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(71) Applicant (for all designated States except AE, AG, AU, BB, BH, BN, BW, BZ, CA, CY, EG, GB, GD, GH, GM, IE, IL, IN, JO, KE, KN, KW, LC, LK, LS, MT, MW, MY, NA, NG, NZ, OM, PG, QA, RW, SA, SC, SD, SG, SL, SZ, TT, TZ, UG, US, VC, ZA, ZM, ZW only):

UNILEVER N.V. [NL/NL]; Weena 455, 3013 AL Rotterdam (NL).

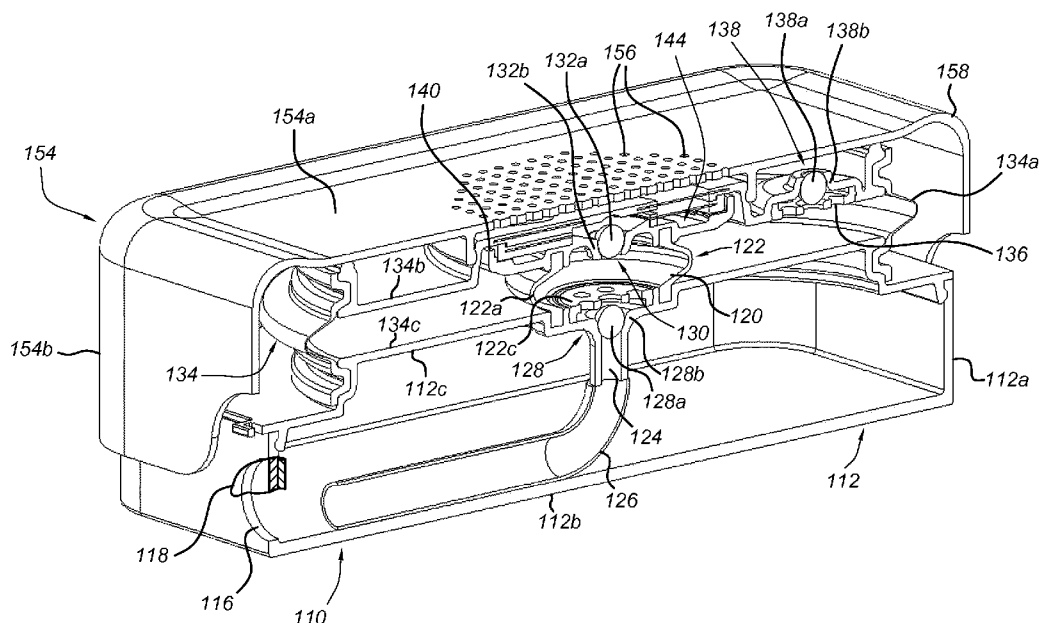
(71) Applicant (for AE, AG, AU, BB, BH, BN, BW, BZ, CA, CY, EG, GB, GD, GH, GM, IE, IL, IN, JO, KE, KN, KW, LC, LK, LS, MT, MW, MY, NA, NG, NZ, OM, PG, QA, RW, SA, SC, SD, SG, SL, SZ, TT, TZ, UG, VC, ZA, ZM, ZW only): UNILEVER PLC [GB/GB]; a company registered in England and Wales under company no. 41424 of, Unilever House, 100 Victoria Embankment, London Greater London EC4Y 0DY (GB).

(71) Applicant (for US only): CONOPCO, INC., D/B/A UNILEVER [US/US]; 700 Sylvan Avenue (A4), Englewood Cliffs, New Jersey 07632 (US).

(72) Inventors: NETHAJI, Alagirisamy; Hindustan Unilever Ltd Research Centre, 64 Main Road, Whitefield, Bangalore 560 066 (IN). B M FERNANDES, Abhishek; Fernandes Innovative Solutions #5, 3rd Floor, Srinivasa Residence,

(54) Title: DISPENSER FOR LIQUID DETERGENTS

Fig. 1



(57) Abstract: A device (110, 210) for dispensing a liquid detergent comprises a reservoir (112, 212) configured to hold a liquid detergent; a liquid bellows (122, 222) in fluid communication with the reservoir (112, 212) via a first one-way valve (128, 228) configured to allow liquid to move from the reservoir (112, 212) to the liquid bellows (122, 222). The liquid bellows are configured to expel liquid contained in the bellows into a mixing chamber (144, 244). A compressible air chamber (134, 234) is also provided with an outlet through which air can be expelled into the mixing chamber upon collapse of the chamber (134, 234). An actuator is provided for compressing the air and liquid chambers and includes at least one dispensing aperture (156, 256) through which a detergent air mixture e.g. foam can be dispensed.



2nd Cross, 1st Main Road, Hoskerahalli, BSK 3rd Stage,
Bengaluru 560085 (IN).

(74) **Agent: CORSTEN, Michael, Allan;** Unilever Patent
Group Olivier van, Noortlaan 120, 3133 AT Vlaardingen
(NL).

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DISPENSER FOR LIQUID DETERGENTS

Field of the invention

The present invention relates to a device for dispensing liquid detergents. In particular,
5 the present invention relates to a dispensing device for dispensing a liquid dishwashing
detergent onto a cleaning implement.

Background of the invention

Any discussion of the prior art throughout the specification should in no way be
10 considered an admission that such prior art is widely known or forms part of the
common general knowledge in the field.

Liquid detergents are used for various types of cleaning, e.g. dish washing, surface
cleaning and personal cleaning on the skin and hair. Detergent compositions, in
15 particular dishwashing detergent compositions, in the form of a bar are common in
many parts of the world, and the bar form of the product is considered convenient and
economical for use.

In a typical dishwashing operation using a detergent bar, a washing implement (e.g. a
20 cloth, sponge or brush) is swiped across the surface of the bar to transfer detergent
material onto the implement. The implement bearing the detergent is then used to
wash the objects to be cleaned (e.g. dishes, pans, windows, etc.). The detergent bars
are popular due to their convenience and their performance in degreasing compared to
other dishwashing formats. However, there are several problems associated with their
25 use, e.g. they have a tendency to become waterlogged and soggy, the detergent can
leave white patches on utensils post-drying and they can be harsh on skin. It has been
found that customers would prefer an alternative that brings minimal change in habit
and the same perception and experience of a conventional bar.

30 US3880532A1 describes a portable cleansing dispenser comprising a closed container
having a plurality of interconnected walls surrounding and defining an interior cleaning
agent storage space. At least one of the walls is flexible with a strong elastic memory,
and at least one wall defines scrub means such as raised spaced ridges. Integral
closed fill means and puncturable dispensing means are also included. Preferably, the

container is of flexible plastic such as polyethylene or the like and of a size and shape to be conveniently hand held for dispensing liquid soaps, detergents, and other cleansers.

- 5 US6287037 describes a fluid-containing brush having a housing with a generally cylindrical wall closed at one end by a base carrying brush bristles and at the other by a cap formed of resilient material. The housing defines a fluid reservoir, and the base has a central opening therein closed by a valve member for dispensing liquid to the brush bristles. A valve stem extends up to an underside of the cap the housing.
- 10 the cap is adapted to provide a fluid tight seal and has a deformable portion constituting a button by which the user can actuate the valve to dispense cleaning fluid.

The prior art does not address the problems of providing a detergent dispensing device that looks like and simulates a conventional dishwashing detergent bar without the

15 need for change in the consumer habit of swipe triggered dispensing of the composition. It also does not provide a system or method for appropriate dosing and dilution of a liquid detergent.

The prior art also fails to address the problem of providing a detergent dispensing

20 device that allows convenient and familiar transfer of liquid detergent to a traditional cleaning implement (e.g. a sponge, dishcloth, brush).

The present inventors have been able to solve many of the problems associated with conventional direct application dishwashing detergent bars and have been able to

25 develop a dispensing device that is filled with a composition with benefit agents that gets dispensed while in use and that can simulate the use of conventional dishwashing detergent bars. The present inventors have been able to solve at least some problems of the art by designing a dispensing device that comprises an actuator that controls the dispensing and dilution of a liquid detergent that can be transferred to a washing

30 implement with a swiping motion that is familiar to many users.

An object of the present invention is to provide a dispensing device that overcomes the above mentioned disadvantages of a dishwashing detergent bar while still providing similar or better performance benefits.

It is another object of the present invention to provide a dispensing device that brings in minimal changes in the consumer habit during use and simulates the use of a conventional dishwashing detergent bar.

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It is yet another object of the invention to provide a system for diluting the detergent with air.

Unlike washing implements that comprise a liquid detergent reservoir, the present inventors have provided a washing solution that allows the user to select an appropriate implement for use with a convenient supply liquid dishwashing detergent. As dishwashing implements must be regularly replaced and or washed themselves, such a system produces less waste and allows for easier cleaning of dishwashing implements.

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These and other objects are accomplished by the invention described in the following text and figures.

Summary of the invention

20 In one aspect of the present invention, there is provided a device for dispensing a liquid detergent. The device comprises a reservoir configured to hold a liquid detergent, e.g. a liquid dishwashing detergent. The device further comprises a first liquid bellows having a first compressible liquid chamber with a first liquid inlet and a first liquid outlet. The first liquid inlet is in fluid communication with the reservoir via a first one-way valve, which is configured to allow liquid to move from the reservoir to the first compressible liquid chamber. A compressible air chamber is also provided as part of the device, the compressible air chamber having an air outlet. An actuator comprises a dispensing aperture and is movable between a first position and a second position, the actuator being configured to compress the first liquid bellows and the compressible air chamber upon movement of the actuator from the first position to the second position. A mixing chamber is provided for mixing air expelled from the compressible air chamber with liquid expelled from the liquid bellows, with the air outlet and the first liquid outlet in fluid communication with the dispensing aperture via the mixing chamber.

The dispensing device according to the present invention allows an amount of liquid detergent to be dispensed with a swiping motion that is familiar to many users. The device further allows the transfer of the liquid detergent to an implement with the same motion (e.g. in one step). This allows one-handed dispensing and transfer of a liquid
5 detergent onto a cleaning implement (e.g. a traditional cleaning implement such as a sponge, dishcloth or brush). The device also provides appropriate dosing and dilution of the liquid detergent, which can decrease consumption of liquid detergent over time.

In another aspect, the present invention provides a process for dispensing a liquid
10 detergent, the process comprising the steps of:

(a) placing a device of the present invention, with a reservoir at least partially filled with a liquid detergent, on a surface; and

(b) pressing the actuator to compress the liquid bellows and the compressible air chamber to dispense a quantity of the liquid detergent through the dispensing
15 aperture.

In yet another aspect of the present invention, the present invention provides a kit comprising a device of the present invention and an instruction manual to use the device for dispensing liquid detergent using the device.
20

Detailed description of the invention

The present invention relates to a device for dispensing liquid detergent and more particularly to a device for dispensing dishwashing detergent that simulates the manner in which a solid dishwashing detergent bar is used, especially when
25 transferring a quantity of detergent onto a washing implement (e.g. a sponge, dishcloth or scrubbing brush) during hand dishwashing.

In the following, it should be noted that the term “comprising” encompasses the terms “consisting essentially of” and “consisting of”. Where the term “comprising” is used,
30 the listed steps or options need not be exhaustive and further steps or features may be included. As used herein, the indefinite article “a” or “an” and its corresponding definite article “the” means at least one, or one or more, unless specified otherwise. The various features of the present invention referred to in individual sections above apply, as appropriate, to other sections *mutatis mutandis*. Consequently features specified in

one section may be combined with features specified in other sections as appropriate. Any section headings are added for convenience only, and are not intended to limit the disclosure in any way. The invention is not limited to the examples illustrated in the drawings. Accordingly it should be understood that where features mentioned in the claims are followed by reference numerals, such numerals are included solely for the purpose of enhancing the intelligibility of the claims and are in no way limiting to the scope of the claims.

In one aspect of the invention there is provided a device for dispensing a liquid detergent. The device comprises a reservoir configured to hold a liquid detergent; a first liquid bellows comprising a first compressible liquid chamber having a first liquid inlet and a first liquid outlet, the first liquid inlet being in fluid communication with the reservoir via a first one-way valve configured to allow liquid to move from the reservoir to the first compressible liquid chamber; a compressible air chamber having an air outlet; an actuator comprising a dispensing aperture the actuator being movable between a first position and a second position, wherein the actuator is configured to compress the first liquid bellows and the compressible air chamber upon movement of the actuator from the first position to the second position; and a mixing chamber for mixing air expelled from the compressible air chamber with liquid expelled from the liquid bellows, wherein the air outlet and the first liquid outlet are in fluid communication with the dispensing aperture via the mixing chamber.

The device according to the present invention allows convenient dispensing of a quantity of pre-diluted (e.g. foam) liquid detergent onto an implement with the habitual swiping motion acquired with use of a traditional solid dishwashing detergent bar.

The device is advantageously configured to allow the transfer of liquid detergent onto a washing implement (e.g. a sponge, dishcloth or scrubbing brush) with a one-handed motion.

The dispensing device according to the present invention conveniently dispenses a liquid detergent, which has superior cleaning and dishwashing properties (e.g. less harsh on hands, fewer drying marks on washed items, etc.) with similar handling advantages to traditional solid dishwashing detergent bars.

The present invention also provides for controlled dosing and dilution of liquid detergent, which can reduce unnecessary consumption over time.

5 The Device

The device comprises a reservoir for holding a quantity of liquid detergent. The shape of the reservoir is any convenient geometric shape, and preferably comprises a housing having a plurality of walls. The plurality of walls preferably includes a flat or substantially flat bottom surface and at least one sidewall. The device is configured to
10 stand on the bottom surface of the reservoir to allow dispensing of liquid detergent through a dispensing aperture on the upper surface of the device.

The reservoir is preferably provided with a fluid inlet port to aid filling of the reservoir with a liquid detergent. The inlet port can be sealed or provided with an air tight closure
15 mechanism. The seal or closure mechanism can comprises a removable cap that preferably allows refilling of the reservoir with liquid detergent. The cap can also be secured to the device (e.g. the reservoir wall) by a tether or hinge to prevent loss of the cap.

20 The plurality of walls that form the shape of the reservoir are preferably made of a rigid, non-flexible material. The thickness of the outer walls of the device is preferably in the range of approximately 0.5 mm to 2.00 mm, although the skilled person will appreciate that the thickness outside of this range may be suitable in other examples. Example dimensions of the reservoir can be 100 mm x 70 mm x 15 mm (e.g. l=105
25 mm; b=67 mm; h= 15 mm). The materials used for moulding the reservoir are preferably selected from polymeric materials such as nylon, polyacrylates, polycarbonates, Teflon®, polyethylene, polypropylene, elastomeric and rubber material, etc. More preferably, high density or low density polypropylene or blends thereof are used. Alternatively, the device can be made of metal, reinforced plastics,
30 laminates, glass or combinations of the above. In some preferred examples, at least a portion of the wall(s) that form the liquid containing reservoir are transparent or semi-transparent such that a liquid level within the reservoir is visible to the user.

A fluid dispensing assembly is operatively coupled to the reservoir to complete the device. The fluid dispensing assembly comprises a liquid dispensing system, an air dispensing system and a mixing structure to facilitate mixing of dispensed liquid and air to create a (air) diluted detergent foam. An actuator initiates dispensing of the liquid
5 detergent by activating the liquid and air dispensing systems. The actuator also comprises a dispensing aperture through which the (air) diluted detergent foam is delivered (e.g. to be transferred onto a washing implement such as a sponge, dish cloth or scrubbing brush).

10 It is preferable that the fluid dispensing assembly is actuated by application of a predetermined threshold pressure to the actuator by a user. This threshold pressure is the pressure below which the fluid and air dispensing mechanisms are not actuated and the liquid detergent is not released.

15 Liquid dispensing system

The liquid dispensing system is configured to deliver a quantity of liquid detergent from the reservoir first into the mixing structure for mixing with air to produce a detergent foam and then to the dispensing aperture, at which point the detergent can be transferred to a washing implement (such as a hand, sponge, dish cloth or scrubbing
20 brush). The liquid dispensing system comprises a first liquid bellows having a first compressible liquid chamber with a first liquid inlet and a first liquid outlet. The first liquid inlet is in fluid communication with the reservoir via a one-way valve, which is configured to allow liquid to move from the reservoir to the first compressible chamber (whilst preventing the flow of liquid in the opposite direction, i.e. from the first
25 compressible liquid chamber to the reservoir).

The liquid bellows can have any configuration that allows fluid to be forced from the compressible liquid chamber through the liquid outlet as the compressible liquid chamber is compressed. Preferably, the first compressible liquid chamber comprises at
30 least one collapsible side wall, an upper wall and a lower wall. In preferred examples, the lower wall comprises the liquid inlet and the upper wall comprises the liquid outlet, although other configurations are possible. In some examples, the compressible liquid chamber can be formed with concertina-type walls, having at least one flexible portion that allows the chamber to be compressed from a first expanded state having a first

volume to a collapsed state having a second volume, the second volume being smaller than the first volume. A single fold line around the sidewall can be sufficient to allow collapse of the compressible liquid chamber or multiple fold lines can be provided. Alternative collapsible configurations will also be apparent to the skilled person. For example, the sidewalls of the compressible liquid chamber can be formed of a flexible material that allows collapse of the compressible chamber under pressure to form a second smaller volume.

The first compressible liquid chamber can be in fluid communication with the reservoir via a first conduit that extends between the first liquid inlet and the reservoir. In preferred examples of the invention, a conduit is provided (e.g. a pipe or tube), which extends from the fluid inlet of the first compressible liquid chamber to the lower part of the reservoir (e.g. adjacent the bottom surface of the reservoir). The conduit can ensure that the first compressible liquid chamber is in direct fluid communication with the detergent liquid contained in the reservoir even when the level of liquid detergent in the reservoir is low. The conduit can be formed of a flexible material or a rigid material. In any event, the conduit should provide a path through which liquid detergent can travel from the reservoir to the first compressible liquid chamber.

In one exemplary arrangement, the conduit can be a flexible tube configured to have its reservoir opening end towards or adjacent the reservoir wall in which the inlet port is provided. This arrangement may help to avoid leakage of the liquid detergent through the compressible liquid chamber because, when the device is turned on its end to allow filling through the fill port, the opening of the conduit is provided above or near to the liquid surface.

The first compressible liquid chamber and the reservoir are in communication with each other via a first one-way valve. The one-way valve can be of any suitable type. In a preferred example, the one way-valve is a first one-way ball valve. In such examples, the one-way valve comprises a ball, which when seated in a valve opening, prevents the flow of fluid through the valve. The first ball can be moved out of its seated position occluding the valve opening to allow the flow of fluid through the valve. The first ball can be biased into a closed position by gravity, pressure within the liquid bellows, dedicated mechanical biasing means or a combination of the above. Since the first

one-way valve is configured to prevent the flow of fluid from the first compressible liquid chamber to the reservoir, as the first compressible liquid chamber is compressed (by the action of the actuator, which will be described in more detail below), liquid detergent contained within the compressible liquid chamber is forced through the first liquid outlet and into the mixing structure. Advantageously, the increased pressure within the first compressible chamber due to compression of the chamber serves to seat the first ball of the first one-way ball valve more firmly in its valve seat.

The first one-way valve of the first compressible liquid chamber allows refilling of the first compressible liquid chamber as the chamber expands to its uncompressed configuration. As the first compressible liquid chamber expands, a negative pressure is created within the compressible chamber, which draws fluid from the reservoir, through the fluid inlet (through the first one-way valve) and into the first compressible liquid chamber.

To facilitate the creation of a negative pressure within the first liquid chamber, the first liquid outlet can be occluded in some way. For example, the first liquid outlet can be occluded by a second one-way valve (e.g. a second one-way ball valve), that allows the flow of liquid out of the first compressible chamber through the second one-way valve (whilst preventing flow in the opposite direction, i.e. into the first compressible chamber via the second one-way valve). The second one-way ball valve can work in a similar manner to the first one-way ball valve. The second-one way ball valve can be biased into a second valve seat by gravity or a mechanical biasing means.

In alternative example, the liquid outlet can be partially occluded by the mixing structure, e.g. a porous material disposed within a mixing chamber. A porous material, e.g. a sponge disposed within the mixing chamber can advantageously facilitate production of a fine foam for dispensing through the dispensing aperture. Further details of the porous element will be provided below with reference to the mixing structure.

The collapsible walls of the first compressible liquid chamber can be formed of one or more thermoplastic elastomers. The first compressible liquid chamber can have an expanded (uncollapsed) interior volume of approximately 0.5 ml to 2.5 ml, although this

- skilled person will understand that volumes outside of this range may be used in some examples. The difference in volume between the uncollapsed chamber and the collapsed chamber is the same the quantity of undiluted liquid detergent that will be delivered to the mixing chamber. In preferred examples, this can be approximately 1 to 5 2 ml, e.g. 1.2 ml, although volumes outside this range may be appropriate in some examples. In preferred examples, the surrounding wall of the compressible liquid chamber is formed (at least partially) of a resilient material such that the compressible liquid chamber is biased into its expanded configuration.
- 10 In some examples, the device according to the present invention can comprise multiple liquid bellows. For example, the invention may further comprise second and third liquid bellows, or four or more liquid bellows. The multiple liquid bellows can be provided in alternating pattern with multiple compressible air chambers.
- 15 Alternatively, one or more liquid bellows may be provided with a circumference or perimeter of a larger compressible air bellows. For example, a relatively small liquid bellows can be disposed concentrically within a larger air bellows. Although liquid bellows and compressible air chambers having circular cross-sections can have favourable manufacturing procedures, non-circular concentric geometries are also 20 possible, as well as off-centre arrangement (e.g. with a liquid bellows disposed within a compressible air chamber without sharing a common central point).

Air dispensing system

- The air dispensing system is configured to deliver a quantity of air from the 25 compressible air chamber into the mixing structure for mixing with the liquid detergent (delivered to the mixing structure as described above) to produce a detergent foam. The air dispensing system comprises a compressible air chamber, which is collapsible from an expanded configuration having a first volume to a collapsed configuration having a second volume, which is smaller than the first volume. The compressible air 30 chamber also comprises an air outlet that is in fluid communication with the mixing structure. Upon collapse of the compressible air chamber, air is forced from the decreasing volume of the compressible air chamber, through the air outlet and into the mixing structure.

The compressible air chamber can have any configuration that allows air to be forced from the compressible air chamber through the air outlet as the compressible liquid chamber is compressed. Preferably, the first compressible air chamber comprises at least one collapsible side wall, an upper wall and a lower wall. In some examples, the compressible air chamber can be formed with concertina-type walls, having at least one flexible portion that allows the chamber to be compressed from a first expanded state having a first volume to a collapsed state having a second volume, the second volume being smaller than the first volume. A single fold line around the sidewall can be sufficient to allow collapse of the compressible air chamber or multiple fold lines can be provided. Alternative collapsible configurations will also be apparent to the skilled person. For example, the sidewalls of the compressible air chamber can be formed of a flexible material that allows collapse of the compressible air chamber under pressure to form the second smaller volume.

In a simplest example, the compressible air chamber can comprise a collapsible chamber as described above with a single air outlet. In such examples, the collapse of the chamber (in response to depression of the actuator) expels air through the air outlet. Subsequent expansion of the air chamber draws air through the air inlet to refill the compressible air chamber.

In alternative examples of the invention, the collapsible air chamber can be provided with an air inlet and an air outlet. In such examples, the air inlet can be closed by a third one-way valve configured to allow the flow of air into the compressible air chamber (from an external air supply), whilst preventing the flow of air in the opposite direction. The third one-way valve can be configured, for example, as a third one-way ball valve. The ball of the third one way valve can be configured to occlude the air inlet by sealing against a third valve seat (when in a closed position). Gravity, air pressure within the chamber or mechanical biasing means can bias the third ball against the third valve seat to prevent the flow of fluid out of the compressible air chamber via the inlet valve.

In this second example of the compressible air chamber, the air outlet need not be occluded by a one-way valve, although that is possible. In any event, the air outlet should be in communication with the mixing structure, as will be described below.

The collapsible walls of the compressible air chamber can be formed of low density polyethylene. The first compressible liquid chamber can have an expanded (uncollapsed) interior volume of between approximately 20 and 100 ml, e.g. approximately 60 ml. However, the skilled person will appreciate that other volumes
5 can be chosen in some examples. In preferred examples, the surrounding wall of the compressible air chamber is formed (at least partially) of a resilient material such that the compressible air chamber is biased into its expanded configuration.

In some examples, the device according to the present invention can comprise multiple
10 compressible air chambers. For example, the invention may further comprise second and third compressible air chambers or four or more compressible air chambers.

Mixing region

The liquid outlet(s) and the air outlet(s) are in fluid communication with the dispensing
15 aperture via a mixing region or chamber, which is configured to facilitate mixing of the expelled air and liquid to form a foam to be dispensed to the user via the dispensing aperture. The mixing chamber can contain one or more mixing structures that facilitate foam formation. The mixing structure(s) can take different forms.

20 In a first example of the present invention, the mixing structure can comprise a porous material (e.g. a sponge, preferably a PU sponge) disposed in a mixing chamber, into which the air and liquid outlets open. In some examples, the porous material can comprise an open pore structure having an average pore size of between approximately 0.05 mm and 0.4 mm, e.g. approximately 0.2 mm, although other pore
25 sizes may be appropriate. The total volume occupied by the porous material can be approximately 25 to 40 ml, although other volumes may be appropriate. An appropriate volume to be occupied by the porous material can be determined by the skilled person depending on the dimensions of the device, the volume of the liquid chamber, etc. The porous material is provided in the mixing chamber between the air and liquid outlets
30 and the dispensing aperture, such that liquid and air expelled from the respective compressible chambers passes through the porous material to reach the dispensing aperture.

As an alternative (or in addition) to the porous element described above, the mixing structure may comprise a plurality of restricted air outlet or a plurality of channels disposed within the mixing chamber that deliver air flow from the compressible air chamber to a quantity of liquid detergent in the mixing chamber. For example, the mixing chamber can comprise a plurality of channels or restricted air openings that provide fluid communication between a well or recess in which liquid dispensed from the liquid bellows collects. The plurality of channels can be provided around at least a part of the circumference or lower surface of the mixing chamber. The well or recess can comprise a recessed portion of the lower surface of the mixing chamber into which liquid expelled through the liquid outlet flows. The well can be formed as the lowest level of stepped arrangement, wherein the liquid outlet is arranged in the upper step or the well can be formed by an inclined lower surface of the mixing chamber, which slopes from the liquid outlet towards the channels or restricted air openings. In any event, the structure of the mixing chamber in this second example should be arranged such that liquid detergent entering the mixing chamber via the liquid inlet flows towards the mixing structure formed of the plurality of channels and/or restricted air openings.

In preferred examples, the mixing chamber has a substantially circular cross-section, with the liquid outlet disposed in a central region of the chamber. The plurality of channels can be arranged around an outer circumference of the mixing chamber, with the lower surface of the mixing chamber configured to allow fluid to flow from the liquid outlet (which may be substantially centrally located within the mixing chamber) towards the channels around the periphery. In preferred examples, the plurality of channels radiate from the outer circumference of the mixing chamber towards the liquid outlet. In such examples, the air outlet can extend circumferentially around the mixing chamber allowing ingress of air from the air outlet around the circumference of the mixing chamber.

Although in the example above, the mixing chamber has been described as having a substantially circular cross section, the skilled person will appreciate that other geometries are possible. For example, the mixing chamber may have a substantially quadrangular or polygonal cross-section, or an irregular cross-section e.g. to accommodate other components of the device.

In any of the examples described above, the mixing chamber can further comprise a mesh through which the foam generated in the mixing chamber is configured to pass before reaching the dispense aperture. The mesh can have any suitable pore size, for example a pore size of approximately 0.2 x 0.2 mm. Larger and smaller pore sizes can also be used, or a mesh comprising a plurality of different pore sizes. The mesh can advantageously aid further mixing and achieve a smaller average bubble size in the foam (e.g. a finer foam).

Actuator

The device comprises an actuator that is configured to dispense a quantity of liquid detergent (e.g. foam generated in the mixing chamber) upon application of a predetermined threshold force thereto such that the foam can be transferred onto a washing implement (e.g. sponge, dishcloth or scrubbing brush, etc.). The predetermined threshold force is the pressure below which the bellows are not compressed. This should be at a level that can be achieved by a user but not so low that it could be accidentally met (e.g. by an accidental bump).

Under the predetermined threshold pressure (or a pressure exceeding the predetermined threshold pressure) the actuator moves from a first position, in which the liquid bellows and the compressible air chamber are uncompressed (e.g. in their expanded configurations), to a second position, in which the liquid bellows and the compressible air chamber are (at least partially) compressed. The movement of the actuator from the first position to the second position can compress the liquid bellows and the compressible air chamber by direct contact between the actuator and the compressible chamber, or alternatively, an additional compression member operatively coupled to the actuator can contact the compressible air and liquid chambers as the actuator moves from its first position to its second position.

The actuator can be formed as a top plate that extends above the compressible liquid and air chambers. The top plate can be formed of substantially rigid non-flexible material, for example, through moulding. The materials used for the actuator are preferably selected from polymeric materials such as nylon, polyacrylates, polycarbonates, Teflon®, polyethylene, polypropylene, elastomeric and rubber material, etc. More preferably, high density or low density polyethylene or blends

thereof are used. Alternatively, the device can be made of metal, reinforced plastics, laminates, glass or combinations of the above

5 The thickness of the top plate is preferably in the range of approximately 0.5 mm to 1.5 mm, although other thickness can be chosen. Example dimensions of the top plate can be approximately 110 mm x 70 mm x 30 mm (e.g. l= 110 mm; b= 72 mm; h=28 mm). However, the dimensions of the top plate can be chosen by the skilled person as appropriate. In preferred examples, the top plate has a surface area with approximately the same dimensions as the reservoir.

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The actuator or top plate comprises an upper surface to which pressure can be applied to move the actuator from the first position to the second position. The top plate can further comprise one or more surrounding walls, that extend downwardly (towards the reservoir) from the upper surface. The surrounding walls can form a skirt that at least partially encloses the compressible air and liquid chambers described above.

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The top plate may further comprise a raised lip running around at least part of, and preferably the entire perimeter of the top plate. Alternatively or additionally, the upper surface of the top plate can be concave or comprise a recessed portion in or towards a central region of the upper surface.

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The dispensing aperture is provided in the actuator and provides fluid communication between the exterior of the device and the mixing chamber in which the foam is formed. The dispensing aperture can comprise a single aperture, although a plurality of dispensing apertures (e.g. arranged as an array of through holes) is preferred. In preferred examples, the dispensing apertures each have a diameter in the range of approximately 0.5 to 1.5 mm, although large and smaller apertures may be appropriate. Each dispensing aperture can have the same diameter or the diameters of the dispensing apertures can vary.

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The dispensing aperture provides an escape for the foam formed in the mixing chamber to exit the device (e.g. for transferral onto a washing implement). In preferred examples, the dispensing aperture(s) are provided as through holes in a top plate.

Preferably, the through holes are provided in the region of the top plate overlying the mixing chamber.

During use of the device, foam is dispensed through the dispensing aperture(s) onto
5 the upper surface of the top plate. From the upper surface of the top plate, the foam is transferred to washing implement.

The actuator is configured to return from its second position to its first position upon removal of the activation pressure. To this end, the actuator is biased into its first
10 position. One or both of the compressible air or liquid chambers can bias the actuator from its second position into its first position. Alternatively or as an additional feature, the device can comprise an additional biasing structure (e.g. mechanical biasing means, such as a spring) to bias the actuator from its first to its second position.

15 The invention will now be further exemplified with the following non-limiting figures and examples.

Figures

By way of example, the present invention is illustrated with reference to the following
20 figures, in which:

Figure 1 shows a perspective cross-sectional view of a device for dispensing liquid detergent according to an embodiment of the present invention;

25 Figure 2 shows a cross-sectional view of the liquid bellows shown in Figure 1;

Figure 3 shows a mixing structure according to an embodiment of the present invention;

30 Figure 4 shows a schematic view of a device for dispensing liquid detergent according to another embodiment of the present invention;

Figures 5A-5C show a device according to the present invention in use, before, during and after liquid detergent dispensing.

Detailed description of the figures

In the detailed description of the figures, like numerals are employed to designate like features of various exemplified devices according to the invention.

5

Figures 1 and 2 show a first embodiment of a device 110 for dispensing a liquid detergent. Figure 1 shows a perspective cross-sectional view of an assembled device. Figure 2 shows a cross-sectional view of the liquid bellows and mixing chamber of Figure 1 to more clearly show the internal working of the device 110.

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As shown in Figures 1 and 2, device 110 includes a reservoir 112 for holding a quantity of liquid detergent. The reservoir comprises a plurality of walls including a surrounding wall 112a, a bottom wall 112b and a top wall 112c. Together, the surrounding wall 112a, the bottom wall 112b and the top wall 112c provide an enclosed space for holding the liquid detergent. The reservoir 112 further comprises a fluid port 116 to allow refilling of the reservoir 112. The fluid port 116 is provided in the surrounding wall 112a and is configured to be sealed by a cap 118, but could be located elsewhere (e.g. in the bottom wall 112b).

20 The reservoir 112 is in fluid communication with a compressible chamber 120 of a liquid bellows 122. The liquid bellows 122 comprises a surrounding wall 122a, an upper wall 122b and a lower wall 122c, which cooperate to define an enclosed volume.

A liquid inlet 124 provides fluid communication between the interior volume of the compressible liquid chamber 120 and the reservoir 112 via a conduit 126. The conduit 126 connects the liquid inlet 124 with a lower region of the reservoir 112 (e.g. near or adjacent to the lower surface 112c of the reservoir) such that the liquid bellows can draw a supply of liquid from the reservoir 112 even if the level of liquid detergent is low.

30 The liquid inlet 124 is selectively closable by a one-way valve 128 which is configured to allow a flow of liquid from the reservoir 112 to the compressible liquid chamber 120, but prevent flow in the opposite direction. The one-way valve 128 shown in Figure 1 is a one-way ball valve, which comprises a ball 128a configured to selectively seal

against a valve seat 128b to prevent the flow of fluid through the valve 128 in one-direction.

5 The liquid bellows 122 is also provided with a liquid outlet 130. The liquid outlet 130 is configured to allow escape of liquid detergent from the liquid bellows 122 as the compressible liquid chamber 120 is collapsed. The liquid outlet 130 depicted in Figure 1 is closed by a second one-way valve 132 which allows the flow of fluid out of the compressible chamber, whilst preventing the flow of fluid into the compressible chamber 120 via the second one-way valve 132. However, other arrangements are
10 possible (e.g. the second one-way valve can be omitted and/or replaced e.g. with a different occluding means).

The second one-way valve 132 has a similar construction to the first one-way valve and includes a ball 132a configured to seal against a corresponding valve seat 132b to
15 prevent the flow of fluid through the second one-way valve in one direction.

The compressible liquid chamber 120 is configured to be collapsible from a first configuration having a first interior volume to a second configuration having a second interior volume, the second volume being smaller than the first. To allow collapse of
20 the compressible chamber 120, the surrounding wall 122a of the chamber 120 is flexible and/or foldable in a concertina like manner.

As shown in Figure 1, the device 110 further comprises a compressible air chamber 134 (e.g. air bellows). The compressible air chamber 134 comprises a surrounding wall
25 134a, a lower wall 134b and an upper wall 134c, which cooperate to define an enclosed interior volume of the compressible air chamber 134. The air chamber 134 further comprises an air inlet 136. The air inlet 136 is selectively closed by a third one-way valve 138. The third one-way valve is configured to permit the flow of air through the air inlet into the compressible air chamber, whilst preventing flow in the opposite
30 direction (i.e. out of the compressible air chamber 134 via the air inlet 136). The third one-way valve 138 can be similar in construction to the first and second one-way valves 128, 132. The third one-way valve 138 comprises a ball 138a and a valve seat 138b against which the ball seals to selectively prevent fluid flow through the valve.

The compressible air chamber 134 also comprises an air outlet 140. The air outlet 140 allows escape of air from the compressible air chamber 134 as the chamber is collapsed. The compressible air chamber 134 is configured to be collapsible from a first configuration having a first interior volume to a second configuration having a second interior volume, the second volume being smaller than the first. To allow collapse of the compressible air chamber 134, the surrounding wall 134a of the chamber 134 is flexible and/or foldable in a concertina-like manner.

The liquid bellows 122 is disposed within the circumference defined by the surrounding wall 134a of the compressible air chamber. The liquid bellows 122 and the compressible air chamber 20 share a lower surface or floor 142, which forms the lower surface 122a of the liquid bellows and the lower surface 134a of the compressible air chamber 134. A seal is formed between the liquid bellows 122 and the compressible air chamber 134 to isolate the interior volume of the liquid bellows 122 from the interior volume of the compressible air chamber 134.

The upper wall 122c of the liquid bellows 122 and the upper wall 134c of the air chamber 134 join to form a circumferential restricted opening that acts as the air outlet 140.

The liquid outlet 130 and the air outlet 140 open into a mixing chamber 144, which is disposed above the compressible air and liquid chambers 120, 134. The mixing chamber comprises a sidewall and a bottom wall that define a mixing volume therein. A mixing structure 146 is provided in the mixing chamber 144, which facilitates mixing of air expelled from the air chamber and liquid expelled from the liquid chamber to form a detergent foam.

The mixing structure 146 can take various forms and preferably includes a plurality of locations or junctions at which air expelled from the compressible air chamber 134 and liquid expelled from the liquid bellows 122 are brought into contact for mixing.

One exemplary mixing structure 146 will now be described in more detail with reference to Figure 3. As shown in Figure 3, the bottom wall 144b of the mixing chamber 144 comprises the mixing structure 146. The mixing structure 146 comprises

a plurality of channels 148 extending from the circumferential air outlet 140 (which runs at least part way around a circumference of the mixing chamber 144) towards a liquid collection region or well 150 into which liquid detergent from the liquid outlet 130 is configured to flow. The plurality of channels 148 are formed between a portion of an upper surface of the bottom wall 144b and a portion of a lower surface of the upper wall 134b of the air chamber 144 arranged in opposing relationship with each other. This arrangement has the effect of providing a plurality of channels 148 along which air from the air outlet 140 can travel for mixing at a plurality of junctions with the collection region or well 150. The skilled person will appreciate that other structures can provide a similar or equivalent result.

The mixing chamber 144 is configured such that liquid detergent entering the mixing chamber 144 via the liquid outlet 140 collects in the collection well 150. In the embodiment shown in Figure 3, this is achieved with a stepped structure, comprising the liquid opening in a highest or upper step, with steps of decreasing height guiding the flow of liquid towards the collection well 150. The skilled person will also appreciate that a sloped lower wall 144b of the mixing chamber 144 can also be used, with the liquid inlet located at a higher elevation (relative to the reservoir base on which the device stands) than the liquid collection region or well 150.

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In the embodiment shown in Figure 3, the mixing chamber further comprises an upper wall 144c, which includes a mesh 152 through which the air/liquid mixture must pass to exit the device.

Referring again to Figure 1, the device 110 further comprises an actuator in the form of a top plate 154, which is configured, upon application of downward pressure by a user to compress the liquid bellows 122 and the compressible air chamber 134 and expel the fluid contained therein into the mixing chamber 144. The actuator 154 is movable between a first position in which the air chamber and the liquid bellows are not compressed and a second state in which the air chamber and the liquid bellows are compressed. The compressible air chamber 134 and/or the liquid bellows 122 bias the actuator 154 into its first position.

As shown in Figure 1, the top plate 154 comprises an upper surface 154a comprising a plurality of dispensing apertures 156, which are in fluid communication with the mixing chamber 144. The dispensing apertures 156 are arranged as an array of through holes that extend through a central portion of the top plate 154.

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The central portion of the top plate is recessed compared to a raised lip 158 that extends around a perimeter of the top plate 154. Top plate sidewalls 154b extend downwardly from the lip 158 to provide a skirt that at least partially encloses the air and liquid bellows 122, 134.

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A second embodiment of the invention will now be described with reference to Figure 4. Figure 4 shows a device 210 according to a second embodiment of the invention. The device 210 comprises a reservoir 212 comprising a sidewall 212a, a bottom wall 212b and an upper wall 212c. Together, the surrounding wall 212a, the bottom wall 212b and the top wall 212c provide an enclosed space for holding the liquid detergent. The reservoir 212 further comprises a fluid port 216 to allow refilling of the reservoir 212. The fluid port 216 is provided in the surrounding wall 212a.

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The reservoir 212 is in fluid communication with compressible chambers 220 of first and second liquid bellows 222. The liquid bellows 222 each comprise a surrounding wall 222a, a lower wall and an upper wall, which cooperate to define an enclosed volume.

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A liquid inlet 224 provides fluid communication between the interior volume of each of the compressible liquid chambers 220 and the reservoir 212 via a conduit 226. The conduit 226 connects the liquid inlet 224 with a lower region of the reservoir 212 (e.g. near or adjacent to the lower surface 212c of the reservoir) such that the liquid bellows 222 can draw a supply of liquid from the reservoir 212 even if the level of liquid 214 is low.

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Each of the liquid inlets 224 is selectively closable by a one-way valve 228 which is configured to allow a flow of liquid from the reservoir 212 to the compressible liquid chambers 220, but prevent flow in the opposite direction (i.e. from the liquid chamber 220 into the reservoir 212). The one-way valve 228 shown in Figure 4 is a one-way ball

valve, which comprises a ball 228a configured to selectively seal against a valve seat 228b to prevent the flow of fluid through the valve 228 in one-direction.

Each of the liquid bellows 222 is also provided with a liquid outlet 230. The liquid outlet
5 is configured to allow escape of liquid detergent 214 from the liquid bellows 222 as the compressible liquid chamber 220 is collapsed.

Each compressible liquid chamber 220 is configured to be collapsible from a first
configuration having a first interior volume to a second configuration having a second
10 interior volume, the second volume being smaller than the first. To allow collapse of the compressible chambers 220, the surrounding walls 222a of the chambers 220 are flexible or foldable in a concertina-like manner.

As shown in Figure 4, the device 210 further comprises a compressible air chamber
15 234. The compressible air chamber 234 comprises a surrounding wall 234a, a lower wall and an upper wall, which cooperate to define an enclosed interior volume of the compressible air chamber 234.

The compressible air chamber 234 also comprises an air outlet 240. The air outlet 240
20 allows escape of air from the compressible air chamber 234 as the chamber is collapsed. Conversely, the air outlet 240 is configured to act also as an air inlet through which air is drawn into the interior of the chamber 234 as the chamber expands to its uncollapsed volume.

25 In a similar manner to the liquid bellows 222, the compressible air chamber 234 is configured to be collapsible from a first configuration having a first interior volume to a second configuration having a second interior volume, the second volume being smaller than the first. To allow collapse of the compressible air chamber 234, the surrounding wall 234a of the chamber 234 is flexible and/or foldable in a concertina
30 like manner.

The compressible air chamber 234 is disposed between the first and second liquid bellows 222. The liquid bellows 222 and the compressible air chamber 234 share a

lower surface or floor 42, which forms the lower surface 222a of the liquid bellows and the lower surface 234a of the compressible air chamber 234.

5 The liquid outlets 230 and the air outlet 240 open into a mixing chamber 244, which is disposed above the compressible air and liquid chambers 220, 234. The mixing chamber 244 comprises a sidewall 244a and a bottom wall 244b that define a mixing volume therein. A mixing structure 246 is provided in the mixing chamber 244, which facilitates mixing of air expelled from the air chamber and liquid expelled from the liquid chamber to form a detergent foam.

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The mixing structure 246 in the embodiment shown in Figure 4 takes the form of a sponge, preferably a PU sponge disposed within the mixing chamber 244. The air outlet 240 and the liquid outlet 230 are in fluid communication with each other via the sponge 246 such that as liquid detergent is expelled from the liquid bellows 222, it enters the sponge and is mixed with air expelled from the air outlet 240, which is also expelled into the sponge 246. To facilitate the delivery of air and liquid into the sponge 246, the air and liquid outlets 240, 230 open directly into the sponge 246.

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Referring still to Figure 4, the device 210 further comprises an actuator in the form of a top plate 254, which is configured, upon application of downward pressure by a user to compress the liquid bellows 222 and the compressible air chamber 234 to expel the fluid contained therein into the mixing chamber 244. The actuator 254 is movable between a first position in which the air chamber and the liquid bellows are not compressed and a second state in which the air chamber and the liquid bellows are compressed. The compressible air chamber 234 and/or the liquid bellows 222 bias the actuator into its first position.

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In the embodiment shown in Figure 4, the actuator 254 is not in direct contact with the liquid bellows 222 or the compressible air chamber 234. Instead, the bottom wall of the mixing chamber 244b can be configured to act as a compression member for compressing the compressible air and liquid chambers. To this end, the lower wall of the mixing chamber 244b is coupled to the actuator 254 such that downward movement of the actuator from its first position to its second position results in downward movement of bottom wall 244b of the mixing chamber, which acts upon the

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liquid bellows 222 and the compressible air chamber 234. The sponge 246 is disposed between the actuator 254 and the bottom wall 244b of the mixing chamber 244.

5 As shown in Figure 1, the top plate 254 comprises an upper surface 254a comprising a plurality of dispensing apertures 256, which are in fluid communication with the mixing chamber 244. The dispensing apertures 256 are arranged as an array of through holes that extend through a central portion of the top plate 254.

10 The upper surface 254a of the top plate 254 is concave to provide a recessed central portion of the top plate when compared to the periphery of the top plate 254. Top plate sidewalls 254b extend downwardly from the edge 258 of the top plate 254 to provide a skirt that partially encloses the air and liquid bellows 222, 234.

15 Use of the device will now be described with reference to Figures 5A-5C, which show a device according to the invention before, during and after a quantity of liquid is dispensed.

20 Figure 5A shows a device according to the second embodiment of the invention (described with reference to Figure 4) as a downward pressure is applied to the actuator 254 in the direction of arrows A. In an exemplary scenario, the downward pressure is applied with a washing implement (e.g. a sponge, dishcloth or scrubbing brush), preferably with a swiping motion.

25 As the actuator moves from its first position to its second position (shown in Figure 5A), the lower wall 244b (acting as a compression member) applies a downward pressure to the liquid bellows 222 and the compressible air chamber 234 thus causing them to collapse from the expanded configuration to the compressed configuration. As the volume of the compressible liquid and air chambers decreases, the fluid (air/liquid detergent) contained therein begin to be expelled through the liquid and air outlets 230, 30 240 into the mixing chamber 244 (which contains the sponge 246).

Figure 5B shows the device at the point at which the actuator 254 has completed its downward travel and the compressible air and liquid chambers have been compressed. At this point, the air contained in the compressible air chamber and the

liquid contained in the compressible liquid chamber have been expelled into the sponge 246, where they mix to form a foam. Since the volume of foam provided by the mixing of the liquid detergent and the air exceeds the freely available volume of the mixing chamber 244, the foam escapes from the mixing chamber 244 through the dispensing apertures 256 and onto the upper surface 254a of the actuator 254. From there the dilute detergent (in the form of a foam) is transferred to the washing implement.

Figure 5C shows the device after the downward pressure has been removed and the actuator 254 returns to its rest position. As shown in Figure 5C, the actuator returns from the second position to the first position under a biasing force provided by the liquid bellows 222 and/or the compressible air chamber. To provide such a biasing force, the surround walls 222a, 234a of the liquid bellows 222 or the compressible air chamber 234 can be made of a resilient material which is biased into its uncompressed state.

As the actuator 254 returns to its first position the interior volumes of the liquid bellows 222 and the compressible air chamber 234 expand to their uncollapsed configurations, thereby drawing fluid into their respective interior volumes.

As the liquid bellows 222 expands to its expanded configuration, a negative pressure created therein draws liquid detergent from the reservoir 212, through the conduit 226 and the one-way valve 228 into the compressible liquid chamber 220.

Similarly, as the compressible air chamber 234 returns to its expanded configuration, a negative pressure created therein draw air through the air inlet into the internal volume of the compressible air chamber 234. The device is therefore refilled and ready to dispense a second quantity of fluid.

The skilled person will appreciate that a negative pressure in the compressible air chamber 234 is easily created since the air chamber 234 comprises only one opening: air outlet 240. A negative pressure sufficient to draw liquid detergent into the liquid bellows 222 is created due to the partial occlusion of the liquid outlet(s) 230 by the sponge 246 disposed in the mixing chamber 244.

The skilled person will also appreciate that the embodiment of the invention described with reference to Figures 1 to 3 operates in a similar manner to that described above with reference to Figures 5A-5C. However, the precise operation of some features differs.

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For example, in the device described with reference to Figures 1 to 3, mixing of the liquid detergent with the air occurs in the mixing structure 146 with the plurality of channels 148. In the embodiment shown in Figures 1 to 4, air ingress into the air chamber is via third one-way valve 138 closing the air inlet 136, which allows the flow of air into the compressible air chamber 134 as it expands, but prevents flow of air through the air inlet 136 as the chamber 134 is compressed, thus forcing air through the air outlet 140 and into the mixing chamber 144.

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Similarly, in the embodiment shown in Figures 1 to 3, the liquid outlet 130 is closed by a second one-way valve 132, which prevents the flow of fluid from the mixing chamber 144 into the liquid bellows 122. This one-way ball arrangement serves to create a negative pressure within the compressible chamber 120 of the liquid bellows 122, which thereby draws fluid from the reservoir 112 into the chamber 120 to refill the liquid chamber as described above.

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While the invention has been described with reference to exemplary or preferred embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular or preferred embodiments or preferred features disclosed, but that the invention will include all embodiments falling within the scope of the appended claims.

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Claims

1. A device (110, 210) for dispensing a liquid detergent, the device comprising:
 - a reservoir (112, 212) configured to hold a liquid detergent;
 - a first liquid bellows (122, 222) comprising a first compressible liquid chamber (120, 220) having a first liquid inlet (124, 224) and a first liquid outlet (130, 230), the first liquid inlet (124, 224) being in fluid communication with the reservoir (112, 212) via a first one-way valve (128, 228) configured to allow liquid to move from the reservoir (112, 212) to the first compressible liquid chamber (120, 220);
 - a compressible air chamber (134, 234) having an air outlet (140, 240);
 - an actuator (154, 254) comprising a dispensing aperture (156, 256), the actuator (154, 254) being movable between a first position and a second position, wherein the actuator (154, 254) is configured to compress the first liquid bellows (122, 222) and the compressible air chamber (134, 234) upon movement of the actuator (154, 254) from the first position to the second position, wherein the actuator (154, 254) comprises a top plate, wherein the dispensing aperture (156, 256) comprises one or more through-holes in the top plate; and
 - a mixing chamber (144, 244) for mixing air expelled from the compressible air chamber (134, 234) with liquid expelled from the liquid bellows (122, 222), wherein the air outlet (140, 240) and the first liquid outlet (130, 230) are in fluid communication with the dispensing aperture (156, 256) via the mixing chamber (144, 244).
2. The device (210) according to claim 1, wherein the mixing chamber (244) comprises a mixing structure (246) comprising a porous material, e.g. a sponge.
3. The device (110) according to claim 1 or claim 2, wherein the mixing chamber (144) further comprises a plurality of channels (148) extending from the air outlet (140) into the mixing chamber (144).
4. The device (110) according to claim 3, wherein the plurality of channels (148) are formed between opposing surfaces of a mixing chamber base (144b) and an upper wall part (134b) of the compressible air chamber (134).

- 28 -

5. The device (110, 210) according to any one of claims 1 to 4, wherein the liquid bellows (122, 222) further comprises a second one-way valve (132) configured to allow fluid flow from the liquid bellows (122, 222) into the mixing chamber (144, 244).

6. The device (110, 210) according to any one of claims 1 to 5, wherein the compressible air chamber (134, 234) further comprises a third one-way valve (138) configured to allow a flow of air into the compressible air chamber (134, 234).

7. The device (110) according to any one of claims 1 to 6, wherein the liquid bellows (122) is provided within a circumference of the compressible air chamber (134).

8. The device (210) according to any one of claims 1 to 7, further comprising a second liquid bellows (222) comprising a second compressible liquid chamber (220) having a second liquid inlet (224) and a second liquid outlet (230), the second liquid inlet (224) being in fluid communication with the reservoir (212) via a fourth one-way valve (228) configured to allow liquid to move from the reservoir (212) to the second compressible liquid chamber (220).

9. The device (210) according to claim 8, wherein the compressible air chamber (234) is disposed between the first and second liquid bellows (122).

10. The device (110, 210) according to any one of claims 1 to 9, wherein the actuator (154, 254) is biased into its first position.

11. The device (110, 210) according to claim 1, wherein the dispensing aperture (156, 256) is disposed on a recessed or concave upper surface (154a, 254a) portion of the plate (154, 254).

12. The device (110, 210) according to any of claims 1 to 11, comprising a plurality of dispensing apertures (156, 256).

- 29 -

13. The device (110, 210) according to any of claims 1 to 12, wherein the mixing chamber (144, 244) further comprises a mesh (152) arranged between the air (140, 240) and liquid (130, 230) outlets and the dispensing aperture (32).

14. A method of forming a device according to any one of claims 1 to 13.

Fig. 1

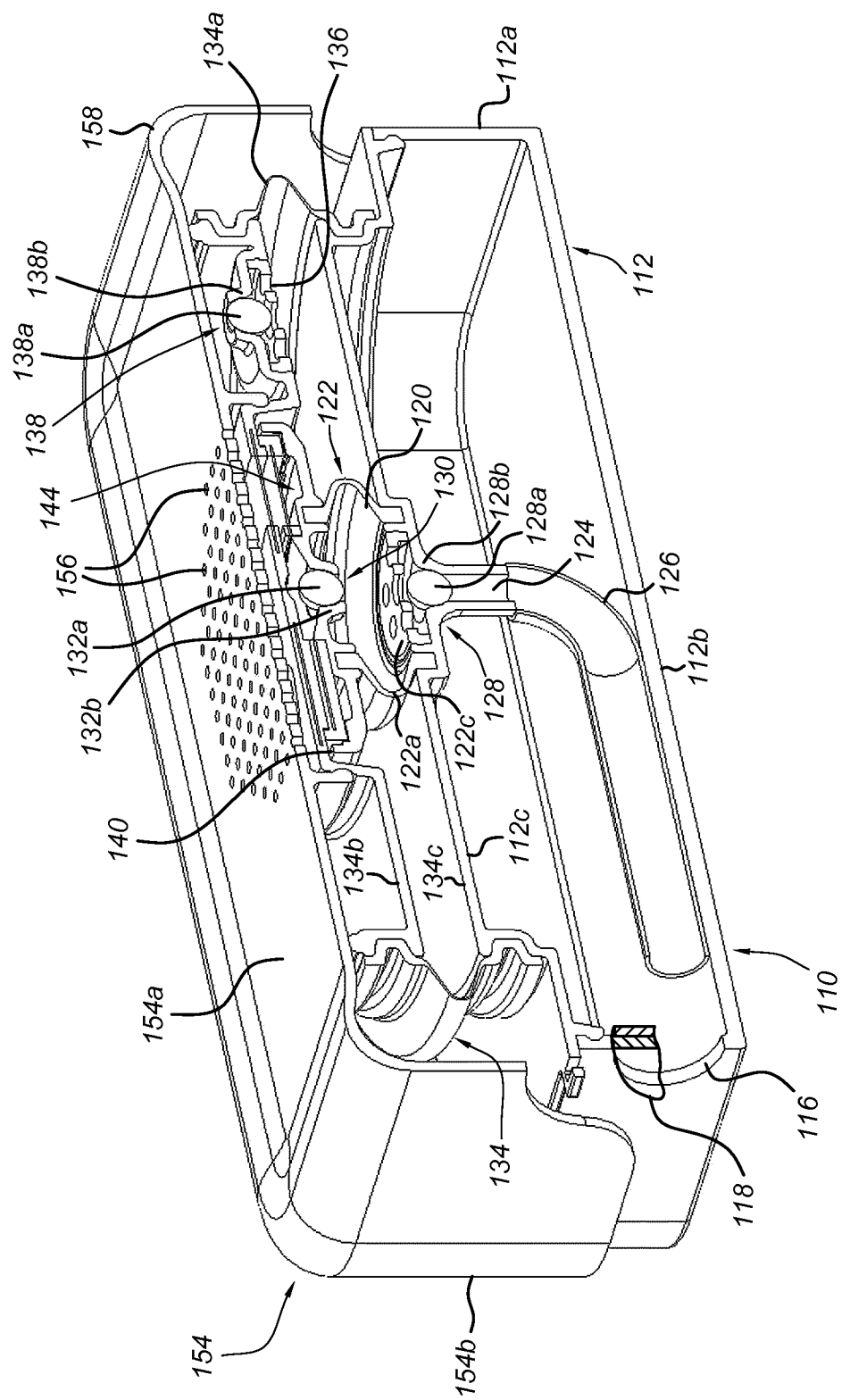


Fig. 2

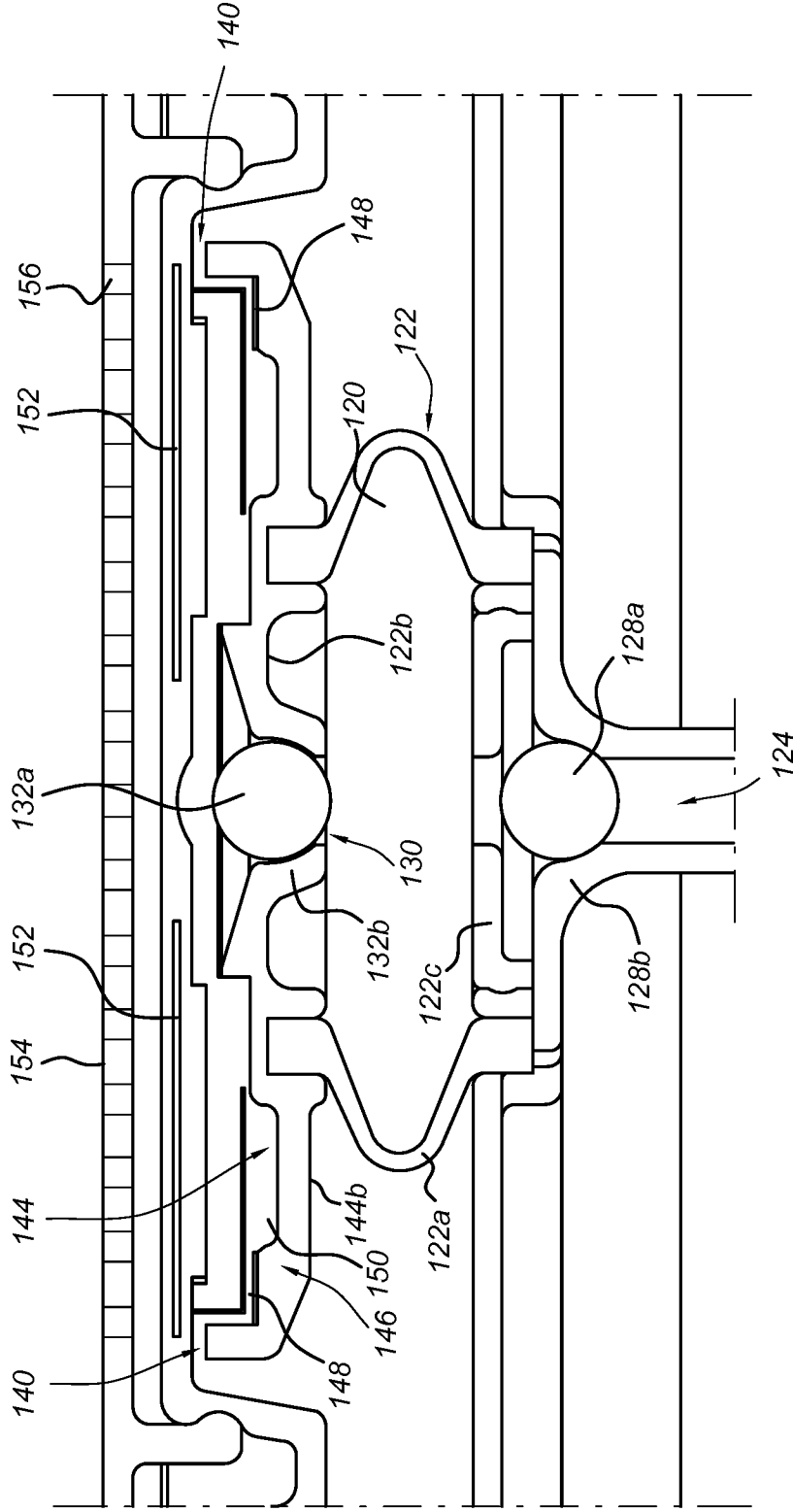


Fig. 3

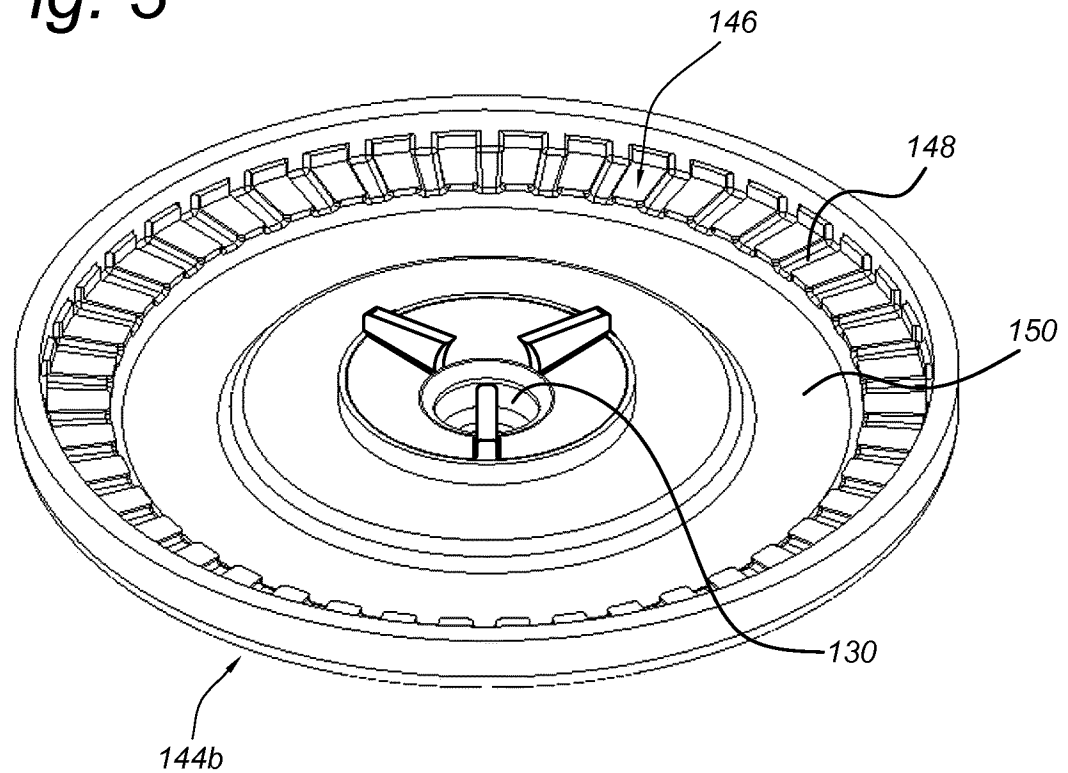


Fig. 4

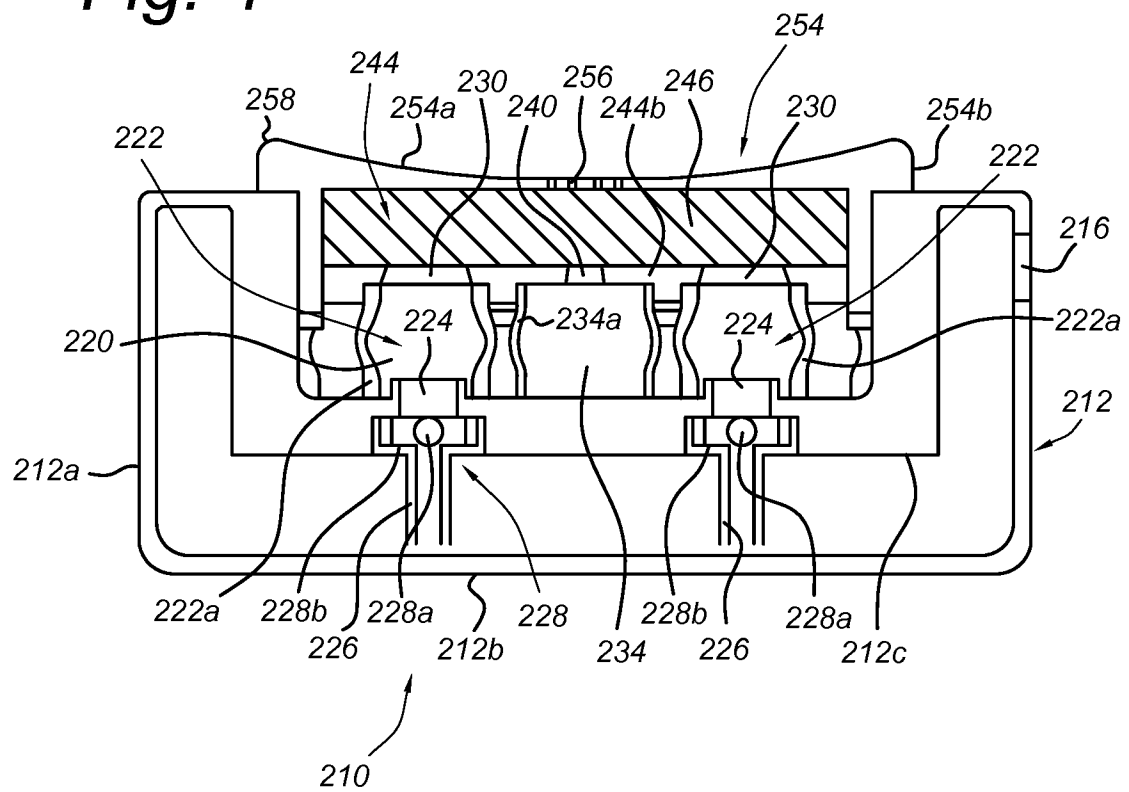


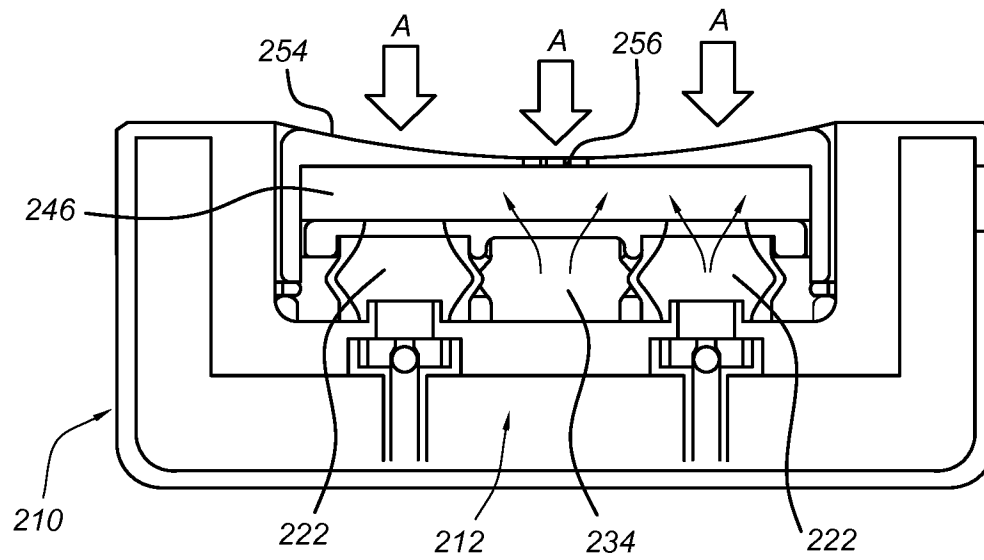
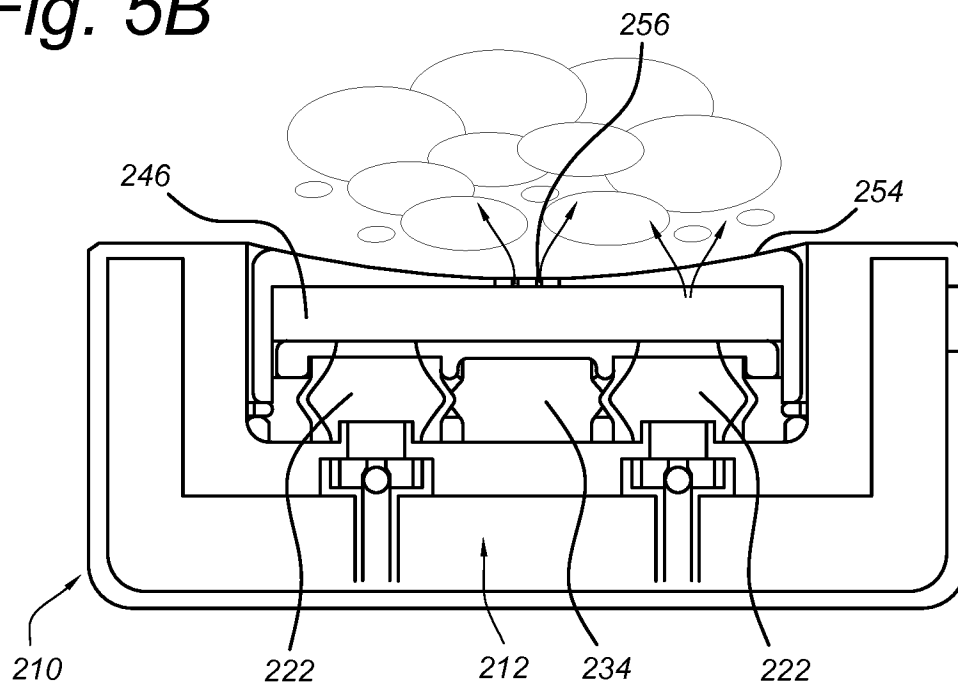
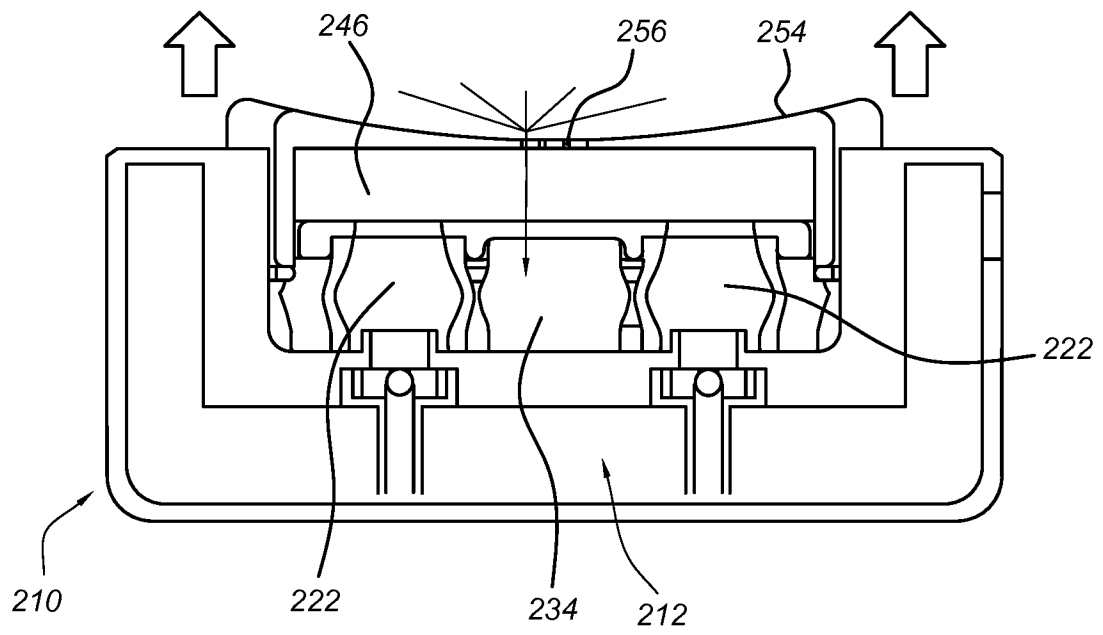
Fig. 5A*Fig. 5B*

Fig. 5C



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/083270

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47K5/12 A47L17/00
ADD.

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)
A47K A47L

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.
A	EP 2 080 464 A2 (GOJO IND INC [US]) 22 July 2009 (2009-07-22) paragraph [0006] - paragraph [0011]; figure 1	1-14
A	----- US 2012/308405 A1 (MCNULTY JOHN J [US] ET AL) 6 December 2012 (2012-12-06) paragraph [0018] - paragraph [0027]; figures 1-3	1-14
A	----- US 2012/074171 A1 (QUINLAN ROBERT L [US] ET AL) 29 March 2012 (2012-03-29) paragraph [0016] - paragraph [0059]; figures -----	1,2,13, 14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

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Date of the actual completion of the international search

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

De Coene, Petrus

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/083270

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