected by tubing (46, 49) with the outlet
10 side (5).

Aspect 36. A device (1) for water purification, the device (1) comprising a medium (4) for water purification;

15 a fluid inlet (3) into an inlet side (2) upstream of the medium (4) and a fluid outlet (6) from an outlet side (5) downstream of the medium (4) with a flow path from the fluid inlet (3) through the inlet side (2), through the medium (4), through the outlet side (5), and to the fluid outlet (6) for providing purified water in the outlet side (5);

20 a supply chamber (8) for supplying an agent to the purified water, the supply chamber (8) having a chamber inlet (12) and a chamber outlet (13) connecting an inner volume (10) of the supply chamber (8) with the outlet side (5) for flow of purified water from the outlet side (5) through the chamber inlet (12), through the inner volume (10), through the chamber outlet (13), and back to the outlet side (5);

25 a clean water tank (50) as part of the outlet side (5) for accumulating purified water downstream of the medium (4);

a drain valve (52) having a first connection (70, 71) to the clean water tank for draining water from the clean water tank (51) through the drain valve (52); the drain valve (52) having a second connection (63, 58) to the chamber outlet (13) for
30 receiving enriched water from the supply chamber (8); the drain valve (52) having means (68, 69, 70, 71) for mixing the water from the supply chamber (8) with the water from the clean water tank (51); wherein the drain valve (52) has a closure member (65) which has means for opening and closing for drain of water from the clean water tank (51) simultaneously with opening and blocking the means for
35 mixing the water.

Aspect 37. A device (1) for water purification, the device (1) comprising

- a filtering unit (47) containing a medium (4) for water purification;

- a dirt water container (50) connected to the filtering unit upstream of the medium (4) for providing water to the medium (4) for purification;

- a clean water tank (51) connected to the filtering unit (48) downstream of the medium (4) for receiving purified water from the filtering unit (47),

5 - a supply chamber (8) for supplying an agent to the purified water, the supply chamber (8) having a chamber inlet (12) and a chamber outlet (13), the chamber inlet (12) being flow connected to the filtering unit downstream of the medium (4) for receiving purified water from the filtering unit (47),

10 - a drain valve (52) having a first connection (70, 71) to the clean water tank (51) for draining water from the clean water tank (51) through the drain valve (52); the drain valve (52) having a second connection (63, 58) to the chamber outlet of the supply chamber (8) for receiving enriched water from the supply chamber (8); the drain valve (52) having means (68, 69, 70, 71) for mixing the water from the supply chamber (8) with the water from the clean water tank (51); wherein the
15 drain valve (52) has a closure member (65) which has means for opening and closing for the drain of water from the clean water tank (51) simultaneously with opening and blocking the means for mixing the water.

Aspect 38. A device according to aspect 36 or 37, wherein the means (68, 69, 70, 71) for mixing the water comprises a first valve channel (68) flow-connected to the
20 chamber outlet (13) for receiving enriched water from the supply chamber (8); and wherein the means for mixing the water comprises a second valve channel (69) flow-connected to the clean water tank (52) for providing enriched water for mixing with the water from the clean water tank (51), and wherein the closure member (66) has means for opening or blocking for flow from the first flow channel (68) to
25 the second flow channel (69)

Aspect 39. A device according to aspect 38, wherein the means for mixing the water comprise a venturi (70) with a waist portion (71) for a stream of water from the clean water tank (51) through the venturi (70) when draining the clean water tank (51) through the drain valve (52), wherein the second valve channel (69)
30 communicates with the venturi (70) for providing enriched water to the stream of clean water through the venturi (70).

Aspect 40. A device according to any one of the aspects 36-39, wherein the drain valve (52) comprises a closure member (65) with manual means for holding open the closure member (65) by the hand of a user when draining water from the clean
35 water tank (51), and wherein the drain valve (52) has an automatic closure mechanism for closing the closure member (65) automatically when the user terminates holding the valve open.

Reference signs

Reference signs used in the figures are as follows:

- | | |
|----|---|
| 5 | 1 – device for purifying and enriching water |
| | 2 – fluid inlet side |
| | 3 – fluid inlet (into the fluid inlet side 2) |
| | 4 – medium |
| | 5 – fluid outlet side |
| 10 | 6 – fluid outlet (from fluid outlet side 5) |
| | 7 – side-stream outlet |
| | 8 – supply chamber |
| | 9 – side-stream return |
| | 10 - inner volume of supply chamber 8 |
| 15 | 11 – matrix |
| | 12 – chamber inlet |
| | 13 – chamber outlet |
| | 14 – second fluid outlet (from fluid inlet side 2) |
| | 15 – valve at second fluid outlet (14) |
| 20 | 16 – valve for purified water |
| | 17 – valve fluid outlet at second fluid outlet 2 |
| | 18 – valve fluid outlet for purified water |
| | 19 – wall |
| | 30 – water-soluble glass plate |
| 25 | 31 – bracket |
| | 32 – resilient fins |
| | 33 – transparent plastics material cylindrical section |
| | 34 – upper bung |
| | 35 – lower bung |
| 30 | 40 – tube |
| | 41, 41', 41'', 41''', 41'''' – opening in dip tube |
| | 42 – bottom of supply chamber 8 |
| | 43 – top of supply chamber 8 |
| | 44 - vent hole |
| 35 | 45 - purifier housing |
| | 46 – tubing from chamber outlet 13 to side stream return 9. |
| | 47 – filtering unit |

- 48 – inclination
- 49 – tubing from side stream outlet 7 to chamber inlet 12
- 50 – dirt water container
- 51 – clean water tank
- 5 52 – drain valve
- 53 – first tubing from dirt water container 50 to filtering unit 47
- 54 – second tubing from filtering unit 47 to distributor 55
- 55 – distributor
- 56 – backflush connector
- 10 57 – third tubing from distributor 55 to supply chamber 8
- 58 – fourth tubing between supply chamber 8 and drain valve 52
- 59 – vent hole of supply chamber 8
- 60 – top ceiling of supply chamber 8
- 61 – longitudinal axis of the single outlet opening 41
- 15 62 – outer wall of the supply chamber 8
- 63 – first water entrance of drain valve 52
- 64 – second water entrance of drain valve 52
- 65 – closure member with handle
- 66 – valve drain
- 20 67 – bottom of drain valve 52
- 68 – first valve channel
- 69 – second valve channel
- 70 – venturi
- 71 – waist of venturi 70
- 25 72 – opening in waist 71 of venturi 70
- 73 – drain valve opening
- 74 – intermediate connector between first 68 and second valve channel 69

CLAIMS

1. A device (1) for providing enriched drinking water by purifying and enriching the water, the device comprising:

5 a medium (4) for water purification;

a fluid inlet (3) into an inlet side (2) upstream of the medium (4) and a fluid outlet (6) from an outlet side (5) downstream of the medium (4) with a flow path from the fluid inlet (3) through the inlet side (2), through the medium (4), through the outlet side (5), and to the fluid outlet (6) for providing purified water in the outlet side (5);

10 a supply chamber (8) for supplying an agent to the purified water, the supply chamber (8) having a chamber inlet (12) and a chamber outlet (13), the chamber inlet (12) and the chamber outlet (13) connecting an inner volume (10) of the supply chamber (8) with the outlet side (5) at different locations at the outlet side (5) for drawing purified water from the outlet side (5) through the chamber inlet (12), through the inner volume (10), through the chamber outlet (13), and back to the outlet side (5) by differential pressure between the chamber inlet (12) and the chamber outlet (13);

20 a matrix (11, 30) inside the inner volume (10) of the supply chamber (8), the matrix (11, 30) comprising a gradually releasable agent for providing agent-enriched water in the inner volume (10) upon contact with the water in the inner volume (10) of the supply chamber (8);

wherein the chamber outlet (13) comprises multiple outlet openings (41a-e, 41', 41'', 41''') at different distances from a bottom (42) of the supply chamber (8) for extracting water from the inner volume (10) of the supply chamber (8) at different positions, or the chamber outlet (13) comprises a single elongate outlet opening (41) with a longitudinal axis extending in a direction away from the bottom (42) of the supply chamber (8), the single elongate outlet opening (41) having an average length along the longitudinal axis (62) and having an average width normal to the longitudinal axis (62), wherein the average length is at least ten times larger than the average width.

2. A device according to claim 1, wherein, for the flow of water from the chamber inlet (12) to the chamber outlet (13), the chamber inlet (12) communicates with the chamber outlet (13) only through the single elongate outlet opening or the multiple outlet openings (41a-e, 41', 41'', 41''') for ensuring that water from the chamber inlet (12) flows into the inner volume (10) and is mixed

with the enriched water in the inner volume (10) before leaving the inner volume through the elongate outlet opening or the multiple outlet openings (41a-e, 41', 41'', 41''').

5 3. A device according to claim 2, wherein the single elongate outlet opening or the multiple outlet openings are provided remote at a distance from the matrix.

10 4. A device according to any one of the claims 1-3, wherein the chamber outlet (13) comprises a tube (40) that communicates with the inner volume (10) of the supply chamber (8) through the single elongate outlet opening (41) or through the multiple outlet openings (41a-e).

15 5. A device according to claim 4, wherein the chamber outlet (13) comprises a tube (40) extending into the inner volume (10) of the supply chamber (8), the tube (40) having the single elongate outlet opening (41) or having the multiple outlet openings (41a-e) spaced along its length, the single elongate outlet opening (41) or the multiple outlet openings (41a-e) communicating with the agent-enriched water of the inner volume in the supply chamber (8) at different distances from the bottom (42) of the supply chamber (8).

20 6. A device according to claim 5, wherein the single elongate outlet opening (41) or the multiple outlet openings (41a-e) in the tube (40) face away from the matrix (11, 30).

25 7. A device according to anyone of the claims 1-3, wherein the chamber outlet (13) comprises a single elongate outlet opening (41) or multiple fluid connections (41', 41'', 41''') connected to the outlet side (5), the single elongate outlet opening (41) multiple fluid connections (41', 41'', 41''') communicating with the inner volume (10) of the supply chamber (8) at different distance from a bottom (42) of the supply chamber (8).

30 8. A device according to claim 7, wherein each of the multiple fluid connections (41', 41'', 41''') individually communicates with the outlet side (5) and communicates individually with the inner volume (10) of the supply chamber (8) at different distance from a bottom (42) of the supply chamber (8).

9. A device according to any preceding claim, wherein at least one of the multiple outlet openings (41a, 41b, 41') is provided in an upper half of the inner volume (10) of the supply chamber (8) and at least one of the multiple outlet openings (41d, 41e, 41'') is provided in the lower quarter of the inner volume (10) of the supply chamber (8).

10. A device according to claim 9, wherein at least one of the multiple outlet openings (41a, 41b) is provided in an upper half of the inner volume (10) of the supply chamber (8) but a distance remote from a top (43) of the inner volume (10) of the supply chamber (8).

11. A device according to any preceding claim, wherein the supply chamber (8) has a vent hole (44) at a top (43) of the inner volume (10) of the supply chamber (8), and wherein the top (43) has an inclination (42) or concavity for accumulating air in a highest part of the inclination (48) or concavity, and wherein the vent hole (44) is in the highest part.

12. A device according to any preceding claim, wherein the water purifying medium (4) is provided in a purifier housing (45), and the supply chamber (8) is provided outside the purifier housing (45).

13. A device according to any preceding claim, wherein the device is of the portable type.

14. A device according to any preceding claim, wherein the device comprises a clean water tank (51) as part of the outlet side (5) for accumulating purified water downstream of the medium (4).

15. A device according to claim 14, wherein the device comprises a drain valve (52) having a first connection (70, 71) to the clean water tank (51) for draining water from the clean water tank (51) through the drain valve (52); the drain valve (52) having a second connection (63, 58) to the chamber outlet (13) for receiving enriched water from the supply chamber (8); the drain valve (52) having means (68, 69, 70, 71) for mixing the water from the supply chamber (8) with the water from the clean water tank (51); wherein the drain valve (52) has a closure member (66) that has means for opening and closing for drain of water from the clean water

tank (51) simultaneously with opening and blocking the means (68, 69, 70, 71) for mixing the water.

5 16. A device according to claim 15, wherein the means (68, 69, 70, 71) for mixing the water comprises a first valve channel (68) flow-connected to the chamber outlet (13) for receiving enriched water from the supply chamber (8); and wherein the means (68, 69, 70, 71) for mixing the water comprises a second valve channel (69) flow-connected to the clean water tank (51) for providing enriched water for mixing with the water from the clean water tank (52), and wherein the
10 closure member (66) has means for opening or blocking for flow from the first flow channel (68) to the second flow channel (69).

15 17. A device according to claim 15 or 16, herein the means for mixing the water comprise a venturi (70) with a waist portion (71) for a stream of water from the clean water tank (51) through the venturi (70) when draining the clean water tank (51) through the drain valve (52), wherein the second valve channel (69) communicates with the venturi (70) for providing enriched water to the stream of clean water through the venturi (70).

20 18. A device according to claim 15, 16, or 17, wherein the drain valve (52) comprises a closure member (66) with manual means (65) for holding open the closure member (65) by the hand of a user when draining water from the clean water tank (51), and wherein the drain valve (52) has an automatic closure mechanism for closing the closure member (65) automatically when the user
25 terminates holding the drain valve (52) open by the manual means (65).

30 19. A device according to anyone of the claims 14-18, wherein the device comprises a dirt water container (50) located above the medium (4) and connected to an upstream side of the medium and located above the clean water tank (52) for driving water from the dirt water container (50) through the medium (4) and into the clean water tank (51) by gravity.

35 20. A device according to any preceding claim, wherein the matrix (30) is water soluble glass with an agent dissolved in the glass matrix.

21. A device according to claim 20, wherein the glass (30) is sintered water soluble glass and the nutrient is provided in voids within the sintered glass.

22. A device according to any preceding claim, wherein the matrix is provided in form of a slab (30) having a thickness at least a factor of 10 less than a length of the slab.

5

23. A device according to any preceding claim, wherein the supply chamber (8) comprises a mount (31, 32) for the matrix (30), the mount having means (32) for shock absorption.

10

24. A device according to claim 23, wherein the means for shock absorption comprises resilient fins (32) connecting a chamber wall (33) with a holder (31) of the matrix (30).

15

25. A device according to any preceding claim, wherein the water purifying medium is a filtration membrane.

26. A device according to claim 25, wherein the filtration membrane comprises multiple hollow membrane fibers.

20

27. A device according to any preceding claim, wherein the agent comprises nutrients, pharmaceuticals, nutraceuticals, nutricosmetics, flavours, iodine, zinc, selenium, iron, magnesium, calcium, vitamins, folic acid or a combination thereof.

25

28. A device according to claim 27, wherein the vitamins are selected from the group consisting of: vitamin A, vitamin B1, vitamin B2, vitamin B6, vitamin B12, niacin, pantothenate, biotin, vitamin C, vitamin D, and vitamin K.

30

29. A device (1) according to claim 4, wherein the chamber outlet (13) comprises a tube (40) that is connected to the inner volume (10) of the supply chamber (8) through the single elongate outlet opening (41) or through the multiple outlet openings (41a-e); wherein the single elongate opening (41) extends from the lower quarter of the of the inner volume (10) to the upper half of the inner volume (10) of the supply chamber (8), or wherein at least one of the multiple outlet openings (41a, 41b, 41') is provided in an upper half of the inner volume (10) of the supply chamber (8) and at least one of the multiple outlet openings (41d, 41e, 41'') is provided in the lower half of the inner volume (10) of the supply chamber (8); wherein the device comprises a clean water tank (51) as part of the

35

outlet side (5) for accumulating purified water downstream of the medium (4); wherein the device comprises a dirt water container (50) located above the medium (4) and connected to an upstream side of the medium; the dirt water container being above the clean water tank (52) for driving water from the dirt water container (50) through the medium (4) and into the clean water tank (51) by gravity.

30. A device according to claim 28, wherein the device comprises a drain valve (52) having a first connection (70, 71) to the clean water tank (51) for draining water from the clean water tank (51) through the drain valve (52); the drain valve (52) having a second connection (63, 58) to the chamber outlet (13) for receiving enriched water from the supply chamber (8); the drain valve (52) having means (68, 69, 70, 71) for mixing the water from the supply chamber (8) with the water from the clean water tank (51); wherein the drain valve (52) has a closure member (66) that has means for opening and closing for drain of water from the clean water tank (51) simultaneously with opening and blocking the means (68, 69, 70, 71) for mixing the water.

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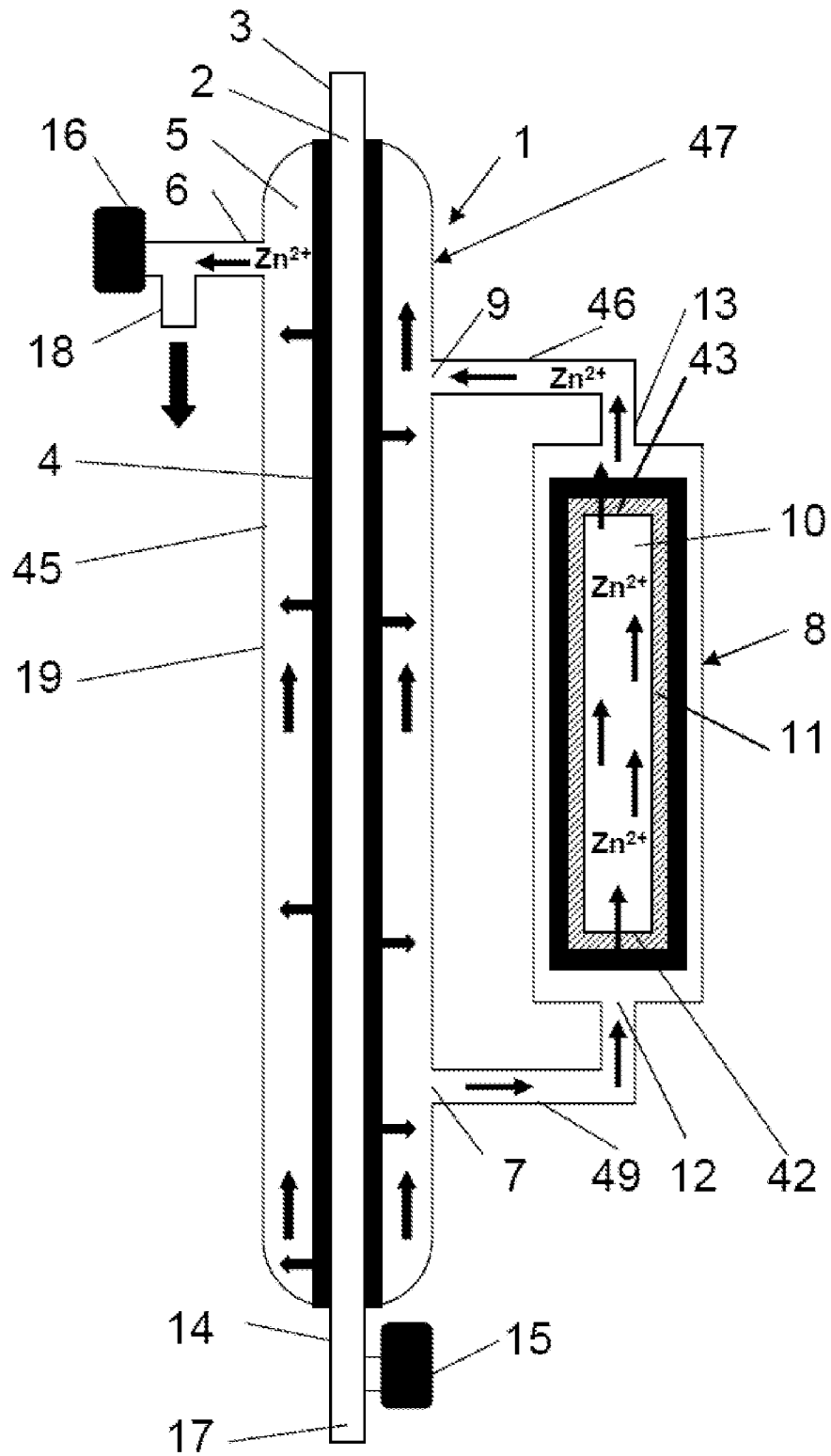


FIG. 1

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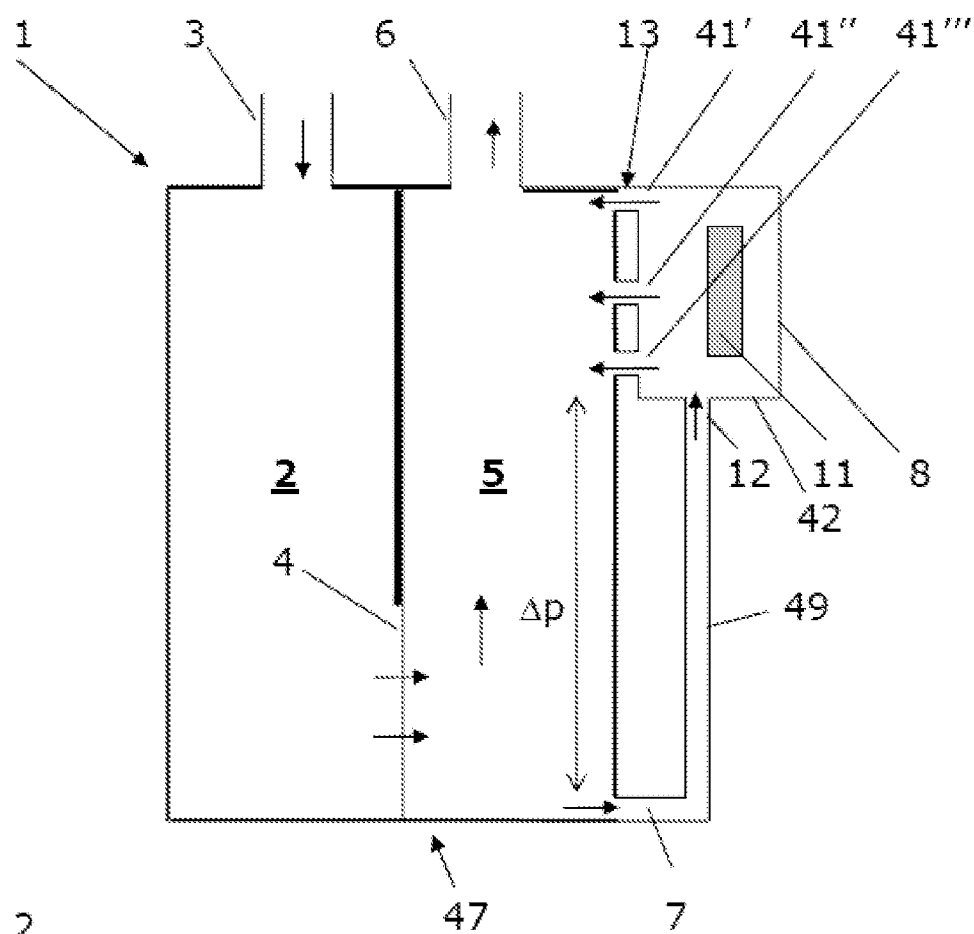


FIG. 2

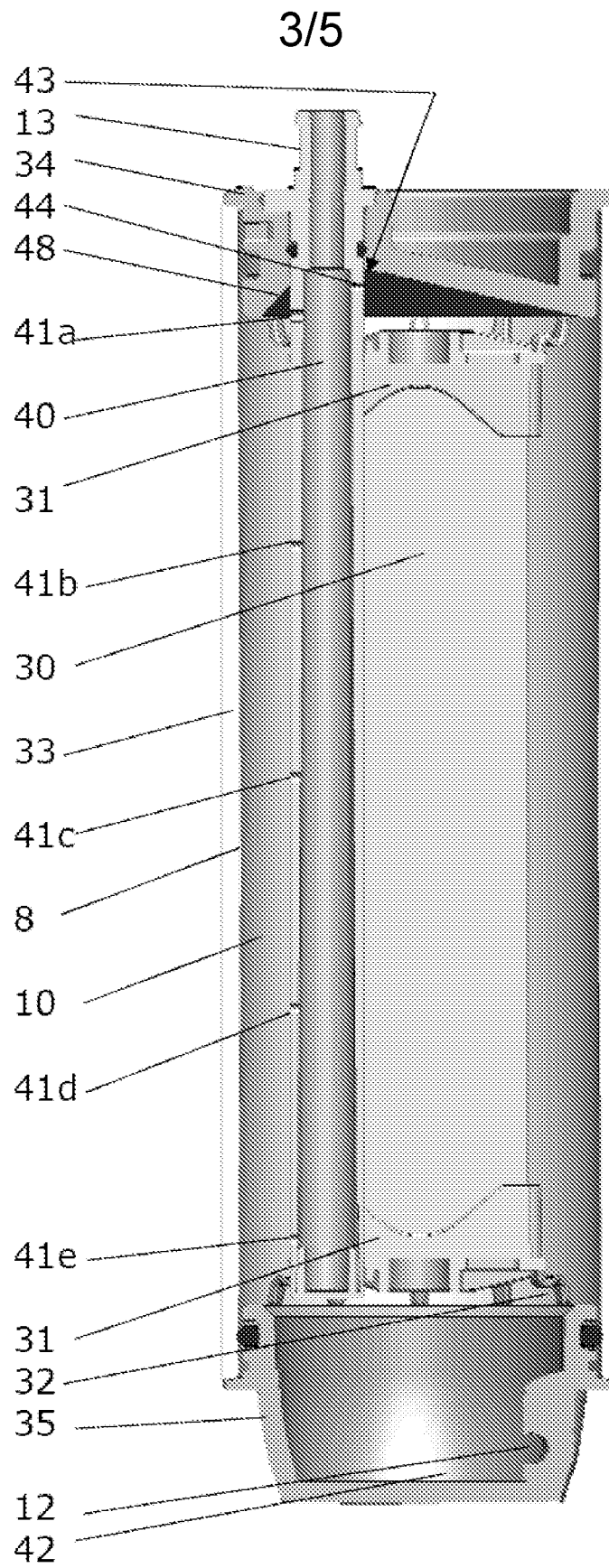


FIG. 3

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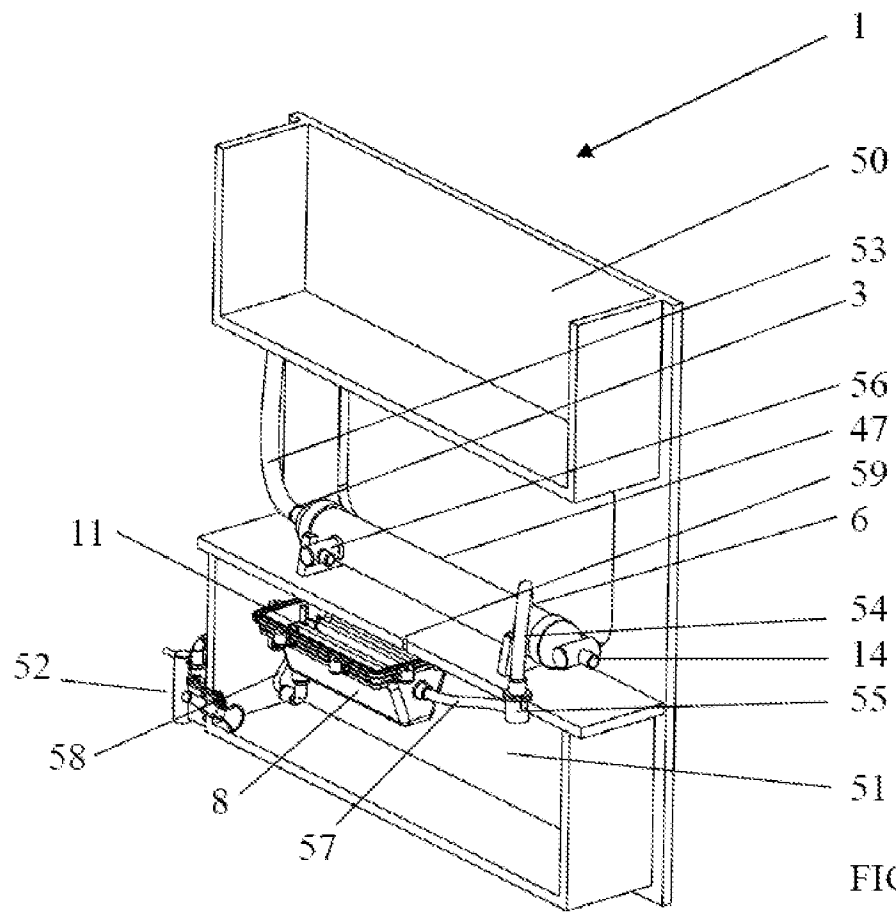


FIG. 4a

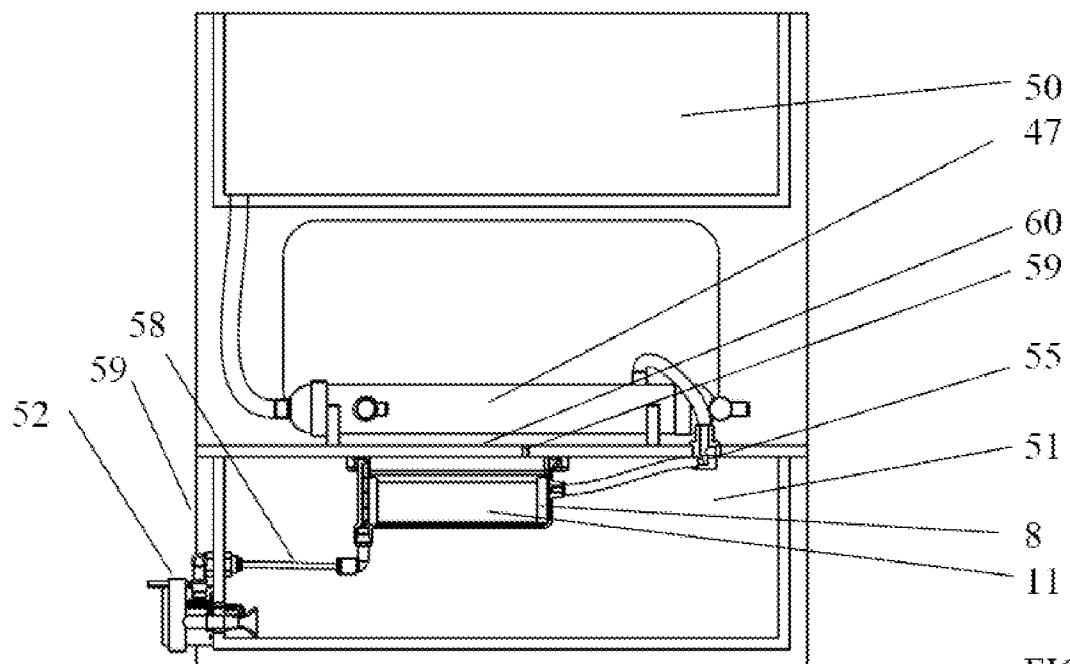


FIG. 4b

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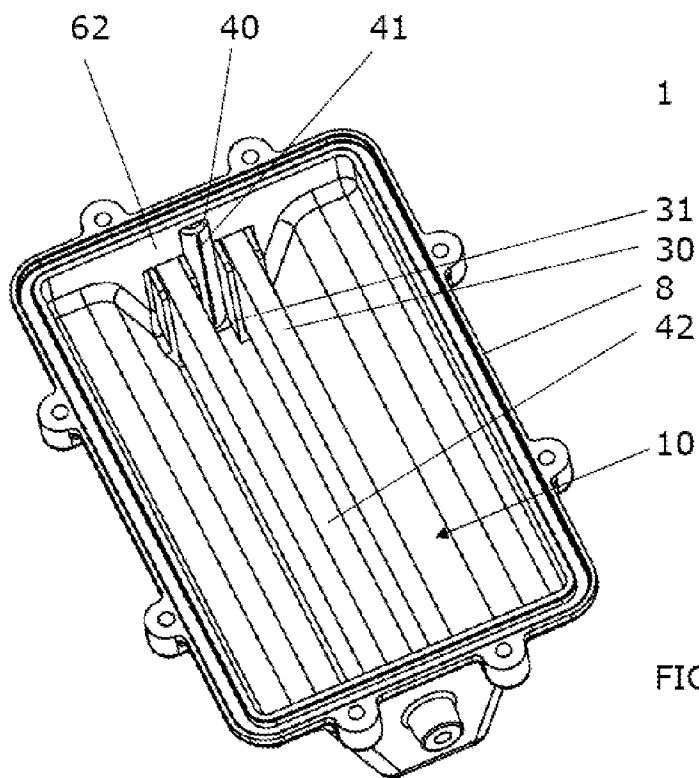


FIG. 5

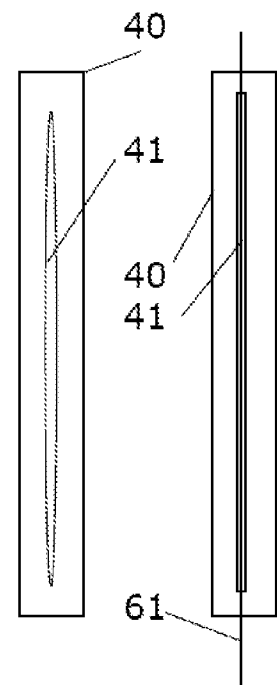


FIG. 7

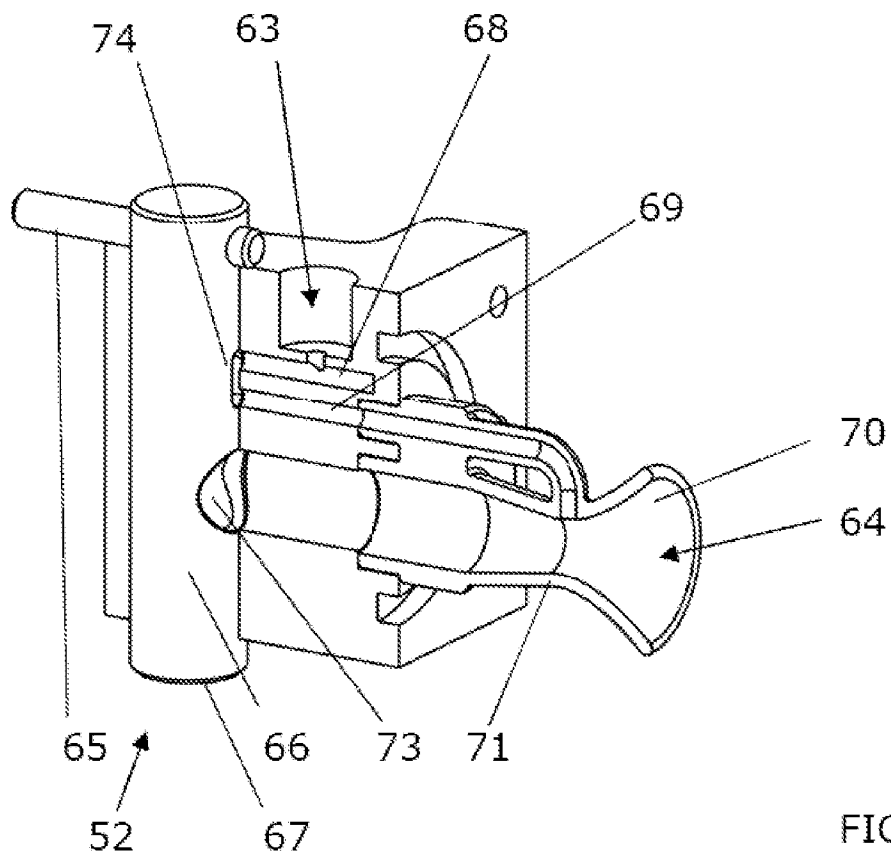


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK2012/050055

A. CLASSIFICATION OF SUBJECT MATTER		
IPC: C02F1/68 (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC: B01D, C02F; ECLA: A47G, B01D, C02F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
DK, NO, FI, SE: C02F1/68		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EPODOC, WPI, English, German and French full text databases		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4419233 A (BAKER) 6 December 1983, see the whole document.	1-3, 7, 8, 12, 14, 19, 23, 25, 26
X	GB 2200901 A (PHILLIPS et al.) 17 August 1988, see the whole document.	1, 4-6, 9-10, 13, 20-23, 27 and 28
A	FR 1289749 A (KLEIN & SOHN KARL) 6 April 1962.	-
A	US 5976385 A (KING) 2 November 1999.	-
A	US 5897770 A (HATCH et al.) 27 April 1999.	-
A	WO 2010043940 A1 (PALMER et al.) 22 April 2010.	-
A	US 4584106 A (HELD) 22 April 1986.	-
A	GB 2164557 A (STC PLC) 26 March 1986.	-
A	EP 0140538 A2 (STANDARD TELEPHONES NAD CABLES PUBLIC LIMITED COMPANY) 8 May 1985.	-
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents:		
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search	Date of mailing of the international search report	
25/04/2012	30/04/2012	
Name and mailing address of the ISA Nordic Patent Institute Helgeshøj Allé 81 DK - 2630 Taastrup, Denmark. Facsimile No. + 45 43 50 80 08.	Authorized officer Verner Holm Telephone No. + 45 43 50 83 54.	

INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK2012/050055

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is only those claims for which fees were paid, specifically claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK2012/050055

A. The subject matter of parts of claims 1-30 describing a device for providing enriched drinking water comprising a medium for water purification, a fluid inlet, a fluid outlet, a supply chamber having a chamber inlet and a chamber outlet wherein the chamber outlet comprises multiple outlet openings at different distances from a bottom.

B. The subject matter of parts of claims 1-30 describing a device for providing enriched drinking water comprising a medium for water purification, a fluid inlet, a fluid outlet, a supply chamber having a chamber inlet and a chamber outlet wherein the chamber outlet comprises a single elongate outlet opening with a longitudinal axis extending in a direction away from a bottom.

The common subject matter between the two inventions A and B is a device for providing enriched drinking water comprising a medium for water purification, a fluid inlet, a fluid outlet, a supply chamber having a chamber inlet and a chamber outlet. However the common subject matter lacks novelty (See US 4419233 A). Neither have we found a common inventive concept linking the two inventions together. Therefore the two inventions A and B lack unity of invention. cf Rule 13.2 PCT

D1 describes a chlorinator (22) and a water recirculating system (12) for a swimming pool (10). The water recirculating system (12) comprises a drain (16) for intake of water from the swimming pool (10), the water is pumped from the drain (16) to a filter (18) and back into the swimming pool (10). The exit of the recirculated water is connected to the chlorinator (22). The chlorinator comprises an inlet (43) where water from the swimming pool (10) can enter a container (35) comprising a water treatment agent such as chlorine tablets (37). The container (35) further comprises inlet apertures (39) and outlet apertures (40) such that water can flow through the chlorinator only through the container (35). Water is driven from the inlet (43) to a return pipe section (49) by a difference in pressure between these two places. Therefore the common subject matter lacks novelty.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK2012/050055

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5244579 A (HORNER et al.) 14 September 1993.	-
A	US 2004168963 A1 (KING et al.) 2 September 2004.	-
A	EP 2060539 A2 (D.A.W. ENTERPRISES LIMITED) 20 May 2009.	-

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/DK2012/050055

Patent document cited in search report / Publication date	Patent family member(s) / Publication date
US 4419233 A 1983-12-06	None
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