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(54) Title: APPARATUS AND METHOD FOR TREATING A LIQUID

(57) Abstract: An apparatus for treating a liquid includes a reservoir (5) for liquid to be treated and a vessel (2) for collecting treated liquid. The apparatus includes a supporting part for holding the reservoir (5) above a bottom wall (4) of an interior of the vessel (2). The reservoir (5) is arranged to support at least one liquid treatment device such as to force liquid to be treated to flow from the reservoir (5) into the vessel (2) through the liquid treatment device. The apparatus includes a resilient part (8) arranged to exert a lifting force for increasing a distance between the reservoir (5) and the bottom wall (4) on at least an end section of the reservoir (5) closest to the bottom wall (4) to maintain a liquid level in the reservoir (5) above a liquid level in the vessel (2).

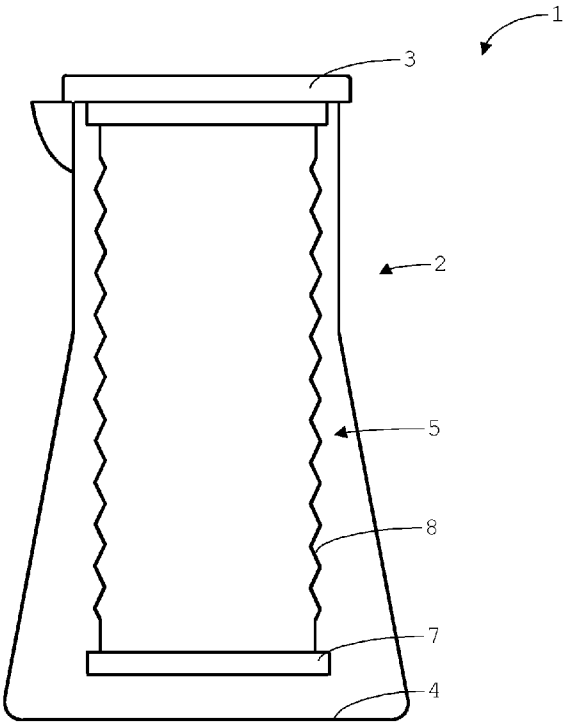


Fig. 2

WO 2015/128372 A1

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APPARATUS AND METHOD FOR TREATING A LIQUID

The invention relates to an apparatus for treating a liquid, including:

a reservoir for liquid to be treated; and

a vessel for collecting treated liquid,

wherein the apparatus includes a supporting part for holding the reservoir above a bottom wall of an interior of the vessel,

wherein the reservoir is arranged to support at least one liquid treatment device such as to force liquid to be treated to flow from the reservoir into the vessel through the liquid treatment device, and

wherein the apparatus includes a part arranged to exert a lifting force for increasing a distance between the reservoir and the bottom wall on at least an end section of the reservoir closest to the bottom wall to maintain a liquid level in the reservoir above a liquid level in the vessel.

The invention also relates to a method of treating a liquid in an apparatus including a reservoir for liquid to be treated and a vessel for collecting treated liquid, which method includes:

holding the reservoir at least partially filled with liquid to be treated above a bottom wall of an interior of the vessel and at least partially within the vessel, and

allowing liquid to flow into the vessel through at least one liquid treatment device supported by the reservoir,

wherein a distance between the reservoir and the bottom wall is caused to be increased during treatment of the liquid.

US 2004/0040899 A1 discloses a collapsible and portable water filtering device including an outer barrel, an inner barrel, a filter unit, a water reserving space and a water dispensing valve. The outer barrel has a rigid first upper frame section and a soft watertight outer bag. The inner barrel has a rigid second upper frame section and a soft watertight inner bag. The filter unit is fixed on a fixing bottom edge of a bottom end of the inner bag, whereby the filter unit

is integrally connected with the inner barrel. The inner and outer bag, which are made of soft material, can be deformed. The device can be collapsed from an original height to a collapse height.

A problem of the known device is that the volume of water that can be treated is limited to half the volume of the outer barrel, so that it is relatively voluminous compared to the maximum volume of a batch of water that can be filtered.

US 2008/0164223 A1 discloses a floating filter holder, comprising a filter platform, which has a top side, a bottom side and holes. The floating filter holder also comprises downward projections and upward projections. The downward projections provide a support structure to hold the filter platform above the floor of a container. The downward projections may provide additional buoyancy if the filter holder is intended to float upward as liquid is filtered. A membrane is attached to the floating filter holder by the use of a snap ring. The other end of the membrane is held in place by friction between a lid and a container. In order to use the floating filter holder, a user first inserts one or more filters into the holes and ensures that any holes that do not have a filter are otherwise plugged or covered. The membrane is attached to the floating filter holder by setting the membrane on the platform and setting the snap ring at the base of upward projections comprised in the floating filter holder. The floating filter holder is then set insider the container at the bottom. With the assembly in place, unfiltered water is poured on top of the floating filter holder and the lid is set on the container, which helps hold the membrane in place. Unfiltered water passes through the filter and flow beneath the platform, thus becoming filtered water. The floating filter holder is able to float upward due to its buoyancy and the presence of filtered water underneath. During the process, the volume of the container that is below the platform increases, whilst the volume of the container above the platform decreases. Thus, the process makes the container more volumetrically efficient than a standard container.

However, the floating filter holder contacts the filtered water in the container over a relatively large surface area.

It is an object of the invention to provide an apparatus enabling the treatment of a batch of liquid with a larger volume than half the volume of the vessel for collecting liquid whilst still allowing a reservoir full of liquid to be treated to be suspended at least partially in the vessel that does not rely exclusively on submerged buoyancy aids.

This object is achieved with the apparatus according to the invention, which is characterised in that the apparatus includes at least one resilient part for exerting the lifting force.

Because the liquid level in the reservoir is maintained above a liquid level in the vessel, the apparatus is suitable for implementation as a gravity-driven liquid treatment apparatus. Liquid to be treated is filled into the reservoir, forced through the liquid treatment device by the gravitational force acting on the volume of liquid in the reservoir and collected in the vessel in which the reservoir is at least partially suspended, at least initially. Thus, the overall height of the apparatus as measured from the bottom wall can be smaller than the combined height of the reservoir and vessel, at least initially. The apparatus is therefore not top-heavy when treatment commences. At this stage, the reservoir can occupy more than half the volume of the (empty) vessel. At least in use, the apparatus includes the at least one liquid treatment devices. As liquid leaves the reservoir, the lifting force increases the distance between a lower end of the (suspended) reservoir, freeing up volume in the vessel for accommodating treated liquid. The lifting force exceeds a weight of the liquid in the reservoir and opposing components of the weight of the reservoir itself and of the supported liquid treatment devices. Generally, the part arranged to exert the lifting force will be configured such that this is the case for liquids having a density equal to or higher than that of water. For lighter liquids, the part may be dimensioned differently, so that the lifting force is smaller. Thus,

at least partial occupation of an interior of the vessel by the reservoir when filled with liquid is ensured.

An effect of the at least one resilient part provided for the purpose of exerting the lifting force is that the lifting force and weight acting counter to the lifting force balance at each stage during emptying of the reservoir whilst a lower end of the reservoir can remain spaced apart from the liquid level in the vessel. It follows that the resilient part or parts may be suitable for exerting the entire lifting force. Regardless, the lower end of the reservoir will at least not sink far into the liquid. This helps to reduce the likelihood of contamination of the treated liquid. The distance between the reservoir and the bottom wall increases gradually as the reservoir empties. The lifting force increases as the resilient part is deformed (compressed or extended) under the weight of the liquid to be treated in the reservoir when it is being filled. Thus, the lower end of the reservoir moves gradually down into the vessel during filling of the reservoir. The extent of the deformation of the resilient part is arranged to decrease with the volume of the liquid in the reservoir, when the reservoir is suspended in the vessel. For a given liquid, the height of the suspended reservoir is defined for each volume of liquid contained in it, independent of exterior factors.

It is observed that US 2010/0187183 A1 discloses a water pump and filtration bottle including an exterior water container. The apparatus incorporates an elongated pleated bag device, carried on an annular rim for nesting on the top edge of the peripheral wall of the container and supporting a flexible pleated bag. A user may reciprocate a piston to alternately generate a negative pressure in a pump chamber to draw filtered water through an outlet to be filtered through a filter and collected in a pump chamber. Upon stroking the piston upwardly, a positive pressure will be generated in the chamber, driving the filtered water up stand pipes to open valves to pass the filtered water over through respective outlets to flow it downwardly into an interior of the pleated bag, thus extending the bag downwardly within the container as the filtered

water therein displaces the unfiltered water being drawn through the outlet and into the pump chamber.

The pleated bag is not arranged to support at least one liquid treatment device such as to force liquid flowing from the reservoir into the vessel through the liquid treatment device. Thus, this apparatus is not a gravity-driven liquid treatment device and requires at least the volume of the pump chamber in addition to the volume provided for accommodating the water to be treated.

In an embodiment, the reservoir is expandable from an at least partially collapsed configuration and the lifting force is arranged to bias the reservoir into the at least partially collapsed configuration.

The total height of the apparatus does not increase as the reservoir is emptied. Rather than raising the reservoir, the lower end is raised by the lifting force as it is at least partially collapsed. The reservoir can expand again when filled with liquid to be treated, as the lifting force is exceeded by a weight of liquid filling the reservoir and opposing components of the weight of the reservoir itself and of the supported liquid treatment devices acting counter to the lifting force. When filled with liquid, e.g. water, the reservoir may occupy more than half an interior volume of the vessel provided by the vessel for collecting treated liquid. In the at least partially collapsed configuration, the reservoir may occupy less than half the interior volume of the vessel. Because the lifting force is arranged to bias the reservoir into the at least partially collapsed configuration, this configuration is assumed also in the absence of liquid in the vessel and the reservoir. The reservoir assumes a compact shaped for storage, when empty.

In an embodiment, the at least one resilient part includes a resilient side wall of the reservoir.

This embodiment does not require separate resilient parts such as springs or a frame with springs around a flexible reservoir. That space is thus available for

the liquid, making the apparatus more compact, as well as simpler and cheaper to manufacture.

In an embodiment of the apparatus, the reservoir has a side wall of which at least a section is pleated.

The reservoir can thus collapse and expand in a relatively controlled manner compared e.g. to a reservoir in the form of a flexible bag. There is no need for external support or guidance of the reservoir as it collapses. The pleating provides for defined folds. The reservoir is thus unlikely to fold in on itself such that large folds stick to each other or to the vessel. Relatively small pleats can be provided to ensure that relatively little space need be provided around the reservoir in the vessel to allow the reservoir to collapse. Furthermore, it is relatively easy to make a pleated wall resilient such as to provide the lifting force.

In an embodiment, wherein the reservoir is provided with a reservoir bottom wall, closest to the bottom wall of the vessel when the reservoir is held by the supporting part, the reservoir bottom wall is arranged to support the at least one liquid treatment device.

This allows for relatively complete emptying of the reservoir. Moreover, a side wall of the reservoir can be made flexible to allow it to collapse and thereby increase the distance to the bottom wall of the vessel when the reservoir is suspended above the bottom wall. The collapsing side wall will not make the liquid treatment device or devices inaccessible to the liquid to be passed through the device or devices in order to treat it and empty the reservoir. The bottom wall may be rigid. This provides better support to the liquid treatment devices, in that they need only be able to withstand a pressure differential due to the weight of the liquid to be treated.

In a variant of this embodiment, the reservoir bottom wall is essentially planar.

An effect is to add relatively little to the height of the reservoir (its dimension in the direction essentially perpendicular to the bottom wall of the vessel when the reservoir is suspended). The distance to the bottom wall of the vessel can therefore be increased more without having to lift the entire reservoir out of the vessel.

In an embodiment, the reservoir is provided with at least one holder for receiving a replaceable liquid treatment device in an essentially sealed relation preventing a flow of liquid past the liquid treatment device through a passage through a wall of the reservoir.

This embodiment allows for the use of liquid treatment devices having a limited treatment capacity. They may include an exhaustible liquid treatment medium, for example. Such a medium may be a medium for the treatment of liquid by sorption (including adsorption, absorption and ion exchange) or by elution. Already where the treatment capacity is only limited because the liquid treatment device is prone to accumulate contamination (e.g. microbial contamination) during treatment of a liquid for human consumption, the use of replaceable liquid treatment devices increases the useful lifetime of the reservoir and the rest of the apparatus.

In an embodiment of the apparatus, the reservoir is arranged to support multiple liquid treatment devices, e.g. multiple liquid treatment devices having equal shapes and dimensions.

An effect is to allow for more efficient production of the systems comprising the apparatus in one of several different sizes and one or more liquid treatment devices. This allows for economies of scale to be achieved, especially where the liquid treatment devices are replaceable liquid treatment devices. The apparatus can be manufactured in a range of vessel widths. The wider versions can treat liquid relatively quickly by including a number of liquid treatment devices arranged to operate in parallel.

In an embodiment, further including at least one of the liquid treatment devices, the at least one liquid treatment device includes a self-supporting porous body.

The weight that the lifting force has to counter can thus be relatively low, since a housing for a liquid treatment medium may be dispensed with.

In a variant, the body is made of at least one liquid treatment medium and at least one binder.

This allows for granular active materials for the treatment of liquid by sorption (including adsorption, absorption and ion exchange) or by elution to be incorporated without having to resort to granular medium in a housing. Thus, other treatments than mere mechanical filtration are made possible. The binder allows for the use of granular liquid treatment media that cannot by themselves be sintered. The binder may also help counter swelling of liquid treatment medium due to the binding of liquid, thus limiting weight gain of the liquid treatment device upon contact with the liquid.

In an embodiment, at least one, e.g. a major, surface of the body is covered by a textile material, e.g. a non-woven material.

This means that the amount of binder can be kept low and the contact between the binder particles and the liquid treatment medium particles need not be very intensive. More liquid treatment medium with a larger area exposed to the liquid to be treated can be used. Any particles not properly bound will not end up in the treated liquid but will be retained by the textile material. The textile material is relatively light. Because the body is self-supporting, the textile material need not provide the support, although it may provide reinforcement.

In an embodiment, further including at least one of the liquid treatment devices, the at least one liquid treatment device has a planar shape.

The liquid treatment device or devices may thus be arranged to be supported with a major surface oriented in a direction towards the bottom wall of the vessel. The liquid treatment device or devices therefore add little to the height of the reservoir supporting them. It can therefore be raised and/or collapsed more fully.

In a variant, the planar shape is a round, e.g. a disc shape.

This increases the cross-sectional area of the liquid treatment device where the reservoir has a side wall arranged in an essentially round shape. That makes it easier to collapse the reservoir by folding of the side wall, because it will not have sharp corners.

In an embodiment of the apparatus including multiple liquid treatment devices for treating the liquid, the reservoir is arranged to support the multiple liquid treatment devices such as to force liquid to be treated to flow from the reservoir into the vessel through at least one of the liquid treatment devices.

Each of the liquid treatment devices is for treating the liquid, i.e. arranged to treat the liquid. At least some, e.g. all of the liquid is forced to flow through at least one of the liquid treatment devices, so that liquid to be treated cannot circumvent all liquid treatment devices.

In an embodiment, the vessel is at least partially collapsible.

In this embodiment, the apparatus can be stored in a relatively compact configuration when not in use.

An embodiment of the apparatus further includes a frame from which the vessel is suspendable.

Thus, it is possible to use a relatively large vessel (and a commensurately large reservoir) for accommodating a volume of treated liquid too large for the vessel to be lifted comfortably. Instead, the vessel may be provided with at

least one outlet port in or near the bottom wall of the vessel, in or to which a dispensing valve or a conduit leading to a dispensing device may be mounted. Gravity is thus also used to dispense the treated liquid. Relatively large batches of treated liquid can be prepared and dispensed with a relatively compact apparatus. The frame may be foldable and/or amenable to disassembly in order to retain the compactness of the apparatus when not in use.

According to another aspect, the method of treating a liquid according to the invention is characterised in that the distance between the reservoir and the bottom wall is caused to be increased by at least a resilient part exerting a lifting force on at least an end section of the reservoir closest to the bottom wall countering at least a weight of the liquid in the reservoir.

The lifting force increases with the weight of liquid contained in the reservoir and is balanced by the lifting force as the reservoir expands and collapses. It may be sufficient to counter the weight of the liquid and that of the reservoir and supported liquid treatment devices. Then, the distance between the reservoir and the bottom wall is caused to be increased only by one or more resilient parts exerting a lifting force on at least an end section of the reservoir closest to the bottom wall countering at least a weight of the liquid in the reservoir. Thus, the reservoir holding a batch of untreated liquid can be suspended largely within the vessel, rather than above it. As the reservoir empties, space is freed and a difference in height between the level of the treated liquid and an outlet of the reservoir is maintained through a gradual increase in the distance between the reservoir and the bottom wall of the vessel. Thus, a volume of treated liquid equal to almost the interior volume of the vessel can be prepared in one batch.

In an embodiment, a lower end of the reservoir may be held spaced apart from the liquid level in the vessel during treatment of the liquid. This helps to reduce the likelihood of contamination of the treated liquid.

In an embodiment, the distance between the reservoir and the bottom wall is caused to be increased during treatment of the liquid by at least partially collapsing the reservoir.

Thus, not only is the apparatus not top-heavy at the start of the treatment of a batch of liquid, its overall height remains low even as the volume of treated liquid collected in the vessel increases.

A variant includes causing the reservoir to expand by filling it with liquid to be treated.

Thus, the reservoir can be biased into a collapsed configuration. It expands under the weight of liquid poured into it.

In an embodiment, the liquid is allowed to flow into the vessel through the at least one liquid treatment device only through the force of gravity.

Pumps and arrangements for pressurising the reservoir or creating an underpressure in the vessel are thus not required. This also makes it easier to ensure that the lifting force is adequate and not too large or small.

An embodiment of the method includes the use of an apparatus according to the invention.

The invention will be explained in further detail with reference to the accompanying drawings, in which:

Fig. 1 is a plan view of a vessel of a first liquid treatment apparatus;

Fig. 2 is a plan view of the first liquid treatment apparatus when filled with liquid to be treated;

Fig. 3 is a plan view of the first liquid treatment apparatus upon treatment of the liquid;

Fig. 4 is a cross-sectional view of a bottom wall of a reservoir of the first liquid treatment apparatus;

Fig. 5 is a plan view of a variant of the first liquid treatment apparatus upon treatment of the liquid;

Fig. 6 is a plan view of a second liquid treatment apparatus;

Fig. 7 is a bottom view of a reservoir of the second liquid treatment apparatus;

Fig. 8 is a cross-sectional view of the bottom wall;

Fig. 9 is a bottom view of the reservoir in a variant of the reservoir of Figs. 7 and 8;

Fig. 10 is a cross-sectional view of the bottom wall of Fig. 9;

Fig. 11 is a plan view of a third liquid treatment apparatus;

Fig. 12 is a bottom view of a reservoir of the third liquid treatment apparatus;

Fig. 13 is a plan view of a fourth liquid treatment apparatus; and

Fig. 14 is a bottom view of a reservoir of the fourth liquid treatment apparatus.

In the following, apparatus for treating aqueous liquids, e.g. drinking water, will be described as examples of apparatus for treating liquids in general. The liquid treatment apparatus can easily be adapted to treat other types of liquids by an appropriate choice of materials for forming the liquid treatment device or devices included in the apparatus.

A first liquid treatment apparatus 1 includes a vessel for collecting treated water in the shape of a carafe 2. The treated liquid can be poured from the carafe 2. The carafe 2 is provided with a removable lid 3 (Figs. 2-3). It has a bottom wall 4 for placing it on a support surface. The bottom wall 4 also delimits an interior space in the carafe 2 in which treated water is collected, in use. The carafe 2 may be made of glass or plastic or the like, and is essentially rigid.

A reservoir 5 is suspendable within the carafe 2. It may, for example, include a rim (not shown) for placement on a rim 6 (Fig. 1) of the carafe 2. The rim 6 of the carafe 2 forms a supporting part for holding the reservoir 5. The lid 3

is then placed on top to cover the contents of the reservoir 5, which is open at the top. The reservoir 5 includes a bottom wall 7 and a side wall 8. The side wall 8 includes a pleated section, extending over most of the height of the reservoir 5. At least this section is resilient, biased to cause the reservoir 5 to assume a configuration in which the reservoir 5 is partially collapsed, i.e. compacted (cf. Fig. 3). When extended, the pleated section exerts a lifting force tending to return the reservoir 5 into the partially collapsed configuration. This force tends to raise the bottom wall 7 of the reservoir 5, increasing its distance to the bottom wall 4 of the carafe 2. The maximum extension of the pleated section is such as to ensure that the reservoir bottom wall 7 remains spaced apart from the bottom wall 4 of the carafe 2.

The side wall 8 may be made of plastic, e.g. polypropylene or polyethylene. It is impervious to liquid.

The reservoir 5 supports a liquid treatment device 9. The liquid treatment device is placed in an aperture 10 of the bottom wall 7 such as to block a flow of liquid through the aperture 10 around the liquid treatment device 9. The liquid is thus forced to flow through the liquid treatment device 9 in order to flow out of the reservoir 5 into the carafe 2. It is treated on its way through the liquid treatment device 9.

The liquid treatment device 9 is essentially disc-shaped. It may have a different shape in another embodiment, e.g. square or oblong in plan view. A planar configuration is useful for restricting the overall height of the reservoir 5 with supported liquid treatment device 9. One major surface of the planar liquid treatment device 9 is oriented towards the bottom wall 4 of the carafe 2.

The liquid treatment device 9 includes a porous self-supporting body 11 covered on one major surface by a layer of textile material 12, e.g. a non-woven. The textile material 12 may be made of spin-laid and/or melt-blown polypropylene fibres, for example. Melt-blown fibres are suitable for capturing rela-

tively fine particles. The liquid treatment device 9 is supported by the reservoir 5 such that the layer of textile material 12 covers the lower major surface, which is on the downstream side of the porous body 11.

The porous body 11 is made of at least one liquid treatment medium and a binder. Both are present in granular form, thermally bonded to form the porous body 11. The granular liquid treatment medium included in the porous body 11 includes at least one medium for the treatment of liquid by sorption, including for the present purposes adsorption, absorption and ion exchange. It may in particular include granular activated carbon. Alternatively or additionally, it may include a substance for binding heavy metals such as lead. The binder will generally be a thermoplastic material. A suitable example is ultra-high molecular weight polyethylene. By causing the thermal bonding to take place at low pressure, only point-contact between the particles is established. The binder will not cover the particles of liquid treatment material completely. More details can be found e.g. in Strauß, S., "Gesinterte Kunststoff-Formteile für die Fest/Flüssig-Filtration", *Technische Mitteilungen* 85 (2), July 1992, pp. 100-104 or in WO 2012/175656 A1. The porous body 11 is obtainable by separating it from a sheet or web of thermally bonded granular material, e.g. by cutting or stamping. The layer of textile material 12 may be applied prior or subsequent to the separation step. It is adhered to the porous body 11 by applying heat to soften the binder at the interface between the body 11 and the layer of textile material 12.

In an alternative embodiment, the liquid treatment device 9 may have a layer of textile material on both major surfaces. In this embodiment, it cannot be placed in the apparatus the wrong way up.

Referring to Fig. 4, the liquid treatment device 9 is at least partially received in a recess in the bottom wall 7. An upper major surface contacts the bottom wall 7 at its edge and along its circumference to prevent a bypass of water through the aperture 10 around the edge of the liquid treatment device 9. The bottom wall 7 is provided with an exterior threaded section for engaging a

threaded section of a retaining device 13 screwed onto the bottom wall 7. The retaining device 13 seals against the lower major surface of the liquid treatment device 9. The retaining device 13 includes an aperture 14 through which the treated liquid can flow into the carafe 2.

When the reservoir is filled with water, the weight of the water, the bottom wall 7, liquid treatment device 9 and retaining device 13 exceeds the resilient lifting force exerted by the pleated section of the side wall 8 of the reservoir 5. The reservoir 5 is thus distended to provide a large volume for the water to be treated. The carafe 2 is otherwise empty.

The weight of the water forces it through the liquid treatment device 9. As the weight pulling on the pleated section of the side wall 8 decreases, the resilient force raises the bottom wall 7 to increase its distance to the bottom wall 4 of the carafe 2, but also to a water level 15 in the carafe 2. When empty of water, the resilient force results in the reservoir 5 assuming the partially collapsed configuration illustrated in Fig. 3.

In a variant of the first liquid treatment apparatus 1' (Fig. 5), the lifting force is additionally provided by a lifting body 16' having a substantially lower density than the liquid. The lifting body 16' may be an integral part of the reservoir bottom wall 7. It may be a hollow body. In an embodiment, it is a body provided with a trough-going passage having an aperture closest to the bottom wall 7 at a distance to the liquid treatment device 9. In this way, the liquid treatment device 9 is held at a distance above the water level 15 even as the lifting body 16' is partially submerged in the treated liquid.

The carafe 2 has a relatively high aspect ratio and an essentially circular cross-section. To accommodate larger volumes without exceeding the limitations imposed by typical dimensions of refrigerator doors, a second liquid treatment apparatus 17 is provided. The second liquid treatment apparatus 17 includes a reservoir 18 for receiving water to be treated and a vessel in the shape of a jug 19 for receiving treated water.

The reservoir 18 is suspended in the jug 19. In the illustrated example, a rim of the reservoir 18 rests on a ledge 20 provided on an inside of a side wall of the jug 19 at its upper end and forming a supporting part. The jug 19 has a bottom wall 21 for placing it onto a support surface. The jug 19 is open at an opposite end to allow the reservoir 18 to be inserted into the jug 19. The jug 19 with the inserted reservoir 18 is closed by a lid 22 in which a fill opening with a closure element 23 is provided. The reservoir 18 can be filled through the fill opening in a manner known *per se*.

An upper section 24 of the reservoir 18 is essentially rigid. A lower section includes a side wall 25 including at least a pleated section. At least this section is resilient, biased to cause the lower section of the reservoir 18 to assume a configuration in which the lower section of the reservoir 18, and thus also the reservoir 18 as a whole, is partially collapsed. When extended, the pleated section exerts a lifting force tending to return the lower section of the reservoir 18 into the partially collapsed configuration until it balances the weight pulling on the pleated section. This lifting force tends to raise a rigid bottom wall 26 of the reservoir 18, increasing its distance to the bottom wall 21 of the jug 19. The maximum extension of the pleated section is such as to ensure that the reservoir bottom wall 26 remains spaced apart from the bottom wall 21 of the jug 19, even when filled to a maximum extent with water to be treated.

In a first variant (Figs. 7 and 8), the bottom wall 26 of the reservoir 18 has a single outlet aperture 27 covered by a single liquid treatment device 28.

The liquid treatment device 28 comprises a self-supporting porous body 29 of which one major surface is covered by a layer of textile material 30. It is in all respects the same as the liquid treatment device 9 of the first liquid treatment apparatus 1. A planar annular retaining device 31 is provided with an exterior screw thread co-operating with a threaded section of the outlet aperture 27 to enable the retaining device 31 to press down on the liquid treatment device 28. The liquid treatment device 28 is thus held in sealed relation

to the bottom wall 26 so as to block the outlet aperture 27. Water is therefore forced to flow through the liquid treatment device 28 through the pull of gravity. The retaining device 31 may protrude slightly from an interior surface of the bottom wall 26 and be provided with protruding parts or indentations (not shown in further detail) to allow a user to unscrew the retaining device 31 when the liquid treatment device 28 is to be replaced.

Again, the resilient force exerted by the pleated section of the side wall 25 counters the weight of the untreated liquid, the bottom wall 26, the liquid treatment device 28 and the retaining device 31. The opposing forces balance as the reservoir 18 empties, until the partially collapsed configuration is reached, whereupon the reservoir continues to empty.

A manufacturer may wish to manufacture both the first and the second liquid treatment apparatus 1,17. Economies of scale are achievable if the liquid treatment devices 9,28 are identical in terms of both their composition and their dimensions. A second variant (Figs. 9 and 10) of the second liquid treatment apparatus 17 allows this to be the case whilst ensuring that treating the liquid in the second liquid treatment apparatus 17 does not take an excessively long time. In the second variant, the bottom wall 26' is provided with two outlet apertures 27',27", each covered by a respective liquid treatment device 28',28". Each of the liquid treatment devices 28',28" is as described above. They are thus essentially disc-shaped and include a self-supporting porous body 29',29" of which a major surface is covered by a layer of textile material 30',30". Retaining devices 31',31" are of the same shape and configuration as the retaining device 31 of the first variant. They hold the liquid treatment devices 28',28" in sealed relation to the bottom wall 26' such as to force water to be treated to flow from the reservoir 18 to the jug 19 through one of the liquid treatment devices 28',28". After a certain period of time has elapsed or a certain volume of water has been treated, the retaining devices 31',31" can be unscrewed to release the liquid treatment devices 28',28", allowing them to be replaced.

A third liquid treatment apparatus 32 (Figs. 11-12) is arranged to allow batches of water of even larger volume to be treated without taking up too much space in the home or at a place of business. It includes a support frame 33 that can be at least partially disassembled and/or folded and from which a vessel 34 for collecting treated water can be suspended. The vessel 34 has a relatively rigid bottom wall 35 and a side wall 42 of which at least a section is pleated. Thus, the vessel 34 is at least partially collapsible when empty. The pleated section may be resilient such as to bias the vessel 34 into the at least partially collapsed configuration without user intervention. Alternatively, a user may need to collapse the vessel 34 when disassembling the third liquid treatment apparatus 32 to store it away.

In the illustrated embodiment, a relatively rigid lower section of the side wall 36 is provided with an outlet in the form of a conduit with a spigot 37, so that treated water can be dispensed from the vessel 34. The support frame 33 raises the vessel 34 and thus the spigot 37 to a height sufficient to place a smaller vessel, e.g. a cooking pot, kettle or the like under the spigot 37, even when the vessel 34 is distended.

A rigid cover 38 is removably attached to the vessel 34 such as to enable it to transfer the weight of the filled vessel 34 to the frame 33. The cover 38 has a fill opening with a closure element 39 that can easily be removed to pour in water to be treated whilst the vessel 34 remains suspended from the frame 33. The entire cover 38 can be removed when the third liquid treatment apparatus 32 is assembled, in order to insert a reservoir 40 into the vessel 34 such that it is supported by at least one of the vessel 34 and the cover 38 in a suspended position above the bottom wall 35 of the vessel 34.

The reservoir 40 has an essentially planar bottom wall 41 and a side wall 42. The bottom wall 41 is essentially rigid and provided with two outlet apertures 43,44, covered by respective liquid treatment devices 45,46 such as to force liquid to be treated to flow from the reservoir 40 into the vessel 34 through the liquid treatment devices 45,46, which operate in parallel. Retain-

ing devices 47,48 are provided to hold the liquid treatment devices 45,46 in sealed relation to the bottom wall 41 of the reservoir 40. The retaining devices 47,48 are of substantially the same configuration as those of the second variant of the second liquid treatment apparatus 17 and therefore not shown in further detail. The same goes for the liquid treatment devices 45,46. These are thus disc-shaped, whereas the bottom wall 41 is oblong in shape. The use of two liquid treatment devices 45,46 operating in parallel allows for relatively fast emptying of the reservoir 40 without lessening the degree of treatment. The disc-shaped liquid treatment devices 45,46 can be used in liquid treatment apparatus with a round bottom wall as well. Naturally, larger variants of the third liquid treatment apparatus 32 may support more than two liquid treatment devices 45,46 operating in parallel.

The side wall 42 includes a resilient pleated section, arranged to exert a force countering the weight of water in the reservoir 40 and of the bottom wall 41, the liquid treatment devices 45,46, and the retaining devices 47,48. This force tends to bias the reservoir 40 into an at least partially collapsed configuration and to raise the bottom wall 41 when the reservoir 40 is suspended in the vessel 34. The forces balance as the reservoir 40 is emptied, so that the height of the reservoir 40 decreases as it is emptied and increases when it is being filled.

A fourth liquid treatment apparatus 49 (Figs. 13-14) is similar to the third liquid treatment apparatus 32. It includes a reservoir 50 for water to be treated and a vessel 51 for collecting treated water. The vessel 51 is open at the top to allow the reservoir 50 to be suspended in the vessel 51. It may be supported by a rim (not shown) resting on an upper rim of the vessel 51, for example. The vessel 51 with the reservoir 50 suspended therein is closed by a cover 52 having a fill opening closable by a closure element 53. Water to be treated can be poured into the reservoir 50 through the fill opening.

The vessel 51 has a double bottom wall. An inner bottom wall 54 forms a bottom wall of an interior of the vessel 51, whereas an outer bottom wall 55 con-

tacts a support surface (not shown) when the vessel 51 is stood on the support surface. The inner bottom wall 54 thus faces a bottom wall 56 of the reservoir 50 when the latter is suspended in the vessel 51. An inclined edge section of the inner bottom wall 54 is provided with an outlet in the form of a conduit with a spigot 57, so that treated water can be dispensed from the vessel 51.

The bottom wall 56 of the reservoir 50 is essentially rigid. It is also planar. The bottom wall 56 is provided with two outlet apertures 58,59. It supports two liquid treatment devices 60,61 of similar shape and configuration to the liquid treatment devices 45,46 of the third liquid treatment apparatus 32. These cover the outlet apertures 58,59. Retaining devices 62,63 similar to those of the third liquid treatment apparatus 32 hold the liquid treatment devices 60,61 in sealed relation to the bottom wall 56, so that liquid to be treated is forced to flow from the reservoir 50 into the vessel 51 through the liquid treatment devices 60,61. The arrangement is essentially the same as in the second variant of the second liquid treatment apparatus 17.

The reservoir 50 has a side wall 64 including a pleated section allowing the reservoir 50 to assume an at least partially collapsed configuration. The pleated section is resilient and biases the reservoir 50 into the at least partially collapsed configuration. It exerts a lifting force countering the weight of any liquid with which the reservoir 50 is filled, as well as the weight of the bottom wall 56, the liquid treatment devices 60,61 and the retaining devices 62,63. Because the pleated section of the side wall 64 is resilient, the forces balance over a range of fill volumes at different extents of the pleated section of the side wall 64, so that the distance between the bottom wall 56 of the reservoir 50 and the inner bottom wall 54 of the vessel 51 increases as the reservoir 50 empties into the vessel 51.

In the at least partially collapsed configuration, when empty of liquid, the reservoir 50, as is the case for the reservoirs 5,40 of the first and third liquid treatment apparatus 1,32, occupies less than half the volume available in the

vessel 51 to accommodate treated liquid. Thus, a larger batch of liquid can be treated for a given size of vessel 51.

The invention is not limited to the embodiments described above, which may be varied within the scope of the accompanying claims. The fact that the reservoir is arranged to support at least one liquid treatment device such as to force liquid to be treated to flow from the reservoir into the vessel through the liquid treatment device does not preclude the possibility that some liquid in the reservoir is not treated intentionally and thus able to flow from the reservoir into the vessel through a bypass channel. Such liquid is not liquid to be treated, but liquid for diluting the treated liquid. Where multiple liquid treatment devices are supported, they are supported such that liquid to be treated must pass through at least one of them on its passage from the reservoir into the vessel.

It is possible to use other types of replaceable liquid treatment device than the ones described herein. To save weight, these would generally be provided with liquid-pervious outer surfaces and arranged to be held in sealing engagement in or over an outlet aperture of the reservoir.

In variants, the bottom walls 26,26',41,56 of the reservoirs 18,40,50 of the second, third and fourth liquid treatment apparatus 17,32,49 include or are partially carried by a buoyant body in the same manner as in the second variant of the first liquid treatment apparatus 1.

List of reference numerals

1,1′	-	1st liquid treatment apparatus
2	-	carafe
3	-	lid
4	-	bottom wall of carafe
5,5′	-	reservoir
6	-	rim of carafe
7,7′	-	bottom wall of reservoir
8,8′	-	side wall of reservoir
9	-	liquid treatment device
10	-	outlet aperture
11	-	porous body
12	-	textile material
13	-	retaining device
14	-	aperture in retaining device
15,15′	-	water level
16′	-	lifting body
17	-	2nd liquid treatment apparatus
18	-	reservoir
19	-	jug
20	-	ledge
21	-	bottom wall of jug
22	-	lid
23	-	closure element
24,24′	-	upper section of reservoir
25,25′	-	side wall of lower section of reservoir
26,26′	-	bottom wall of reservoir
27,27′,27″	-	outlet aperture
28,28′,28″	-	liquid treatment device
29,29′,29″	-	porous body
30,30′,30″	-	textile material
31,31′,31″	-	retaining device

32	-	3rd liquid treatment apparatus
33	-	support frame
34	-	vessel
35	-	bottom wall of vessel
36	-	side wall of vessel
37	-	spigot
38	-	cover
39	-	closure element
40	-	reservoir
41	-	bottom wall of reservoir
42	-	side wall of reservoir
43	-	outlet aperture
44	-	outlet aperture
45	-	liquid treatment device
46	-	liquid treatment device
47	-	retaining device
48	-	retaining device
49	-	4th liquid treatment apparatus
50	-	reservoir
51	-	vessel
52	-	cover
53	-	closure element
54	-	inner bottom wall
55	-	outer bottom wall
56	-	bottom wall of reservoir
57	-	spigot
58	-	outlet aperture
59	-	outlet aperture
60	-	liquid treatment device
61	-	liquid treatment device
62	-	retaining device
63	-	retaining device
64	-	side wall of reservoir

Claims

1. Apparatus for treating a liquid, including:

a reservoir (5;18;40;50) for liquid to be treated; and

a vessel (2;19;34;51) for collecting treated liquid,

wherein the apparatus includes a supporting part (6;20) for holding the reservoir (5;18;40;50) above a bottom wall (4;21;35;54) of an interior of the vessel (2;19;34;51),

wherein the reservoir (5;18;40;50) is arranged to support at least one liquid treatment device (9;28;45,46;60,61) such as to force liquid to be treated to flow from the reservoir (5;18;40;50) into the vessel (2;19;34;51) through the liquid treatment device (9;28;45,46;60,61), and

wherein the apparatus includes a part (16) arranged to exert a lifting force for increasing a distance between the reservoir (5;18;40;50) and the bottom wall (4;21;35;54) on at least an end section of the reservoir (5;18;40;50) closest to the bottom wall (4;21;35;54) to maintain a liquid level in the reservoir (5;18;40;50) above a liquid level in the vessel (2;19;34;51),

characterised in that

the apparatus includes at least one resilient part (8;25;42;64) for exerting the lifting force.

2. Apparatus according to claim 1,

wherein the reservoir (5;18;40;50) is expandable from an at least partially collapsed configuration, and

wherein the lifting force is arranged to bias the reservoir (5;18;40;50) into the at least partially collapsed configuration.

3. Apparatus according to claim 1 or 2,

wherein the at least one resilient part includes a resilient side wall (8;25;42;64) of the reservoir (5;18;40;50).

4. Apparatus according to any one of the preceding claims,
wherein the reservoir (5;18;40;50) has a side wall (8;25;42;64) of which at least a section is pleated.

5. Apparatus according to any one of the preceding claims,
wherein the reservoir (5;18;40;50) is provided with a reservoir bottom wall (7;26;41;56), closest to the bottom wall (4;21;35;54) of the vessel (2;19;34;51) when the reservoir (5;18;40;50) is held by the supporting part (6;20), and
wherein the reservoir bottom wall (7;26;41;56) is arranged to support the at least one liquid treatment device (9;28;45,46;60,61).

6. Apparatus according to any one of the preceding claims,
wherein the reservoir (5;18;40;50) is arranged to support multiple liquid treatment devices (28',28";45,46;60,61), e.g. multiple liquid treatment devices (28',28";45,46;60,61) having equal shapes and dimensions.

7. Apparatus according to any one of the preceding claims,
further including at least one of the liquid treatment devices (9;28;45,46;60,61),
wherein the at least one liquid treatment device (9;28;45,46;60,61) includes a self-supporting porous body (11;29).

8. Apparatus according to any one of the preceding claims,
further including at least one of the liquid treatment devices (9;28;45,46;60,61),
wherein the at least one liquid treatment device (9;28;45,46;60,61) has a planar shape.

9. Apparatus according to any one of the preceding claims,
wherein the vessel (34) is at least partially collapsible.

10. Apparatus according to claim 9,

further including a frame (33) from which the vessel is suspendable.

11. Method of treating a liquid in an apparatus including a reservoir (5;18;40;50) for liquid to be treated and a vessel (2;19;34;51) for collecting treated liquid, which method includes:

suspending the reservoir (5;18;40;50) at least partially filled with liquid to be treated above a bottom wall (4;21;35;54) of an interior of the vessel (2;19;34;51) and at least partially within the vessel (2;19;34;51), and

allowing liquid to flow into the vessel (2;19;34;51) through at least one liquid treatment device (9;28;45,46;60,61) supported by the reservoir (5;18;40;50),

wherein a distance between the reservoir (5;18;40;50) and the bottom wall (4;21;35;54) is caused to be increased during treatment of the liquid,

characterised in that

the distance between the reservoir (5;18;40;50) and the bottom wall (4;21;35;54) is caused to be increased by at least a resilient part (8;25;42;64) exerting a lifting force on at least an end section of the reservoir (5;18;40;50) closest to the bottom wall (4;21;35;54) countering at least a weight of the liquid in the reservoir.

12. Method according to claim 11,

wherein a lower end of the reservoir (5;18;40;50) is held spaced apart from the liquid level in the vessel during treatment of the liquid.

13. Method according to claim 11 or 12,

wherein the distance between the reservoir (5;18;40;50) and the bottom wall (4;21;54;56) is caused to be increased during treatment of the liquid by at least partially collapsing the reservoir (5;18;40;50).

14. Method according to any one of claims 12-13, including causing the reservoir (5;18;40;50) to expand by filling it with liquid to be treated.

15. Method according to any one of claims 11-14, including the use of an apparatus (1;17;32;49) according to any one of claims 1-10.

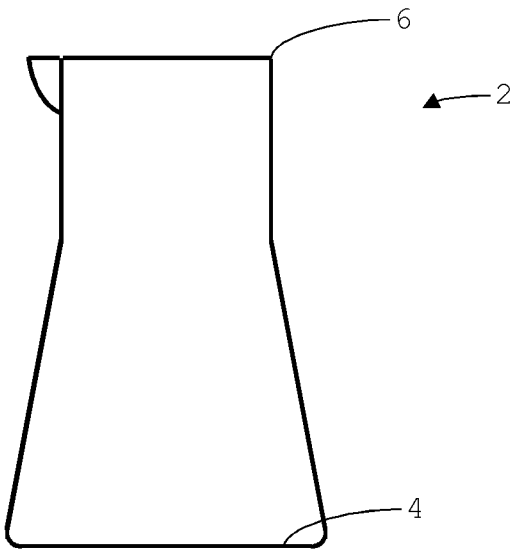


Fig. 1

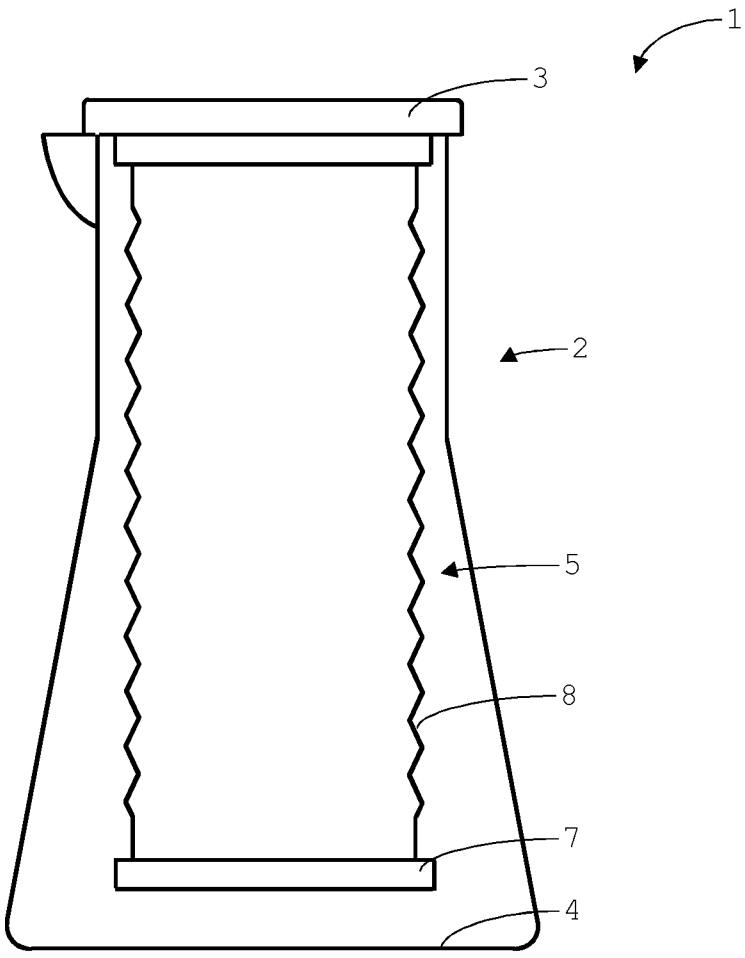


Fig. 2

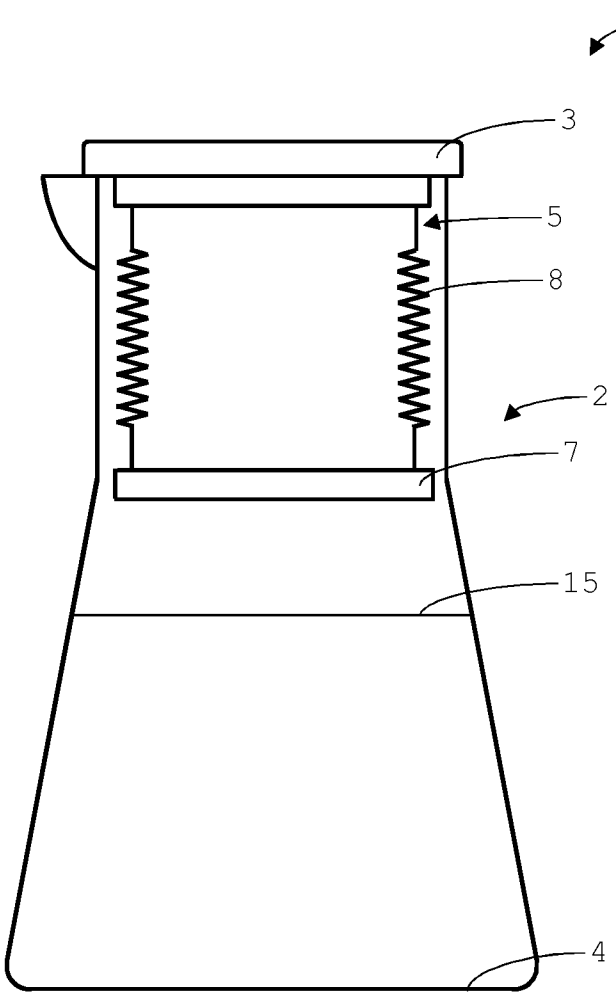


Fig. 3

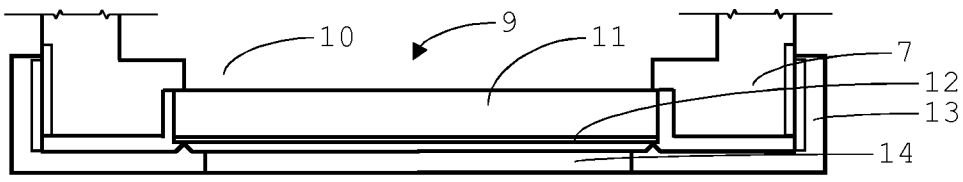


Fig. 4

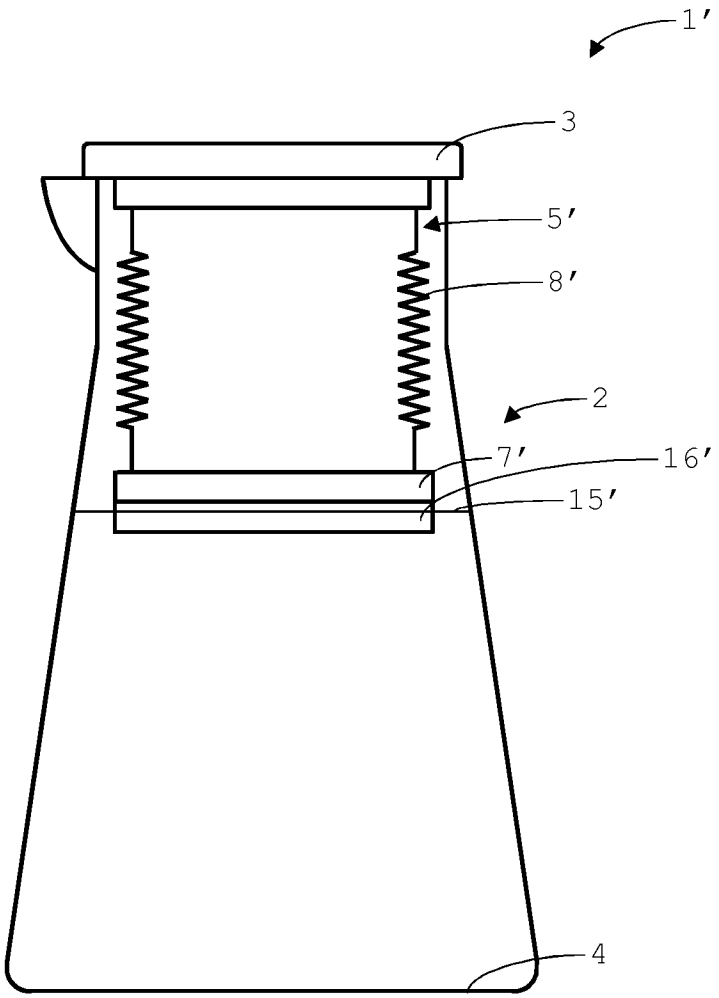


Fig. 5

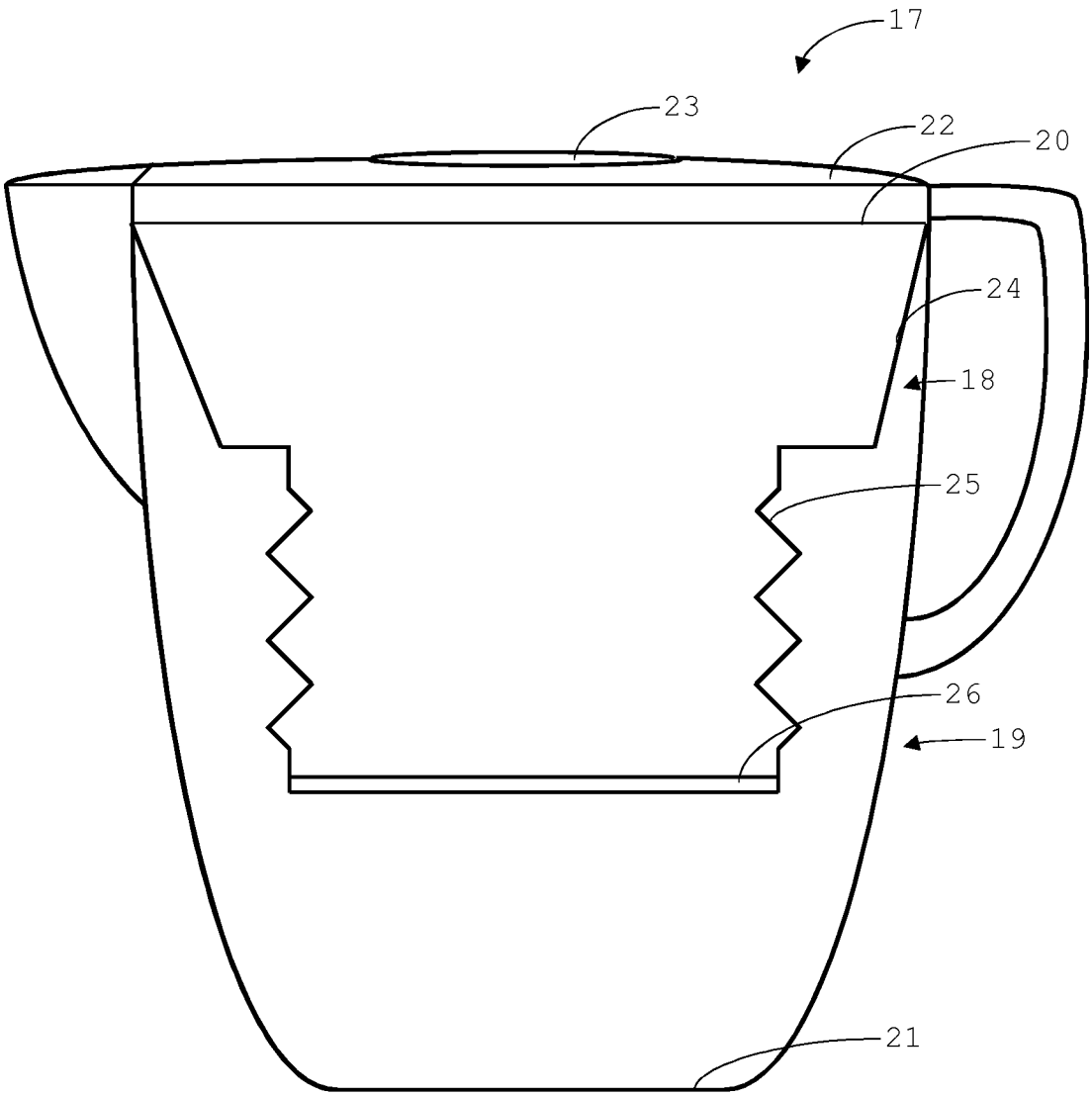


Fig. 6

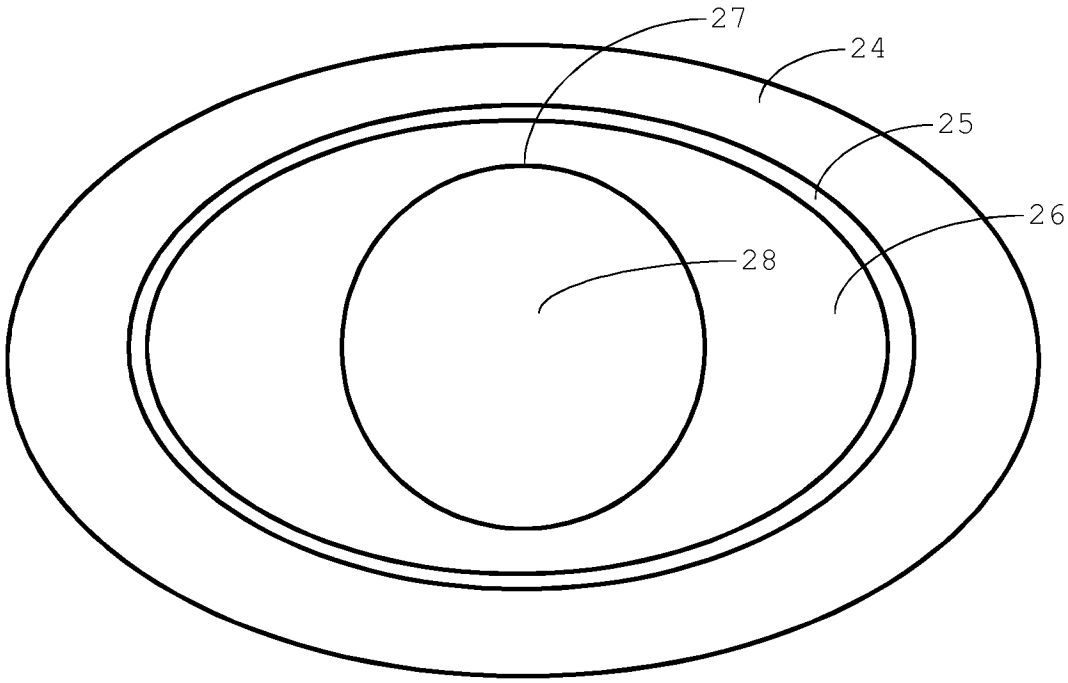


Fig. 7

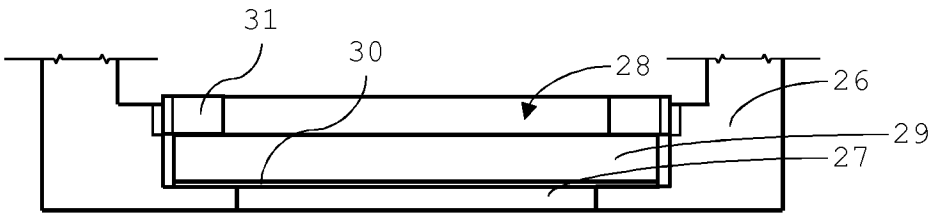


Fig. 8

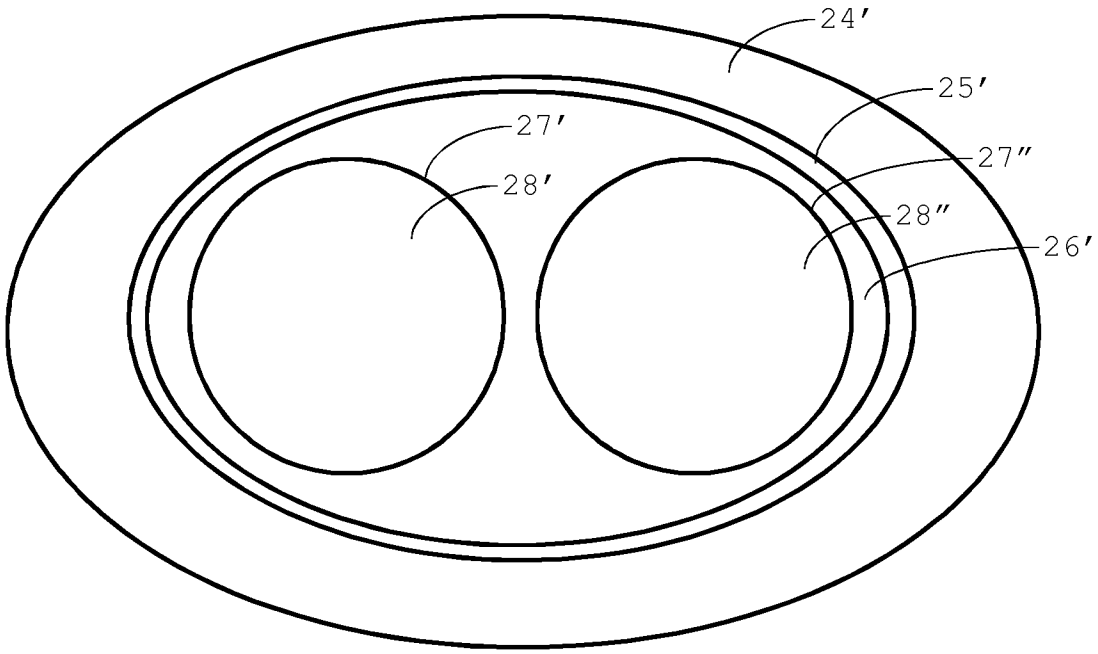


Fig. 9

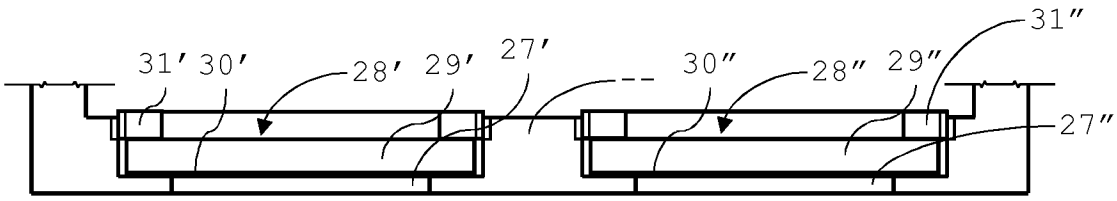


Fig. 10

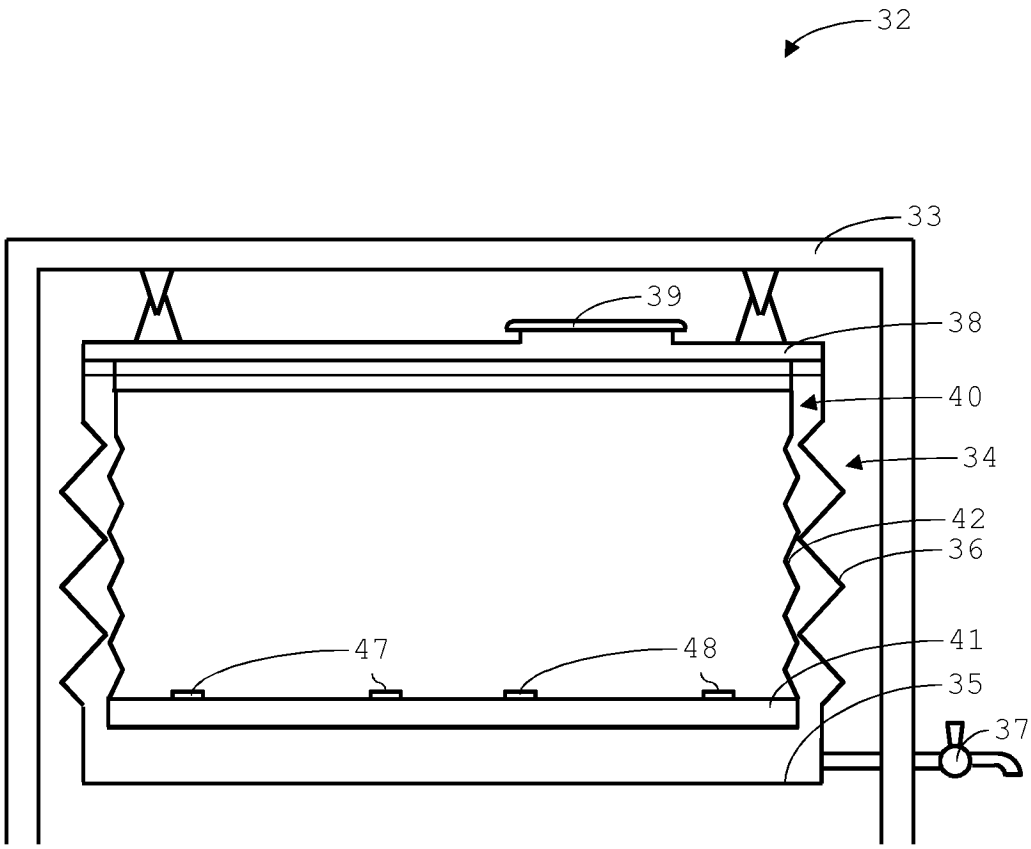


Fig. 11

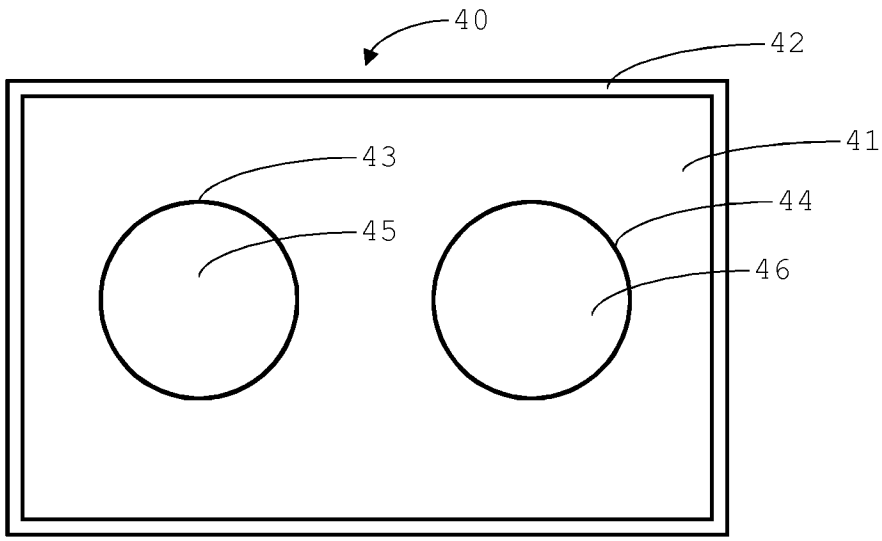


Fig. 12

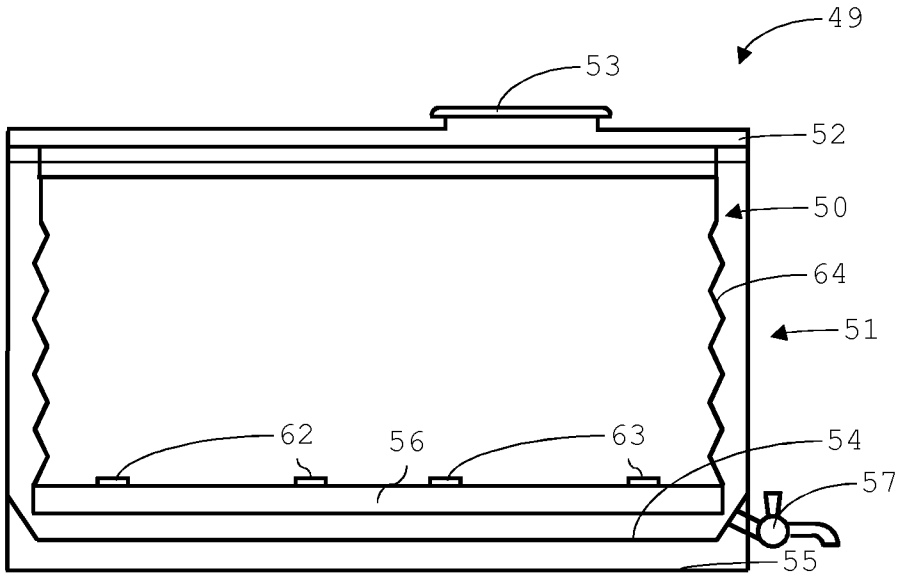


Fig. 13

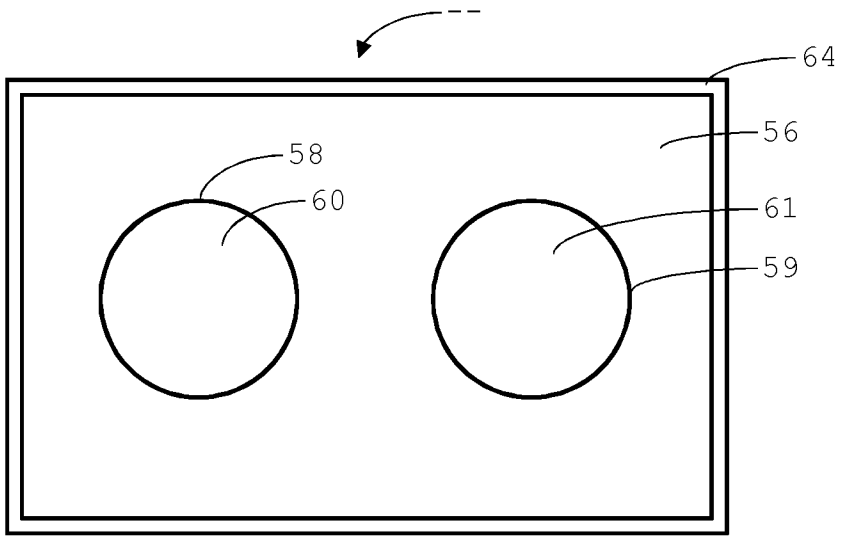


Fig. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/053923

A. CLASSIFICATION OF SUBJECT MATTER
INV. C02F1/00 B01D27/06 B01D29/05 B01D29/07 B01D29/23
ADD. C02F1/28 C02F1/42

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)
C02F B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/164223 A1 (WILSON KELCE S [US]) 10 July 2008 (2008-07-10) figures 2-3 page 1, paragraph 1 - page 1, paragraph 7 page 2, paragraph 16 - page 3, paragraph 23	1-15
A	US 2010/187183 A1 (NELSON STEVEN D [US] ET AL) 29 July 2010 (2010-07-29) cited in the application figures 15-22 page 1, paragraph 2 - page 1, paragraph 14 page 3, paragraph 55 - page 4, paragraph 64	1-15
A	US 4 492 313 A (TOUZANI WILLIAM [US]) 8 January 1985 (1985-01-08) the whole document	9

☐ 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
2 June 2015	12/06/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Zsigmond, Zoltán

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2015/053923

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008164223 A1	10-07-2008	US 2008164223 A1	10-07-2008
		US 2010252493 A1	07-10-2010
US 2010187183 A1	29-07-2010	NONE	
US 4492313 A	08-01-1985	DE 3582957 D1	04-07-1991
		EP 0164173 A2	11-12-1985
		US 4492313 A	08-01-1985