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(54) **Device and Method for Ultrasonic Cleaning**

(57) Device and method for cleaning glasses and other objects. The device (1) is an ultrasonic cleaning apparatus comprising a cleaning tank (2), one or more ultrasonic generators (10a), for producing ultrasonic waves in the tank, one or more inlet and outlet openings (3) for guiding a cleaning liquid (9) through a fluid chan-

nelling system comprising one or more ducts (4) into said tank (2), the device (1) comprising one or more pumps (6) for pumping the liquid (9) into and out of the tank (2), the device further comprising one or more valves (5). Additionally, a cartridge (8) comprising a cleaning liquid (9), is used with or by the device (1).

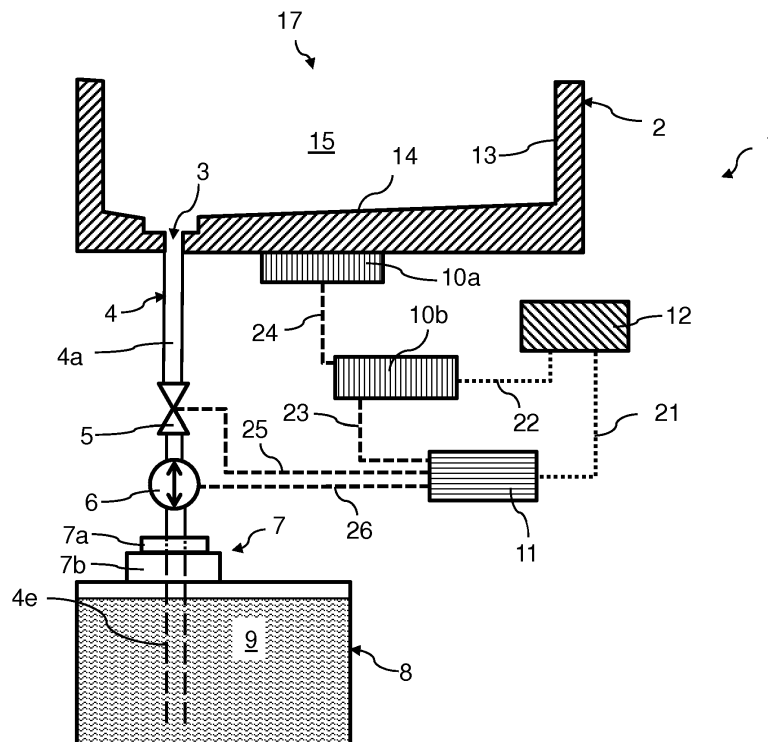


Figure 1

Description**Technical Field**

5 **[0001]** The present invention relates to cleaning devices for glasses, in particular an ultrasonic cleaning device, to cartridges comprising a cleaning liquid, cartridges comprising a rinsing and/or drying liquid, and methods for cleaning glasses or other objects.

Prior Art and the Problem Underlying the Invention

10 **[0002]** The present invention addresses problems related to the cleaning of glasses and other small objects in general, household objects, jewellery and the like. For cleaning glasses, for example, a wearer of glasses generally uses a cleaning cloth and cleans the glasses by hand. While this type of cleaning may be suitable to remove visible dirt from the glasses and thereby improve transparency, there are several disadvantages. First of all, the manual cleaning is
15 generally not complete in that some parts of the glasses cannot be cleaned, in particular surfaces of the glasses around the bridge of the glasses, close to the nose pads or around the articulation of the temple arms. Secondly, manual cleaning may damage delicate parts of glasses, such as the mount of the nose pad, for example. Thirdly, manual cleaning does not remove very small dirt and omnipresent microbes. Microorganisms present on the skin are generally found on all parts of the glasses.

20 **[0003]** Ultrasonic cleaning devices are known to address some of the problems of manual cleaning, and such devices are used specifically by opticians. Some of these ultrasonic cleaners are not suitable for use at home, due to the professional handling that is required for running the device. Most of these devices provide direct access to the cleaning tank without any protection with regard to the cleaning liquid, so that there is a risk of spilling the cleaning fluid present in the device. Some ultrasonic cleaning devices are used in that the optician immerses the glasses by holding it on a
25 part of the temple arms, generally on one of the bows at the extremity of a temple arm. Therefore, the part where the glasses are held are not immersed into the cleaning liquid and thus not cleaned.

[0004] Recently, ultrasonic cleaning devices for domestic use have been developed. The user generally pours the cleaning liquid into a cleaning tank and puts the glasses into the tank thereafter. After cleaning, the glasses are removed and the cleaning liquid may be left in cleaning tank, may be poured back into a recipient of the cleaning liquid manually,
30 or may be discarded. This is of course an inconvenient process. Even when using a funnel there is a risk of spilling the liquid. Furthermore, the cleaning liquid may stay on the glasses for some time, so that drying is required, using again a drying cloth or leaving the glasses in the open air for drying. In general, commercially available ultrasonic cleaning devices for domestic use are not user-friendly. The handling with the cleaning liquid is inconvenient. The user is not well protected from getting in contact with the cleaning liquid, in particular when adding the liquid or removing it from the
35 cleaning tank.

[0005] There is thus a need for providing means that enable rapid and convenient cleaning of glasses, preferably without any manual manipulation of cleaning. Preferably, such a cleaning should be complete and thorough, removing macroscopic as well as microscopic dirt and killing microbes.

[0006] The present invention addresses the problems depicted above.

Summary of Invention

[0007] Surprisingly, the present invention provides novel devices for conveniently cleaning glasses and other objects. The invention also provides recipients, in particular cartridges, containing a cleaning and/or rinsing liquid. The recipients
45 are preferably adapted to be used with the devices of the invention. Furthermore, the invention provides compositions that can be used for cleaning and/or rinsing glasses and other objects.

[0008] In an aspect, the present invention provides a cleaning device for glasses and other objects, the device comprising a cleaning tank, one or more inlet and outlet openings for guiding a cleaning liquid through one or more fluid channeling system comprising one or more ducts into said tank, the device comprising one or more pumps for pumping
50 the liquid into and out of the tank.

[0009] In an aspect, the present invention provides an ultrasonic cleaning device for glasses and other objects, the device comprising a cleaning tank, one or more ultrasonic generator, for producing ultrasonic waves in the tank, one or more inlet and outlet openings for guiding a cleaning and/or rinsing liquid through one or more fluid channeling system comprising one or more ducts into said tank, the device comprising one or more pumps for pumping the liquid into and
55 out of the tank, the device further comprising one or more valves for controlling a flow of the cleaning liquid into and out of said tank.

[0010] In an aspect, the invention provides a cartridge comprising cleaning liquid.

[0011] In an aspect, the invention provides a cartridge comprising a rinsing and/or a drying liquid.

[0012] In an aspect, the invention provides a cartridge comprising a cleaning liquid and a rinsing or a drying liquid. In an embodiment, the invention provides a cartridge comprising two compartments, one compartment comprising a cleaning liquid and the other compartment comprising a rinsing/drying liquid.

[0013] In an aspect, the invention provides cartridges for use with the device and/or in the methods of the invention.

[0014] In an aspect, the invention provides a cartridge for cleaning and/or rinsing liquid for the cleaning device of the invention, said cartridge comprising one or more connectors and/or openings.

[0015] In an aspect, the invention provides a cartridge for cleaning and/or rinsing liquid for the cleaning device of the invention, said cartridge comprising one or more opening comprising a self-closing valve.

[0016] In an aspect, the invention provides a cartridge for cleaning and/or rinsing liquid for the ultrasonic cleaning device of the invention, said cartridge comprising one or more opening comprising a self-closing valve.

[0017] In an aspect, the invention provides a cartridge containing a cleaning and/or rinsing liquid for the ultrasonic cleaning device of the invention, said cartridge comprising one or more openings, wherein said opening comprises a self-opening valve, said valve being adapted to open when a connector is connected to said opening.

[0018] In an aspect, the invention provides a cartridge for cleaning and/or rinsing liquid for a cleaning device, said cartridge comprising one or more openings for connecting the cartridge with the device of the invention, wherein said cartridge comprises two separate compartments, a first compartment and a second compartment, wherein said first and second compartments comprise different liquids.

[0019] In an aspect, the invention provides methods for cleaning glasses and other objects using the device, cartridge and/or compositions of the invention.

[0020] In an aspect, the invention provides a method for cleaning glasses or other objects, the method comprising the steps of:

- pumping a cleaning liquid through one or more fluid channeling system or duct into a cleaning tank of the cleaning device of the invention, wherein an object to be cleaned is present and/or has previously been placed to the cleaning tank;
- cleaning the object by the and/or in presence of said cleaning liquid; and,
- pumping said cleaning liquid out of said cleaning tank.

[0021] In an aspect, the invention provides a method for cleaning glasses or other objects, the method comprising the steps of:

- pumping a cleaning liquid through one or more fluid channeling system or duct into a cleaning tank of an ultrasonic cleaning device comprising an object to be cleaned;
- applying an ultrasonic treatment so as to clean said object;
- pumping said cleaning liquid out of said cleaning tank.

[0022] Further aspects and preferred embodiments of the invention are defined herein below and in the appended claims.

[0023] Further features and advantages of the invention will become apparent to the skilled person from the description of the preferred embodiments given below, which illustrate the invention without limiting its scope.

Brief Description of the Drawings

[0024]

Figure 1 is a schematic representation of first embodiments of the device and of a cartridge, respectively, of the invention.

Figure 2 shows schematic representations of other embodiments of the device and the cartridge of the invention.

Figure 3 is a schematic representation of further embodiments of the device and the cartridge of the present invention.

Figure 4 is a schematic representation of yet other embodiments of the device and the cartridge of the present invention.

Figure 5 is a schematic representation of still other embodiments of the device and the cartridges of the present invention.

Figure 6 is a schematic representation of other embodiments of the device and the cartridges of the present invention.

Figure 7 is a schematic representation of other embodiments of the device and the cartridges of the present invention.

5 **Figure 8** is a schematic representation of other embodiments of the device and the cartridges of the present invention.

Figure 9 schematically represents an embodiment of the cleaning tank of the device of the present invention.

10 **Figure 10** schematically represents an embodiment of the cleaning tank and its lid in accordance with an embodiment of the device of the present invention, the lid being shown in an open position.

Figure 11 is as Figure 10, with the lid being shown in a closed position.

15 **Figure 12** schematically represents an embodiment of the invention including a housing and a pivotable cleaning tank, the tank being closed.

Figure 13 is as Figure 11, the cleaning tank being open.

20 **Figure 14** shows a cleaning tank and an insert in accordance with an embodiment of the invention.

Figure 15 shows an empty cleaning tank according to an embodiment of the invention.

Figure 16 shows the embodiment of Figure 15, the cleaning tank being filled with a cleaning fluid.

25 Detailed Description of the Preferred Embodiments

30 **[0025]** The present invention concerns, in some aspects, a device for cleaning glasses and other objects. The expression "glasses", for the purpose of this specification, encompasses all types of ophthalmic appliances, such as corrective appliances such as eyeglasses and spectacles, but also non-corrective appliances, for sunglasses, shades, and appliances that may be both, corrective and non-corrective and which may or may not comprise a UV protection. The expression "glasses" preferably encompasses all types of appliance comprising an at least partially transparent medium such as glass or plastic to be carried by a human subject, wherein the appliance is used by the subject by glaring and/or viewing the subject's environment across the at least partially transparent medium.

35 **[0026]** For avoiding any doubts it is clarified that the term "glasses" is not intended to mean that the appliances necessarily need to comprise or consist essentially of glass. If the "glasses" comprise lenses, the latter may be made from and/or comprise plastic material, for example.

40 **[0027]** The expression "other objects", for example in the larger expression "for glasses and other objects", encompasses objects that can be put into the cleaning tank and thus be cleaned by the device and methods of the invention. Preferably, the objects are not susceptible to the contact with water and/or other liquid compositions. For example, if the "object" is a watch, for example a wrist-watch, the latter is preferably water resistant. Other objects may be jewellery, watches, medical equipment, household objects and the like. For example, cutlery and/or silverware may be "objects" that can be cleaned with the device of the invention. In an embodiment, the device of the invention can be used for cleaning glasses, jewellery, watches and medical equipment, which all are encompassed by the expression "other objects".

45 **[0028]** In general, the expression "other objects" encompasses any object that is small enough to fit into the cleaning tank of the device of the invention and which is preferably not damaged when being exposed to and/or immersed in any one of the cleaning and/or rinsing liquids that may be used in the context of the uses, methods, devices and cartridges of the present invention.

50 **[0029]** In a preferred embodiment, the device of the invention is an ultrasonic treatment apparatus. In other embodiments, the device does not use ultrasonic treatment for cleaning.

[0030] In an embodiment, the device is designed for domestic use, to be used by an individual at home or at work. In other embodiments, the device is used commercially, for example in commercial cleaning methods. For example, the device is used by an optician and/or a pharmacist who offers the cleaning of glasses and other objects to clients.

55 **[0031]** **Figure 1** schematically shows a first embodiment of the cleaning device **1** and the cartridge **8** of the invention. The cleaning device comprises a cleaning tank **2** comprising a lumen or inner volume **15** in which cleaning can take place. The cleaning tank **2** comprises inner side walls **13** and a bottom wall or surface **14**, defining the volume of the tank. The tank comprises an inlet and/or outlet in the form of an opening **3**. Cleaning and/or rinsing liquid **9** enters and/or leaves the cleaning tank **2** through the inlet and/or outlet **3**.

[0032] The device of the invention comprises one or more liquid channeling system or duct system **4**. The liquid channeling/duct system comprises tubes, ducts, tube sections **4a** and generally further comprises one or more pumps **6** and/or one or more valves **5**. In the embodiment shown in Figure 1, the device comprises one bidirectional pump **6** and one valve **5**, which may be a two-way valve.

[0033] The channeling system **4** provides for a connection between the tank **2** and the cartridge **8**, allowing a communication between the compartment of the tank and the cartridge. In particular, the liquid channeling system **4** allows for controlled transport of liquid from the cartridge **8** to the tank and vice versa.

[0034] The connector **7a** is also part of the liquid channeling system **4**. The connector **7a** is adapted to connect the device of the invention **1**, and in particular the duct system **4**, to the cartridge **8**. In this regard, the cartridge **8** comprises also a connector **7b**, adapted to be connected with connector **7a**. Connectors **7a** and **7b** of the liquid channeling system and the cartridge, respectively, are part of the connection assembly **7**. The connection assembly allows a water proof connection of the inside of the duct system **4** with the inside of the cartridge. Connectors **7a** and **7b** are adapted to be connected to each other, for example via a femalemale connection system. Connector **7b** is associated with the opening of the cartridge. Therefore, reference numeral **7b** also refers to the opening of the cartridge. The opening **7b** preferably comprises a connector, allowing connection with the connector **7a** of the liquid channeling system.

[0035] As the skilled person will understand from the foregoing, the device of the invention is adapted to and/or capable of pumping the liquid contained in the cartridge into the cleaning tank and back from the cleaning tank into the cartridge. The valve **5** interrupts and/or blocks liquid flow when required, for example to prevent liquid **9** to flow back to the cartridge after having been pumped into the tank.

[0036] The device of the invention further comprises one or more ultrasonic generators and/or ultrasonic transducers **10a**. In the embodiment shown, the ultrasonic transducer **10a** is activated, deactivated and/or more generally controlled by the ultrasonic unit **10b**. While there is only one ultrasonic transducer **10a** shown in Figure 1, the invention encompasses that the device of the invention comprises two or more, for example 2, 3, or 4 ultrasonic transducers. This applies to all embodiments described in this specification. In other embodiments, the invention encompasses that ultrasonic transducers and ultrasonic units are entirely absent. In this case, cleaning is achieved by the cleaning liquid **9** in the absence of ultrasonic treatment.

[0037] The device of the invention further comprises one or more electronic controller **11**. Preferably, the electronic controller is a micro-controller, comprising, for example, one or more data processing units, preferably microprocessors. In the embodiment shown, the controller **11** controls the ultrasonic unit **10b**, the valve **5** and the pump **6**.

[0038] In an embodiment, the device of the invention comprises a power supply **12** for providing electric energy to one or more selected from said ultrasonic generator, electronic controller, one or more pumps and said one or more valves.

[0039] A power supply **12** provides power of required voltage to the controller **11**, the ultrasonic unit and other constituents of the device as required. In this regard, reference numerals **21** and **22** represent electric current cables. Reference numerals **23**, **24**, **25** and **26** refer to cables that communicate instructions and/or current as applicable. Accordingly, the controller **11** may activate pump **6** by activating a pump driver (not shown) that may have its own power source, or by directly providing power to the pump and thus activating it, for example.

[0040] The controller **11** may activate valve **5** by activating a valve driver (not shown) that may have its own power source, or by directly providing power to the pump and thus activating it, for example. The power of pump and/or valve drivers, as applicable, may also be provided by power supply **12**, for example.

[0041] The device of the invention is operated as follows: If a user wishes to clean his and/or her glasses (or another object), the latter are placed into the cleaning tank. The cleaning tank preferably contains a holder device (Figure 14), which supports the glasses and which prevents the glasses from being in direct contact with the bottom surface **14** and/or inner side surfaces **13** of the cleaning tank. At that moment, the cleaning tank **2** is substantially or totally free of any fluid, in particular free of the cleaning and/or rinsing liquid as described elsewhere in this specification.

[0042] In an embodiment, valves, pumps, ultrasonic units/generators, sensors, closures, and/or other electric and/or electronic components of the device of the invention are controlled, operated and/or coordinated by the one or more electric controller **11**. Preferably, the electronic controller is programmed and/or susceptible of being programmed to conduct the protocols and/or cleaning processes as described in this specification, in particular herein below.

[0043] Preferably, the device comprises a lid, not shown in Figure 1 (see Figs. 10-13). Once the lid is closed, the electronic controller makes sure that valve **5** is in an open position and induces pump **6** to pump the cleaning liquid **9** from the cartridge through the liquid channelling system **4** into the cleaning tank. When the tank is filled to its maximum permissible filling level, the controller **11** instructs valve **5** to close and switches off pump **6**. Then, the one or more ultrasonic transducers **10a** are induced to produce ultrasound inside the cleaning tank **2**. In this regard, it is noted that the ultrasonic generator **10a** is in contact with the outside of a side or bottom wall of the cleaning tank and is thus arranged to effectively produce ultrasound inside the tank. Thanks to the composition of the cleaning liquid and to the ultrasound, the glasses that are present in the tank are completely and effectively cleaned. The ultrasound destroys in particular microbes and even small particles of dirt.

[0044] The ultrasound treatment is preferably produced regularly and/or continuously. The ultrasound treatment is

preferably conducted for a determined period, preferably 10 seconds to 10 minutes, preferably 20 seconds to 6 minutes, more preferably 30 seconds to 4 minutes, and most preferably for 45 seconds to 3 minutes.

[0045] After the determined ultrasonic treatment period, the controller **11** is programmed to stop the ultrasound generation by the ultrasonic unit and/or transducer, opens valves **5** and activates pump **6**, this time in the other direction, so that the cleaning liquid is again transported back into the cartridge **8**. When all liquid has been pumped out of tank **2**, the valve **5** is preferably closed.

[0046] At this moment the cleaning process is terminated, the user can open the lid of the device and remove the glasses, now perfectly cleaned. It is noted that the user has not been at any risk to be in contact with the cleaning liquid during the entire cleaning process.

[0047] The cleaning process may be activated by the user. For example, once the user has put his glasses into the cleaning tank, he/she may actuate a button or switch, which starts the cleaning protocol. In a preferred embodiment, the cleaning process is started automatically. In particular, the device may be equipped with a sensor (not shown), which senses whether or not an object is present in the cleaning tank. Another sensor (not shown) may be provided to check whether the lid is open or closed. In case the controller receives information from the sensors that the lid is closed and an object is present in the tank, the cleaning process as described above or elsewhere in this specification is started and executed automatically, including the pumping back of the cleaning fluid into the cartridge.

[0048] **Figure 2** shows another embodiment of the device **100** of the invention. The device of **Figure 2** differs from the one shown in **Figure 1** in that it comprises two separate liquid channelling systems **4**, **4'**, one **4'** adapted to pump the cleaning liquid **9** from the cartridge into the cleaning tank and the other **4** being adapted to pump the liquid from the cleaning tank **2** into the cartridge **8**. Accordingly, there is a second opening **3'** in the cleaning tank, which functions as inlet, whereas opening **3** functions as liquid outlet. Furthermore, instead of bidirectional pumps, monodirectional pumps **6a** and **6a'** are used, as each pump pumps the liquid **9** in one direction only.

[0049] The two liquid channelling systems **4**, **4'** each comprises its own connector **7a**, **7a'**, matching a corresponding connector **7b**, **7b'**, respectively, on the cartridge **8**. There are thus two connectors **7b**, **7b'** on the cartridge. There are thus two connection assemblies **7**, **7'**, one assembly **7'** adapted to allow taking out liquid from the cartridge **8** and the other adapted to letting the liquid back into the cartridge. Each liquid channelling system **4**, **4'** comprises its own valve **5**, **5'**. In summary, the embodiment of **Figure 2** comprises two separate liquid channelling systems **4**, **4'**, one **4'** for transporting liquid from the cartridge to the tank and a second, separate channelling system **4**, for transporting liquid from the tank to the cartridge. In this embodiment, the liquid flows only in a single direction through each of the channelling systems **4**, **4'**.

[0050] As the embodiment of **Figure 2** comprises two pumps **6a**, **6a'** and two valves **5**, **5'**, it is clear that there are connections, shown as dotted lines in **Figure 2**, from the controller **11** to each pump and each valve.

[0051] As the skilled person will understand, during operation of the device **100** of the embodiment represented in **Figure 2**, the valve of one of the liquid channelling systems will be closed when liquid is transported through the other liquid channelling system and vice versa. For example, valve **5** is closed (and valve **5'** open) when liquid is transported through system **4'** from the cartridge to the tank, whereas valve **5** is open (and valve **5'** closed) when liquid is pumped from the tank to the cartridge. In other words, liquid is pumped only through one system **4** or **4'** at one time.

[0052] In the embodiment of the device and cartridge shown in **Figure 3**, the cartridge has two separate openings and/or connectors. In particular, a first connection assembly **7** is provided at the top one of cartridge **8**, and a second connection assembly **70** is provided at the bottom of the cartridge **8**. Connection assembly **7** comprises two connectors **7a** and **7b**, provided on the end of the tube **4b** and on the cartridge **8**, respectively, as shown in previous embodiments (**Figs 1** and **2**). The second connection assembly **70** comprises a self-closing valve as known from water tanks in typical espresso machines. The valve in assembly **70** is opened by positioning the cartridge on a rigid connector (not shown) fixed on the housing of the device. The self-opening may be, for example, a spring-based water tank inlet valve, as used in espresso machines with removable water tanks, for example. An exemplary valve assembly of this type is disclosed in US2005/0247204A1. Of course, the invention encompasses the presence of only one connection assembly of the type of the second connection assembly **70** on one cartridge (for example, using assembly **70** on the cartridge shown in **Fig. 1**). The invention also encompasses one or two connection assemblies of the type **70** shown in **Fig. 3** with cartridges comprising two compartments, as shown in **Figs. 6** and **7**, for example.

[0053] The embodiment of **Fig. 3** differs from the one shown in **Fig 2** in particular in that two completely separated liquid channelling systems are absent. A multi-way valve **50**, in particular a three-way valve, receives tubes **4b** and **4c**, which are linked to the two separate connection assemblies **7** and **70**, respectively. From three-way valve **50**, a single duct **4a** is guided via the bidirectional pump **6** to the combined inlet/outlet opening **3**. During liquid transport, the valve **50** and pump **6** are preferably activated so that liquid flow is controlled as follows: during filling of the tank, valve **50** opens and/or connects tubes **4c** and **4a**, so that pump **6** pumps liquid from the cartridge into the tank. At this moment, liquid flow through tube **4b** is closed at valve **50**. After cleaning, valve **50** opens the channel from tube section **4a** to **4b** and closes the way to tube **4c**, so that pump **6** can now pump the liquid **9** from the tank through tube **4b** and connection assembly **7** back into the cartridge.

[0054] As the skilled person will understand, the two-channel system **4, 4'** of Fig. 2 can be combined with the two different connection assemblies shown in Fig. 3, or the two assemblies **7, 70** of Fig. 3 can be used in a device comprising two separate channelling systems **4, 4'** as shown in Fig. 2, for example.

[0055] The embodiment of the device and cartridge shown in **Figure 4** is a variation of the embodiment shown in Fig. 1, for example. The bidirectional pump **6** of Fig. 1 is replaced by two separate monodirectional pumps **6a** and **6b**. There still is a single liquid channelling system **4**, but two multi-way (in particular three-way) valves **50, 51** are arranged to provide separate liquid channels **4b** and **4c**, which guide liquid flow during emptying and filling tank **2**, respectively. The action of the two three-way valves **50** and **51** is coordinated so that liquid can flow from the cartridge over valve **51** through tube section **4c**, valve **50** and tube **4a** into the tank **2**. For emptying the tank, liquid is guided through tube or tube section **4a** via valve **50** through tube **4b** and via valve **51** through tube **4d** back into the cartridge. When there is no liquid transport, during cleaning or when the device is not used, one or both valves **50, 51** may be closed completely, or at least passage through tube **4a** (valve **50**) and/or tube **4d** (valve **51**) may be closed. Since the separate tube sections **4b** and **4c** for guiding liquid to the cartridge and to the tank, respectively, are joined at valve **50**, only one inlet/outlet opening **3** is provided. In the same line (but independently), since the separate tube sections **4b** and **4c** for guiding liquid to the cartridge and to the tank, respectively, are joined at valve **51**, only one connection assembly **7** is required.

[0056] The embodiments shown in Figures 5 to 8 differ from the previously described embodiments in that there are either two or more separate cartridges **8, 8'** (Figs. 5, 8) or that there is one cartridge **80** comprising two or more non-communicating compartments **81, 82** within the single cartridge (Figs. 6 and 7). In all these embodiments, different liquids **9a** and **9b** may be used, which may thus be either provided in two different cartridges **8, 8'** or in two separate compartments **81, 82** of a single cartridge. The two cartridges/compartments may comprise the same or different liquid compositions. For example, there may be a first liquid and a second liquid. In an embodiment, the first liquid **9a** is a cleaning liquid, which comprises components that are suitable for ultrasonic cleaning, for example, while the second liquid **9b** is a rinsing liquid, comprising ingredients suitable for rinsing the object to be cleaning, for facilitating drying and/or for providing perfume on the object after cleaning, for example. Exemplary compositions of said first and second liquids are disclosed elsewhere in this specification.

[0057] Turning now specifically to **Figure 5**, the cleaning device **111** shown comprises thus two separate liquid channelling systems **4, 4'**, each connecting, respectively, one of the cartridges **8, 8'** to one of the two outlet/inlet openings **3, 3'** provided in the cleaning tank **2**. Each of the two liquid channelling systems **4, 4'** is constructed as the single liquid channelling system **4** shown in Figure 4. In general, the components comprised in the second liquid channelling system **4'** may be the same as those of the first liquid channelling system **4**. In Figure 5, the components of the first and second liquid channelling systems have the same reference numerals, but those of the second system **4'** are distinguished in Figure 5 by the prime sign (') added at the end.

[0058] Reference numerals **27** and **28** indicate the presence of cables connecting the controller **11** to the pumps and valves of the device. Accordingly, the controller controls the action and operation of these valves and pumps and thus controls the functioning and operation of the device.

[0059] In Figure 5, there are two connection assemblies **7, 7'**, one for each of the two cartridges **8, 8'**. Accordingly, the distal extremity **4d** of the first liquid channelling system is connected to a first connector **7a**, adapted to connect the first liquid channelling system to a first cartridge connector **7b**, so that connectors **7a** and **7b** form a first connection assembly **7**.

[0060] "Distal", for the purpose of this specification, means away (distal) from or with respect the cleaning tank **2**, and "proximal" means closer to the cleaning tank. Accordingly, tube section **4a** is proximal, and tubes **4b** and **4c** are intermediate.

[0061] Regarding the second liquid channelling system, the same as said above applies accordingly: The distal extremity **4d'** of the second liquid channelling system is connected to a second connector **7a'**, adapted to connect the second liquid channelling system **4'** to a second cartridge connector **7b'**, so that connectors **7a'** and **7b'** form a second connection assembly **7'**.

[0062] As becomes apparent, two first and second liquid channelling systems **4, 4'** could be operated completely independently one from the other, for example pumping their respective liquid **9a** and **9b** simultaneously into and/or out of the cleaning tank. Preferably, however, the two cartridges **8, 8'** connected to the first and second liquid channelling systems, respectively, contain liquids that have a different composition and thus preferably fulfil a different function. As a consequence, the device is preferably programmed and/or arranged to pump liquid compositions **9a** and **9b** sequentially in and out of the tank **2**. More specifically, liquid **9a** is preferably a cleaning liquid, comprising, for example, one or more detergents (more details on components of the liquids **9a** and **9b** are given elsewhere in this specification). Once glasses are placed into an empty tank, and preferably the lid of the device being closed, the controller activates the pump **6a** and valves **50** and **51** such that liquid **9a** is pumped into the tank from cartridge **8**. After cleaning the device using ultrasound, as described elsewhere in this specification, the cleaning liquid **9a** is pumped back into corresponding cartridge **8**, using this time pump **6b**, with valves **50** and **51** being set to the appropriately position. When the cleaning tank is emptied from liquid **9a** with the cleaned glasses in it, the second liquid channelling system **4'** is preferably activated.

The second cartridge **8'** preferably comprises a rinsing liquid, which may be an aqueous solution comprising an alcohol and which facilitates evaporation of the rinsing liquid **9b** from the surfaces of the glasses, once the second liquid **9b** being pumped back into its second cartridge **8'**. This part of the operating protocol may be referred to as a rinsing step, which is thus preferably conducted after the cleaning step. The rinsing step has the main purpose of removing residual cleaning liquid **9a** from the glasses. This may be important, because some of the cleaning components (detergents etc), may be irritating and/or unhealthy and should thus not remain on the surface of the glasses. As with the cleaning step, the composition comprising the rinsing liquid **9b** is pumped back into the second cartridge. During the rinsing step, there is preferably no ultrasonic treatment, so that during the rinsing step the glasses are exposed to the rinsing liquid for a time period, and is then pumped back into the cartridge.

[0063] In embodiments and/or process steps of the invention where there is no ultrasonic treatment, the device of the invention may be equipped with means for stirring the liquid in the tanks. Such means may include, for example, one or more pumps, screws, (e.g. magnetic) stir bars, just to mention a few. The liquid in the tank may be stirred in the cleaning steps in case there is no ultrasonic treatment and/or generator, and/or during the rinsing step, for example in embodiments where there is an ultrasonic unit/generator but there is no ultrasonic treatment during the rinsing step.

[0064] During the rinsing step, the rinsing liquid **9b** is kept in the cleaning tank **2** for a period determined period, the "rinsing period", which preferably lasts from 1 second to 5 minutes, preferably 5 seconds to 3 minutes, more preferably 10 seconds to 2 minutes, and most preferably for 15 seconds to 1 minute. In accordance with the above mentioned, the liquid in the cleaning tank during rinsing may be stirred but is preferably not stirred in addition to the stirring caused by pumping the rinsing liquid into the tank.

[0065] The embodiment shown in **Figure 6** is similar to the one shown in Fig. 5 and differs basically from the latter in that a single cartridge **80** comprising two compartments **81, 82**, instead of two physically separate cartridges is used. The two separate, first and second liquid channelling systems **4, 4'** are constructed in the same manner as described with respect to Fig. 5. Furthermore, the device **112** shown in Figure 6 may be operated in the same manner as the one of Fig. 5. Even the first and second connectors **7a** and **7a'** may be the same as the corresponding connectors shown in Fig. 5. The connectors **7b** and **7b'** of the cartridge allow connection of the first and second liquid channelling systems **4, 4'**, respectively, to the first and second compartments **81, 82**. As discussed previously, the distal extremities of the tubes **4d** and **4d'** are connected to the connectors **7a, 7a'**, respectively, thereby allowing access of the liquid channelling systems **4, 4'** to the contents of the respective, first and second compartments **81, 82**.

[0066] Figures 7 and 8 show preferred embodiments of the invention. In **Figure 7**, there are two separate liquid channelling systems **4, 4'**, each comprising its respective bidirectional pump **6, 6'**. Each channelling system has its own inlet/outlet access **3, 3'** to tank **2**. Whether or not a single cartridge with two compartments **81, 82** or two separate cartridges (as shown in Figs 5 and 8) are used, is not relevant, although a single cartridge system is preferred for practical reasons, reducing the handling associated with connecting and/or disconnecting cartridges, for example during maintenance and/or exchange of a cartridge.

[0067] Comparing Fig. 7 with Fig. 6, the skilled person will understand that two unidirectional pumps **5a, 5b**, two three-way valves **50, 51** and a branched liquid channelling system comprising tube sections **4a, 4b, 4c, 4d** are replaced in a liquid channelling system by a single bidirectional pump **6**, a single two-way valve **5** and a single (non-branched) tube and/or channel **4a**. The channelling system of Fig. 7 is thus structurally and/or technically simplified by using a bidirectional pump **6**, while providing the same functionality. Of course, the same applies to the second liquid channelling system **5'** in Figure 7, concerning continuous tube **4a'**, valve **5'** and bidirectional pump **6'**. Overall, the solution shown in Fig. 7 is developed from the one shown in Fig. 1, taking into account that the device of Fig. 7 allows to branch the device to two different cartridges and/or two compartments **81, 82** of a single cartridge **80**.

[0068] The device **103** shown in **Figure 8** is yet another preferred embodiment of the present invention. This embodiment may be operated with two cartridges **8, 8'** as shown or with a single cartridge comprising two compartments, as shown in Figs. 6 and 7.

[0069] The device **103** comprises a single liquid channelling system **4**, with a proximal tube or tube section **4a**, connecting the inlet/outlet opening **3** to a multi-way valve **50**. From valve **50**, two separate tubes **4b** and **4c** bifurcate. Each tube **4b** and **4c** comprises an own bidirectional pump, **6, 6'**, respectively. Tube **4b** is branched via connector **7a** to connector **7b** of the first cartridge **8**, and tube **4c** is branched via connector **7a'** to connector **7b'** of the second cartridge **8'**.

[0070] For cleaning glasses put into the empty tank **2** using device **103**, the controller activates pump **6** to pump the cleaning liquid through tube **4b**, valve **50** and tube **4a** into the cleaning tank **2**. Valve **50** was set accordingly by controller **11** to prevent any liquid from passing into tube **4c** at this stage. Once the liquid is in tank **2**, the controller shuts channel **4a** in valve **50**, so that the liquid **9a** is locked in the tank. The ultrasonic cleaning treatment is conducted as described elsewhere in this specification. After ultrasonic cleaning, valve **50** is set as before, opening a connection and/or communication between tubes **4a** and **4b**, and pump **6** pumps the cleaning liquid **9a** back into cartridge **8**. Thereafter, controller **11** switches valve **50** so that channel **4b** is now closed at valve **50** and a liquid duct between tubes **4a** and **4c** is opened. The second bidirectional pump **6'** is now driven so as to pump the rinsing liquid **9b** out of the second cartridge **8'** into the cleaning tank. Once the rinsing liquid is in tank **2**, valve **50** shuts channel **4a**, so that the liquid **9b**, now in the

tank **2**, cannot drain from the latter. Rinsing of the object in the tank **2**, cleaned in the previous step, is now conducted as described elsewhere in this specification. The entire cleaning process is terminated after the rinsing liquid **9b** is pumped back via tubes **4a** and **4c** (tube **4b** being again closed at valve **50**), to the second cartridge **8'**.

[0071] Figure 8 further shows pH sensors **52**, **52'** and conductivity sensors **53**, **53'**. In accordance with an embodiment of the invention, the device comprises one or more pH sensors **52**. In addition and/or alternatively, the device of the invention comprises one or more conductivity sensors **53**. The pH and/or conductivity sensors are preferably associated with and/or on the liquid channelling system. For example, the pH and/or conductivity sensor may be fixed on a duct of the duct system of the device of the invention. Preferably, the sensors are fixed in such a way as to be able to measure pH and/or conductivity of the cleaning and/or rinsing liquid, for example. For example, the sensors are fixed so as to have a component that is in contact with the cleaning and/or rinsing liquid, for example during pumping the liquid into the tank and/or from the tank into cartridge, as shown in Figure 8. Alternatively or in addition, the sensors may be associated to the tank **2** and may thus sense the conductivity and/or pH of liquid being in the tank. In an embodiment, conductivity and/or pH sensors may be provided in and/or on the cartridges **8**, **8'**, **80**. For example, the sensors may be adapted to sense pH and/or conductivity of the liquid in the cartridge.

[0072] The pH and/or conductivity sensor is/are preferably connected to (or adapted to be connected to) the electric controller **11**, for example by electric connections **29**. Accordingly, the controller **11** is programmed to receive a signal from any one, several or all sensors **52**, **52'**, **53**, **53'** and to compare the value read with a reference value so as to be able to warrant safety and/or orderly conduct of the process and/or protocol conducted by the device. For example, if certain pH and/or conductivity values are beyond a predetermined, admissible range, the controller **11** may refuse running a cleaning operation.

[0073] While pH sensors **52**, **52'** and/or conductivity sensors **53**, **53'** are shown in Figure 8, the above said with respect to sensors preferably applies to all embodiments independently. The sensors are thus preferably present in the embodiment described with reference to Figures 1-7 and 9-16. The device may comprise both types of sensors, one or more pH sensor *and* one or more conductivity sensor.

[0074] Furthermore it is noted that the device of the invention may comprise no sensor at all or only one type of sensors, for example one or more sensor selected from pH sensors, or one or more conductivity sensors. In some embodiments, the device is equipped with one or more sensors to measure either conductivity or pH. In other embodiments, both are measured.

[0075] In embodiments where there are two liquids (for example **9a** and **9b**), either pH or conductivity or both may be measured for one or both liquids. It is also encompassed that pH is measured with respect to one liquid and conductivity with respect to the other. In Figure 8, this could mean that only sensors **52** and **53'** or only **53** and **52'** are present, for example.

[0076] Figure 9 shows in greater detail an embodiment of the cleaning tank **2** and of the inlet and/or outlet opening **3** of the cleaning tank. As can best be seen in this figure, the inner surfaces and/or inner walls of the cleaning tank are downwardly inclined towards the opening **3**. In this way, any liquid present in tank **2** is drained by gravity towards opening **3**. In particular, the bottom surface **14** of the cleaning tank is skewed and/or has a curved profile. In this way, the bottom and/or inner walls of tank **2** form positions of various depths within said tank. Preferably, the opening(s) **3**, **3a**, **3b**, **3'** is provided at the deepest position in said tank. In embodiments where there are several openings **3**, **3'**, **3a**, **3b**, the openings are preferably close together in the cleaning tank, both or all at the deepest position of the cleaning tank. In Figure 9, a filter or mesh **16** is shown, which prevents any large particles from passing from the cleaning tank into the liquid channelling system **4**. Such a filter is preferably present in any one of the embodiments shown in Fig. 1 to 8, and with respect to all openings, in case there are several.

[0077] Figures 10 and 11 show an embodiment of the device comprising a lid **18**. Although not shown in Fig. 1 to 9, a lid or cover is preferably present in the device of the invention. The lid or cover has been omitted in Figs. 1 to 9 as it is now separately discussed.

[0078] In the embodiment shown in Figs. 10 and 11, the lid is connected via an articulation **19** to the housing of the device and/or to the cleaning tank **2** itself. The device preferably comprises a closure and/or lock assembly or mechanism **30**. The mechanism or assembly **30** is adapted to keep the lid on the tank **2**, and/or to keep the tank covered before or during the cleaning and/or rinsing process. In the embodiment shown, the closure mechanism **30** comprises two parts, **31**, **32**, a tank-part or first part **31** provided on the tank or on the housing of the device, and a lid part or second part **32** provided on the lid. The first and second parts **31**, **32** can be locked together and can be released, for example disengaged. For example, the lock mechanism is an electromagnetic lock. Alternatively, a mechanical lock comprising, for example, a lock bar or bolt and a latch, or other types of locks may be used. The lock mechanism is preferably controlled by the controller **11** as schematically shown in Figs 10 and 11. The controller **11** closes the lock assembly **30** when an object is placed into the tank **2** and the lid **18** is closed. From that moment, and preferably during the entire cleaning and, if applicable, rinsing process, the controller keeps the mechanism **30** locked, so that a user cannot open the lid during cleaning. This is a safety feature that prevents any spilling of liquid **9'**, **9a** or **9b** that may be present in the tank, as shown in Fig. 11. In a preferred embodiment, the lid and/or the tank comprises one or more gasket or other sealing materials,

so that the tank is leakproof and/or waterproof when the lid is closed, and in particular when the lid is locked in the closed position by the locking assembly **30**. Preferably, there is no spilling of liquid even in case the device of the invention is shaken and/or falls down, for example from a table onto the floor, with cleaning liquid being present inside the tank **2**.

[0079] One or more grips and/or handles (not shown) may be provided on the lid and/or tank (in the embodiment discussed below) so as to allow a user to conveniently open the tank.

[0080] **Figures 12 and 13** shows an alternative manner of closing the cleaning tank **2** for the purpose of performing the cleaning process. In the embodiment shown in these figures, the lid **18a** is part of and/or rigidly connected with the housing **40** of the device. For example, the lid **18a** may be formed in one piece with the housing **40**. Sealing material may be provided on the lid **18a** or on the tank **2a** (not shown) for example. The cleaning tank **2a** is opened by pivoting at articulation **19a** so as to pivot the cleaning tank away from lid **18a**. The pivoting movement of the tank, illustrated in Fig. 13, generates the opening **17** of the tank, so that an object to be cleaned can be inserted into the tank. In particular, articulation **19a** may pivotally connect the tank **2a** to the housing **40**. The tank and/or the opening **17** is closed by pivoting back the tank from the position shown in Fig. 13 to the one shown in Fig. 12. As the skilled person will understand, the tube **4a** is preferably sufficiently flexible and/or has extra length, so as to be able to follow and compensate the distance that the opening **3** covers when the tank is pivoted. The flexibility and/or sufficient length preferably also applies to the cable by which the ultrasonic transducer **10a** is connected to the ultrasonic unit **10b**, to the power supply **12** and/or to the controller **11**, as may be applicable.

[0081] In the embodiment shown in Fig. 13, the one or more ultrasonic transducers **10a** remain attached to the cleaning tank **2a**. The invention also encompasses that the ultrasonic transducer remains in a fixed position with respect to the housing **40**, for example, so that rotation of the tank **2a** at articulation **19a** results in physical separation of the (fixed) transducer **10a** from the articulated tank. The physical contact is re-established when the tank **2a** is rotated back to the position where the tank is closed (Fig. 12).

[0082] **Figure 14** shows an embodiment on an insert **35** which has not been shown in the cleaning tank of Figs 1-12. The insert **35** has the purpose of carrying the object to be cleaned and preventing that the object gets in direct contact with the bottom and/or lateral surfaces of the cleaning tank **2**. In particular, the insert prevents that the object to be cleaned is supported directly by the bottom inner surface **14** of the cleaning tank. The insert **35** may be supported and/or held in any suitable way in and/or by the cleaning tank. Preferably, the insert may have a part that will be immersed into the cleaning and/or rinsing liquid during cleaning. The insert may comprise a grid and/or sieve, so that the liquid will easily enter the inner volume of the insert. The insert **35** may comprise one or more holding elements **38**, which hold and of fix the insert. For example, the holding elements may prevent the insert itself getting into contact with the inner walls and or bottom walls **13**, **14** of the cleaning tank. In an embodiment, the insert **35** comprises a flange **38** that is arranged to lie on the rim **36** of the tank **2**, so that the entire insert **35** may be supported on the upper rim **36**.

[0083] **Figures 15 and 16** show embodiments of an isolated empty cleaning tank **2** (Fig. 15) and of an isolated cleaning tank **2** filled with cleaning liquid **9** (Fig. 16). These tanks may be used with any one of the embodiments discussed herein comprising one single outlet/inlet opening **3**. The tank shown in Fig. 16 comprises a three way valve **50** and fits thus well, for example, with the embodiments shown in Figs 3, 4, and 8.

[0084] The invention also provides liquids and/or liquid compositions for use with the device of the invention, and liquid compositions for use in cleaning methods, in particular ultrasonic cleaning.

[0085] In an embodiment, the composition comprises water, one or more alkaline compounds or salts, such as NaOH and/or NH₃, and surfactants. This applies preferably to the cleaning composition **9**, **9a**, for example in cases when there are two different compositions **9a** and **9b**. The cleaning composition may but need not comprise an organic solvent, such as isopropanol, for example. Water is preferably used as the main or only solvent of the cleaning composition. The organic solvent may be used in the cleaning composition for dissolving organic components that may be present. The alkaline product is preferably used for saponification of fats and other lipids and allows their suspension in water. Surfactants reduce surface tension and solubilises lipids, in particular fats and oils.

[0086] The rinsing composition **9b** preferably also comprises water and further comprises an alcohol or another volatile, nonhazardous solvent, for example isopropanol, for aiding the drying of the glasses after rinsing.

[0087] In an embodiment, one or more of the liquid compositions **9**, **9a** and **9b** comprises perfumes. Preferably, the rinsing composition **9b** comprises perfumes, for example for improving the perception of the cleaning and/or for hedonic purposes in general.

[0088] In an embodiment, one or more of the liquid compositions **9**, **9a** and **9b** comprises a colouring agent. Colouring is preferably used to identification of the product and/ distinguishing from another product.

[0089] More details on the cleaning and/or rinsing liquids are given elsewhere in this specification.

[0090] Preferably, each cartridge **8**, **8'**, **80** comprises a product identification code and/or or chip. The device of the invention preferably comprises a reader and/or sensor (not shown), which may be connected to the controller **11**. In an embodiment, the invention encompasses a method in which the controller **11** of the device counts the number of cleaning cycles performed with a given cartridge. The controller preferably compares the number of cycles performed with a given cartridge with a reference value and, if the reference value is reached, may refuse to perform any further cleaning cycle.

Alternatively, or in addition, the device may comprise output devices, and the controller may inform the user via the output device that the cartridge has to be changed. The output device may comprise a source of light, for example an LED, which is switched on once the recommended or maximum number of cleaning cycles (reference value) is attained with a given cartridge. The reference value may be in the range of 10 to 70 cleaning cycles, for example 20 to 60, more preferably 30 to 50 cleaning cycles.

[0091] Herein below, certain preferred embodiments of the invention are set out.

[0092] In an embodiment, the device of the invention comprises one or more electronic controller **11** for operating said ultrasonic generator, said one or more pumps and/or said one or more valves.

[0093] In an embodiment, the device of the invention comprises a connector **7a**, **7a'**, suitable to connect the device of the invention to a cartridge **8**, **8'**, **80** comprising said cleaning and/or rinsing liquid.

[0094] In an embodiment, the device of the invention comprises a connector **7a**, **7a'**, suitable to connect the device to one or more cartridge **8**, **8'**, **80** as defined elsewhere in this specification.

[0095] In an embodiment, the device of the invention comprises a connector **7a**, **7a'**, adapted to connect said fluid channelling system in a water tight manner to an opening **7b**, **7b'** of said cartridge.

[0096] In an embodiment, the device of the invention comprises one or more connector **7a**, **7a'**, adapted to reversibly and/or detachably connect one or more ducts of said duct system to said cartridge. In an embodiment, the one or more connector **7a**, **7a'** comprises a clip mechanism for connecting to the connector to said cartridge.

[0097] In an embodiment of the device of the invention, said cartridge comprises an opening and/or connector **7b**, **7b'** comprising a self-closing valve.

[0098] In an embodiment of the device of the invention, the connector **7a**, **7a'** comprises a protruding structure adapted to interact with a valve provided on an opening **7b**, **7b'** of said cartridge, wherein said protruding structure is arranged so as to open said valve with the connector **7a**, **7a'**, being connected with said opening.

[0099] In an embodiment of device of the invention, an opening **7b**, **7b'** of said cartridge comprises a resilient element, said resilient element acting on a closure of said opening so as to keep said opening closed, wherein said protruding structure of said connector **7a**, **7a'** is adapted to act on said resilient element so as to prevent the resilient element from keeping said opening closed.

[0100] In an embodiment of device of the invention, said connector **7a**, **7a'** comprises a first entity adapted to engage with a second entity provided on the opening **7b**, **7b'** of said cartridge, so as to form a releasable connection assembly, preferably a clip mechanism, with said second entity.

[0101] In an embodiment of device of the invention, said one or more pumps comprise one or more bidirectional pumps **6**, **6'**.

[0102] In an embodiment of device of the invention, said tank **2**, **2a** comprises a bottom surface **14**, said bottom surface comprising a surface that is inclined so as to form positions with lesser depths and positions with comparatively deeper depths in said tank, wherein and/or one or more inlet and outlet openings **3**, **3'** are provided at the position of deepest depth of said tank.

[0103] In an embodiment of device of the invention, said fluid channelling system connects the outlet or inlet opening **3**, **3'** in said tank **2**, **2a** to the connector **7a**, **7a'**, wherein said one or more valve is arranged to open and/or close one or more ducts of said liquid channelling system, and wherein said one or more ducts of said fluid channelling system is transported through and/or by a bidirectional pump **6**, **6'** adapted to pump one or more cleaning liquids **9a**, **9b** through said duct and/or fluid channelling system.

[0104] In an embodiment, the device of the invention comprises two at least partially separate ducts **4b**, **4c** (Fig. 3, 4, 8) and/or two separate fluid channelling systems **4**, **4'** (Fig. 5, 6, 7) for transporting two different liquids **9a**, **9b** into said cleaning tank.

[0105] In an embodiment of the device of the invention, two separate ducts **4b**, **4c**, **4b'**, **4c'** of a fluid channelling system **4**, **4'** are connected at a valve **50**, **50'**, said valve being connected to said inlet and/or outlet opening **3**, **3'** via a common duct **4a**, **4a'**.

[0106] In an embodiment of the device of the invention, said one or more fluid channeling system **4**, **4'** comprises a duct **4a**, **4b**, **4d** connected to a connector **7a**, adapted to be connected to an opening **7b**, **7b'** of a cartridge **8**, **8'**, **80**. In an embodiment, said duct **4a**, **4b**, **4d** is connected to a pump **6**, **6a** adapted to pump a liquid through said duct into a cleaning tank **2**, **2a**. Preferably, the device comprises a valve adapted to close said duct and/or duct system.

[0107] In an embodiment of the device of the invention, said one or more fluid channelling system **4**, **4'** comprises a first duct **4a**, **4b**, **4d** and a second duct **4a'**, **4c**, **4d'**, wherein said first duct is connected to a first connector **7a** and said second duct is connected to a second connector **7a'**, wherein said first and second connectors, respectively, are adapted to be connected to a first and a second openings **7b**, **7b'** of two separate cartridges **8**, **8'** or of two separate compartments **81**, **82** of a single cartridge **80**. In an embodiment, said first duct **4a**, **4b**, **4d** is connected to a first pump **6**, **6a** adapted to pump a liquid through said first duct, and/or said second duct **4a'**, **4c**, **4d'** is connected to a second pump **6'**, **6a'**, **6b** adapted to pump a liquid through said second duct.

[0108] In an embodiment, the device of the invention comprises a tank opening **17** suitable for introducing an object

into said tank **2, 2a** the device further comprising a lid **18, 18a** adapted to close the opening **17** and a closure mechanism **30** adapted to lock the lid in a closed position. In an embodiment, said closure mechanism is activated by said electronic controller **11**.

[0109] In an embodiment, said closure mechanism is activated by said electronic controller **11** so as to lock the lid in a closed position when a cleaning liquid is present in said tank.

[0110] In an embodiment, said closure mechanism comprises an electromagnetic lock **31, 32**.

[0111] In an embodiment, said lid **18, 18a** is adapted to close said opening **17** water-tightly.

[0112] In an embodiment, said tank **2, 2a** of the device of the invention has a reservoir capacity of 200 ml to 750 ml, preferably 250-600 ml, and most preferably 300-500 ml.

[0113] In an embodiment, the device of the invention is adapted to perform the cleaning method of as defined elsewhere in this specification.

[0114] The invention concerns also a cartridge **8, 8', 80** for cleaning liquid **9, 9a, 9b** for a cleaning device, said cartridge comprising one or more opening **7b, 7b'** comprising a connector and/or a connection valve.

[0115] The invention concerns also a cartridge **8, 8', 80** for cleaning liquid **9, 9a, 9b** for an ultrasonic cleaning device, said cartridge comprising one or more opening **7b, 7b'** comprising a connector and/or a connection valve.

[0116] The invention concerns also a cartridge **8, 8', 80** for cleaning and/or rinsing liquid **9, 9a, 9b** for an ultrasonic cleaning device, said cartridge comprising one or more opening **7b, 7b'** comprising a self-closing valve.

[0117] In an aspect, the invention provides a cartridge **8, 8', 80** for cleaning liquid **9, 9a, 9b** for an ultrasonic cleaning device, said cartridge comprising an opening **7b, 7b'** comprising a valve, said opening being adapted to be connected with the connector **7a, 7a'** of the device of the invention.

[0118] In an aspect, the invention provides a cartridge **8, 8', 80** for cleaning liquid **9, 9a, 9b** for an ultrasonic cleaning device, said cartridge comprising one or more openings **7b, 7b'**, wherein said opening comprises a self-opening valve, said valve being adapted to open when the connector **7a, 7a'** is connected to said opening.

[0119] In an aspect, the invention provides a cartridge **8, 8', 80** for cleaning liquid **9, 9a, 9b** for an ultrasonic cleaning device, said cartridge comprising one or more openings **7b, 7b'**, for connecting the cartridge with the device of the invention.

[0120] In an embodiment, said cartridge comprises two separate compartments **81, 82**, a first compartment **81** and a second compartment **82**, wherein said first and second compartments comprise different liquids **9a, 9b**.

[0121] In an embodiment, the cartridge of the invention comprises one or more compartments, wherein said compartment has a volume in the range of 200 ml to 750 ml, preferably 250-600 ml, and most preferably 300-500 ml.

[0122] In an aspect, the invention provides a cartridge **8, 8', 80** comprising two separate compartments **81, 82**, a first compartment **81** and a second compartment **82**, said cartridge comprising two separate openings **7b, 7b'** through which liquid in said compartments can be removed, wherein said first compartment comprises a first liquid **9a**, said first liquid being cleaning liquid for an ultrasonic cleaning device and said second compartment comprises a second liquid **9b**, said second liquid being a rinsing and/or drying liquid.

[0123] In an embodiment, said wherein said first liquid/compartment comprises water and one or more cleaning agent and said second liquid/compartment comprises water and an alcohol.

[0124] In an aspect, the invention provides a method for cleaning glasses or other objects, the method comprising the steps of: pumping a cleaning liquid **9, 9a, 9b** through one or more fluid channeling system **4, 4'** or duct into a cleaning tank **2, 2a** of an ultrasonic cleaning device **1, 100, 101, 102, 103, 110, 111** comprising an object to be cleaned; applying an ultrasonic treatment so as to clean said object; pumping said cleaning liquid out of said cleaning tank.

[0125] In an embodiment of the method of the invention, said cleaning liquid is pumped from a cartridge **8, 8', 80** through said one or more fluid channeling system **4, 4'** or duct into said cleaning tank and/or said cleaning liquid is pumped back into a said cartridge when being pumped out of said tank.

[0126] In an embodiment, the method of the invention comprises the step of closing a valve **5, 50, 51, 5', 50', 51'** after the step of pumping said cleaning liquid into said tank **2, 2a**.

[0127] In an embodiment of the method of the invention, said cleaning liquid is a first liquid **9a**, and wherein said method further comprises the steps of: pumping a second liquid **9b** into said cleaning tank so as to expose the object to be cleaned to said second liquid; and, pumping said second liquid out of said cleaning tank.

[0128] In an embodiment, the invention provides a cleaning liquid, for example liquid **9** (Figs. 1-4). The invention also provides a cartridge **8, 8', 80** comprising the cleaning liquid **9**. The cartridge may be as described elsewhere in this specification, in particular with respect to any one of Figs 1 to 8, for example.

[0129] The cleaning liquid **9** may also be considered as the first liquid **9a**, for example if the liquid is contained in a cartridge **80** comprising two compartments or if the device of the invention is adapted to be connected to two separate cartridges **8, 8'**.

[0130] The cleaning liquid **9, 9a** preferably comprises water and a cleaning agent. The water is preferably demineralized. The cleaning agent may be acid-based, alkaline or neutral. Preferably, the cleaning agent is alkaline, such as NaOH or NH₃, for example. The cleaning agent may comprise soap. The cleaning agent may be added as a mixture of cleaning

agents, such as a liquid concentrate to the water, for example as a commercially available cleaning agent.

[0131] The cleaning liquid may preferably comprises one or more surfactants. The surfactant may be present in and/or as part of the cleaning agent, for example of the liquid concentrate cleaning agent. If the cleaning agent does not contain a surfactant, the surfactant may be added as such.

[0132] In an embodiment, the cleaning liquid **9**, **9a** comprises one or more anti-fog agents. The anti-fog agent has the purpose of preventing condensation of water on the surface of glasses cleaned with the device of the invention. For example, glycerol may be used as anti-fog agent. Preferably, the anti-fog agent is present at a concentration of 0-1wt% of the cleaning liquid. In an embodiment, a mixture of anti-fog agents is present.

[0133] In a preferred embodiment, the cleaning liquid **9**, **9a** comprises water (preferably demineralized) acting as a solvent, a cleaning agent selected from acid-based, alkaline or neutral cleaning agents, preferably an alkaline cleaning agent. Preferably, a surfactant is present, for example as part of a cleaning agent concentrate. Furthermore, an anti-fog agent, for example glycerol is also present.

[0134] For example, a liquid concentrate cleaning agent is added at 0.5 to 7wt.%, preferably 1-5wt%, most preferably 2-3 wt.%. The surfactant, if present, may be added at 0.05 to 1.5 wt%, preferably 0.1 to 1wt%, most preferably 0.2 to 0.9wt%, for example 0.3wt%. The anti-fog agent is may be added at a concentration of ≤ 0.9 wt%, for example 0.4wt%.

[0135] The present invention provides a rinsing and/or drying solution **9b**. The rinsing solution preferably comprises water and a high volatility solvent, such as alcohol, preferably isopropanol. Preferably, the rinsing agent comprises water and 0.5 to 6% alcohol, preferably isopropanol. More preferably, the rinsing agent comprises water and 1 to 4% alcohol, more preferably 1 to 3wt% alcohol. Preferably, the water is not demineralized.

[0136] In an embodiment, the rinsing liquid **9b** further comprises a surfactant. The surfactant may be present, for example, at the same concentration as specified above with respect to the washing liquid.

[0137] It was mentioned above that the cleaning liquid may comprise an anti-fog agent such as glycerol. In an embodiment, the cleaning liquid is free of an antifog agent such as glycerol but instead the rinsing liquid comprises an anti-fog agent, such as glycerol, at the same concentrations as specified above with respect to the cleaning liquid **9**, **9a**.

[0138] In an embodiment, the invention provides a cartridge comprising a cleaning liquid **9a** and a rinsing or a drying liquid **9b**. In an embodiment, the invention provides a cartridge comprising two compartments, one compartment comprising a cleaning liquid **9a** and the other compartment comprising a rinsing/drying liquid **9b**. The cleaning and the rinsing liquids may be as defined elsewhere in this specification, in particular as defined herein above. The cleaning liquid preferably comprises water as solvent (preferably demineralized), a cleaning agent, and, optionally, an anti-fog agent. The rinsing liquid preferably comprises water as a solvent (preferably non-demineralized), an alcohol (0.5 to 6%), and optionally an anti-fog agent, for example if an anti-fog agent such as glycerol is absent in the cleaning solution.

[0139] The cleaning and/or rinsing liquid preferably comprise a coloring agent.

[0140] In an embodiment, the cleaning and/or the rinsing liquid comprise a perfume. Preferably the rinsing liquid comprises a perfume.

Legend of reference numbers in the figures

[0141]

1, 100, 101, 102, 103, 110, 111, 112	device of the invention (apparatus)
2, 2a	recipient for glasses / cleaning tank
3, 3'	opening for cleaning and/or drying liquid
4	liquid channeling system or duct system
4a, 4b, 4c, 4d 4a', 4b', 4c', 4d'	tube or duct of duct system
5, 50, 51, 5', 50', 51'	valves
6, 6a, 6b, 6', 6a', 6b'	monodirectional and/or bidirectional pumps
7, 7'	connection assembly
7a, 7a'	connectors
7b, 7b'	openings/closures of cartridge
8, 8', 80	cartridge for cleaning and/or drying agent
81, 82	compartment for cleaning and/or drying agent within cartridge
9	cleaning and/or drying liquid
9a	cleaning liquid
9b	drying liquid
10a, 10a'	ultrasonic transducer
10b	ultrasonic unit
11	electronic controller
12	power supply

13	inner side wall of cleaning tank
14	bottom surface of cleaning tank
15	lumen of cleaning tank
16	filter or mesh
5 17	opening of cleaning tank
18	lid
19, 19a	articulation
21, 22	power cable
23-28	electric and/or signal cables
10 30	closure mechanism
31	tank-part of closure 30
32	lid-part of closure 30
35	insert
36	top rim of tank
15 37	grid or sieve of insert
38	flange of insert
40	housing

20 Claims

1. An ultrasonic cleaning device (1, 100, 101, 102, 103, 110, 111) for glasses and other objects, the device comprising a cleaning tank (2, 2a), one or more ultrasonic generator (10a, 10a', 10b), for producing ultrasonic waves in the tank, one or more inlet and outlet openings (3, 3') for guiding a cleaning and/or rinsing liquid (9, 9a, 9b) through one or more fluid channelling system (4, 4') comprising one or more ducts (4a, 4b, 4c, 4d, 4a', 4b', 4c', 4d') into said tank, the device comprising one or more pumps (6, 6a, 6b, 6', 6a', 6b') for pumping the liquid into and out of the tank, the device further comprising one or more valves (5, 50, 51, 5', 50', 51') for controlling a flow of the cleaning liquid into and out of said tank.
2. The device of claim 1, further comprising one or more electronic controller (11) for operating said ultrasonic generator, said one or more pumps and/or said one or more valves.
3. The device of any one of claims 1 and 2, further comprising a connector (7a, 7a'), suitable to connect the device of the invention to a cartridge (8, 8', 80) comprising said cleaning and/or rinsing liquid.
4. The device of claim 3, wherein said connector (7a, 7a') is adapted to connect said fluid channelling system in a water tight manner to an opening (7b, 7b') of said cartridge.
5. The device of claims 3 and 4, wherein said connector (7a, 7a') is adapted to reversibly and/or detachably connect one or more ducts of said duct system to said cartridge.
6. The device of any one of the preceding claims, wherein said tank comprises a bottom surface (14), said bottom surface comprising a surface that is inclined so as to form positions with lesser depths and positions with comparatively deeper depths in said tank, wherein and/or one or more inlet and outlet openings (3, 3') are provided at the position of deepest depth of said tank.
7. The device of any one of the preceding claims, wherein two separate ducts (4b, 4c, 4b', 4c') of a fluid channelling system (4, 4') are connected at a valve (50, 50'), said valve being connected to said inlet and/or outlet opening (3, 3') via a common duct (4a, 4a').
8. The device of any one of the preceding, wherein said one or more fluid channelling system (4, 4') comprises a first duct (4a, 4b, 4d) and a second duct (4a', 4c, 4d'), wherein said first duct is connected to a first connector (7a) and said second duct is connected to a second connector (7a'), wherein said first and second connectors, respectively, are adapted to be connected to a first and a second openings (7b, 7b') of two separate cartridges (8, 8') or of two separate compartments (81, 82) of a single cartridge (80).
9. The device of claim 8, wherein said first duct (4a, 4b, 4d) is connected to a first pump (6, 6a) adapted to pump a liquid through said first duct, and/or said second duct (4a', 4c, 4d') is connected to a second pump (6', 6a', 6b)

adapted to pump a liquid through said second duct.

10. The device of any one of the preceding claims, comprising a tank opening (17) suitable for introducing an object into said tank (2, 2a), the device further comprising a lid (18) adapted to close the opening (17) and a closure mechanism (30) adapted to lock the lid in a closed position.

11. The device of claim 10, wherein said closure mechanism is activated by said electronic controller so as to lock the lid in a closed position when a cleaning liquid is present in said tank.

12. A cartridge (8, 8', 80) for cleaning liquid (9, 9a, 9b) for an ultrasonic cleaning device, said cartridge comprising one or more openings (7b, 7b') for connecting the cartridge with the device of any one of claims 1-11.

13. The cartridge of claim 12, comprising two separate compartments (81, 82), a first compartment (81) and a second compartment (82), wherein said first and second compartments comprise different liquids.

14. A cartridge (8, 8', 80) comprising two separate compartments (81, 82), a first compartment (81) and a second compartment (82), said cartridge comprising two separate openings (7b, 7b') through which liquid in said compartments can be removed, wherein said first compartment comprises a first liquid (9a), said first liquid being a cleaning liquid for an ultrasonic cleaning device and said second compartment comprises a second liquid (9b), said second liquid being a rinsing and/or drying liquid.

15. The cartridge of claim 13 and 14, wherein said first liquid/compartment comprises water and one or more cleaning agent and said second liquid/compartment comprises water and an alcohol.

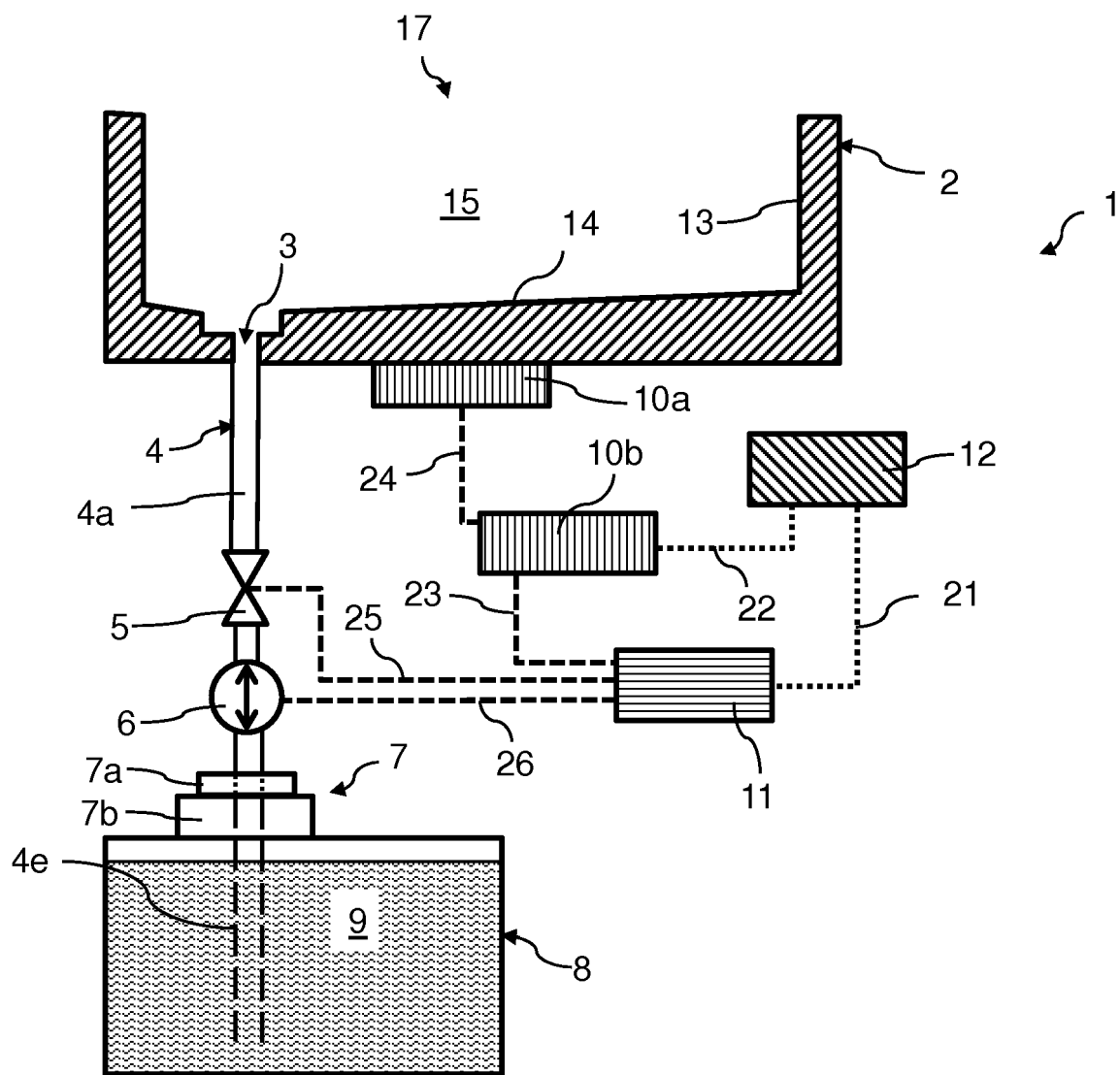


Figure 1

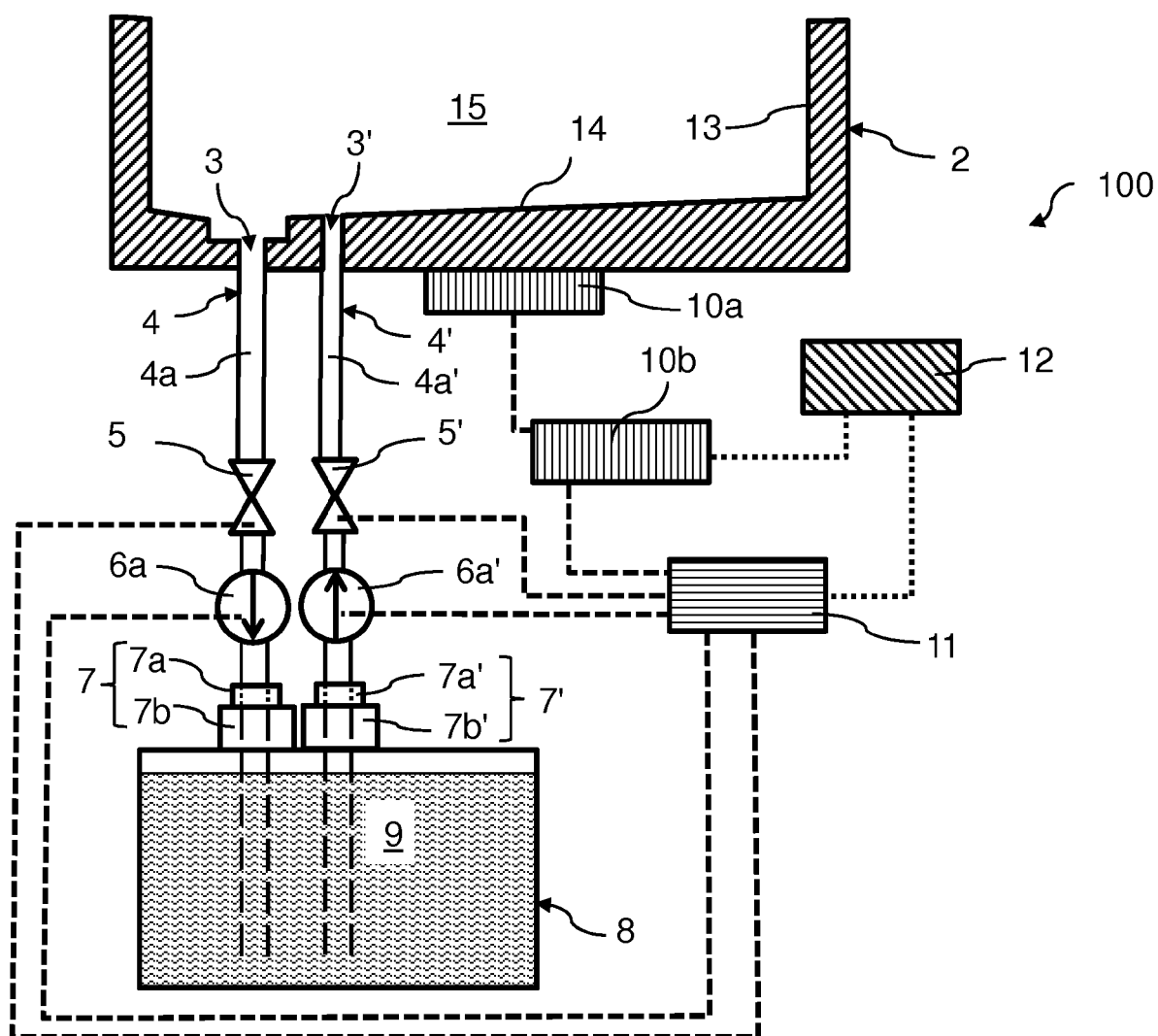


Figure 2

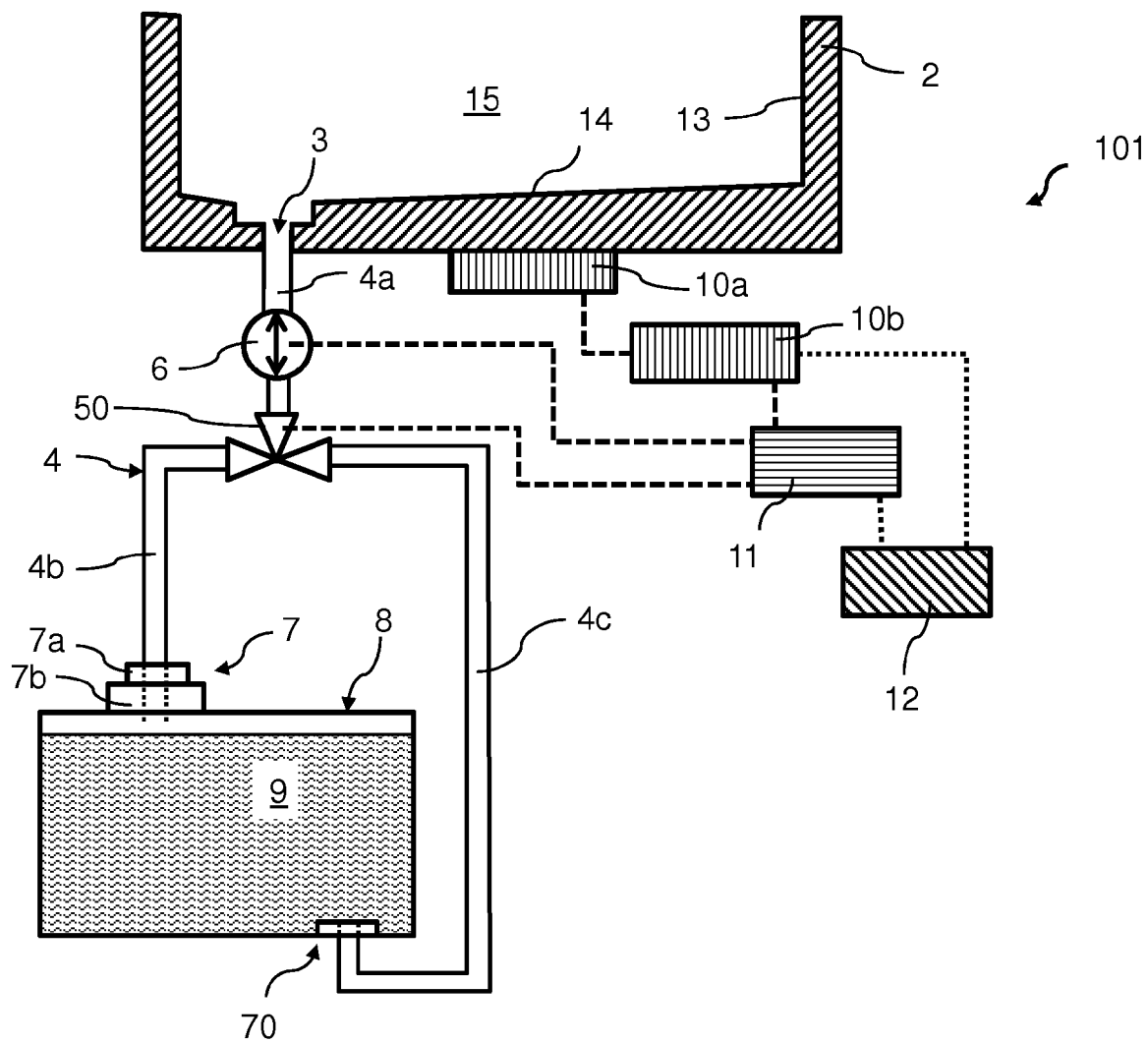


Figure 3

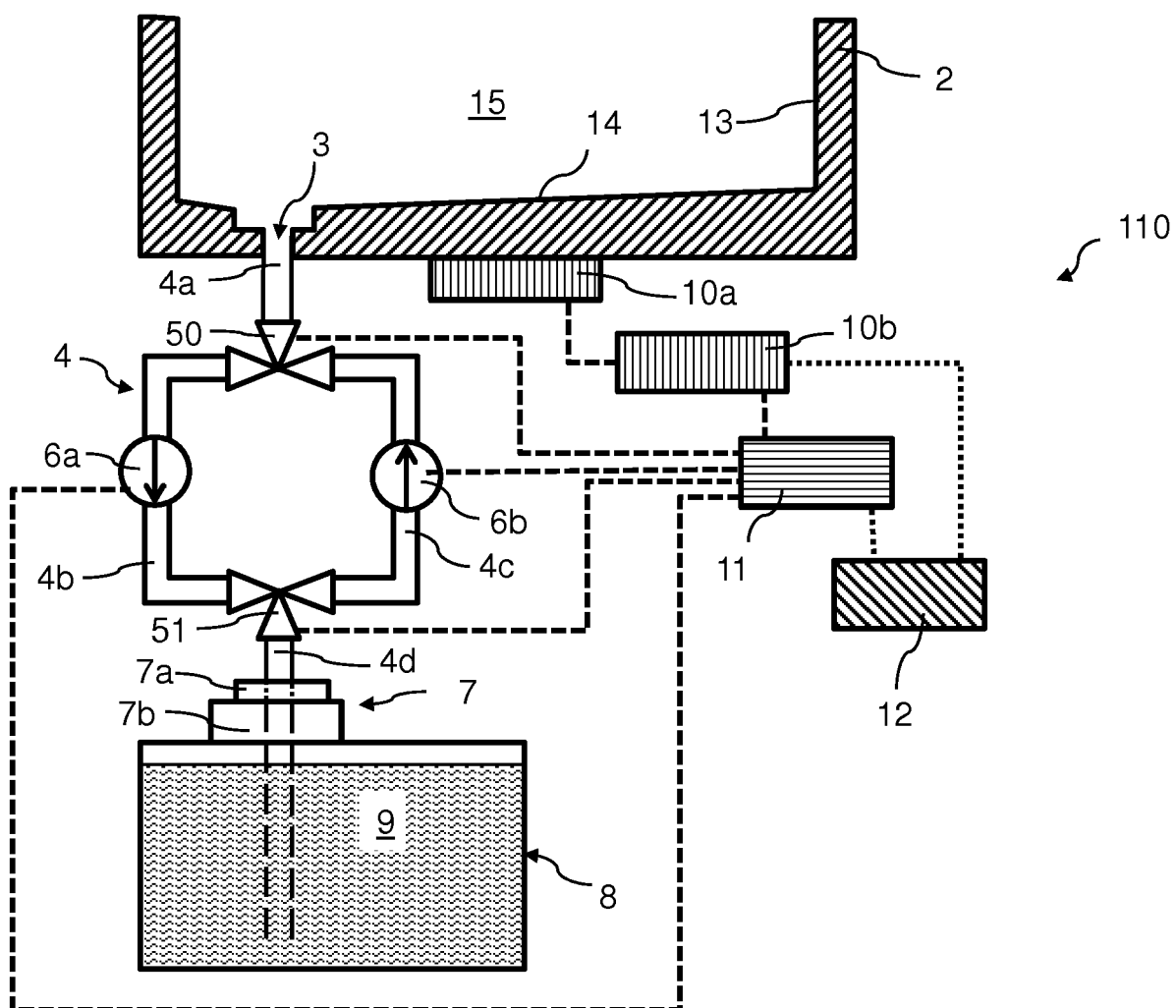


Figure 4

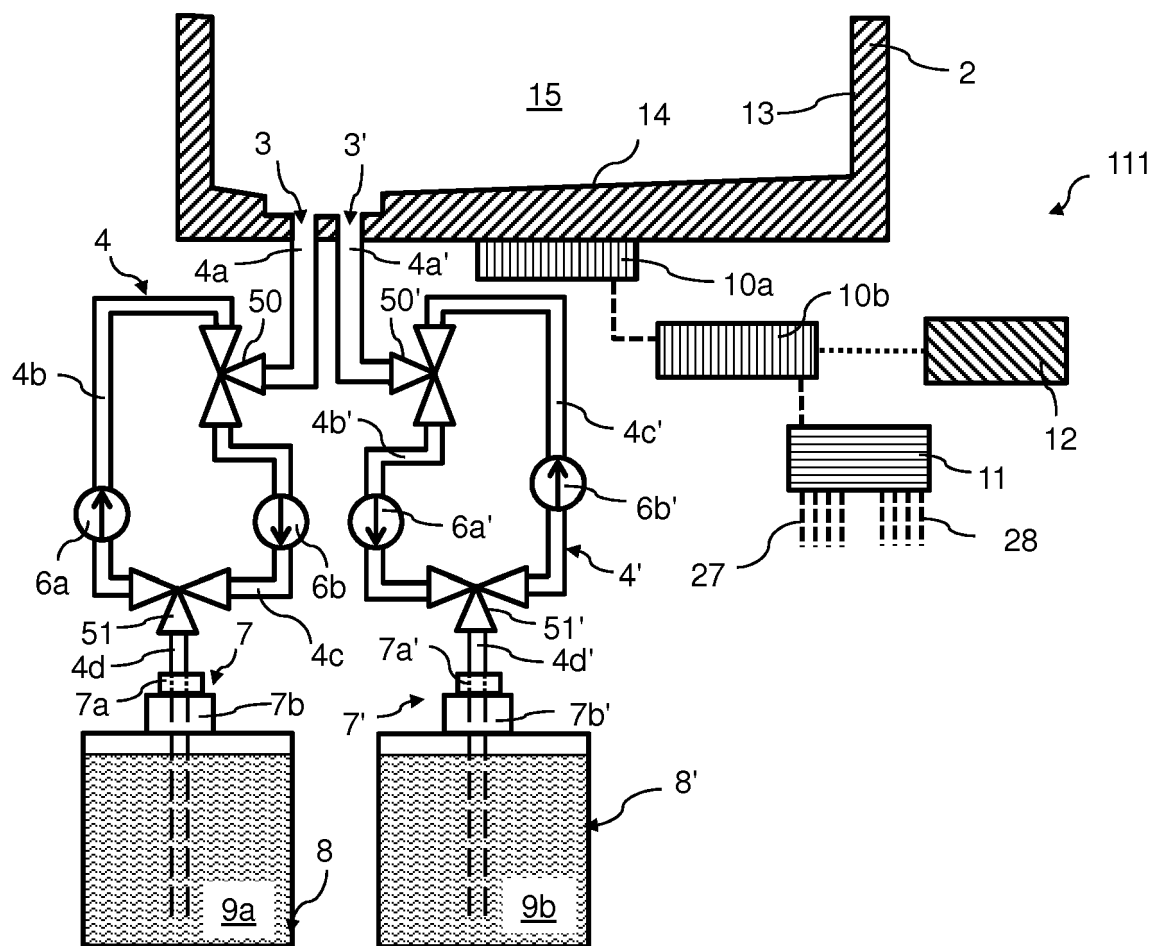


Figure 5

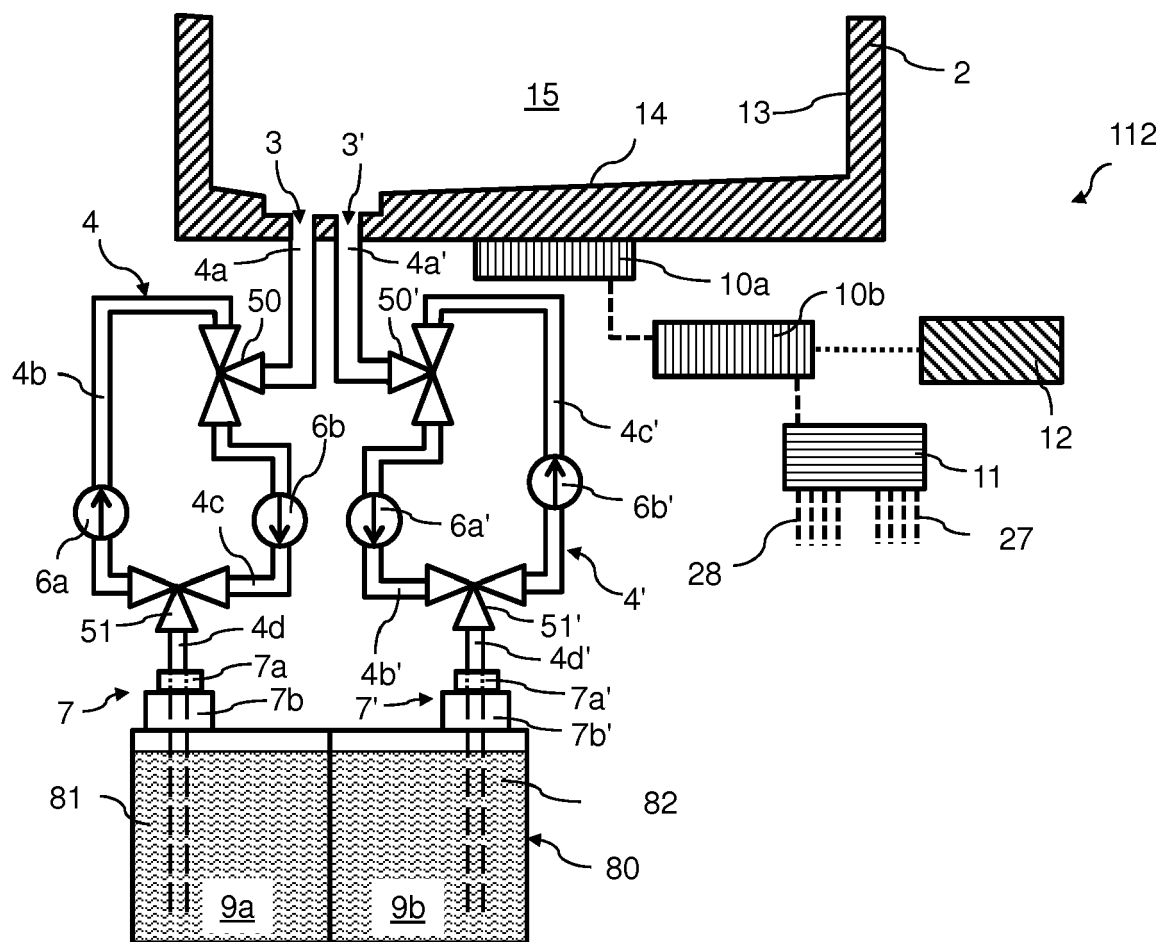


Figure 6

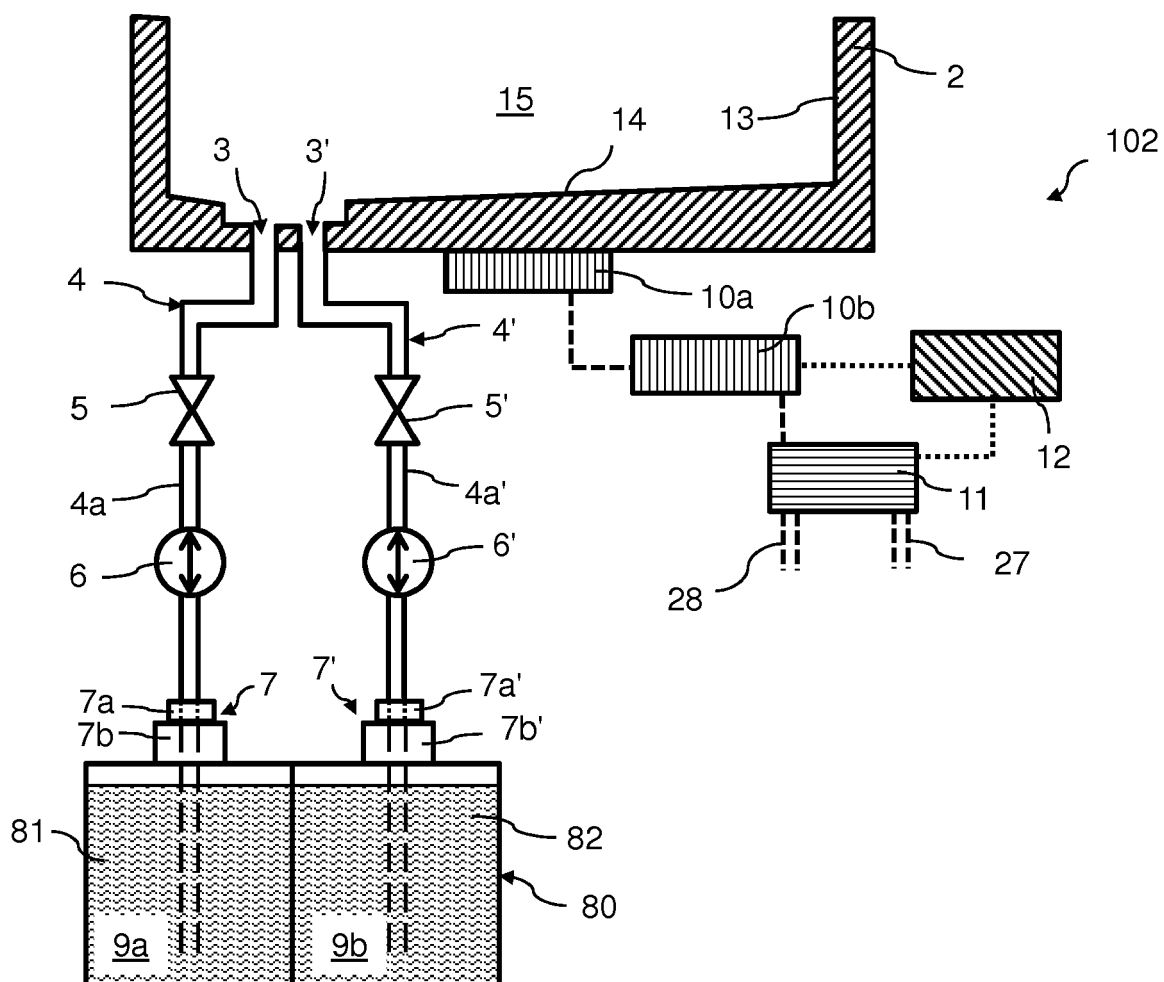


Figure 7

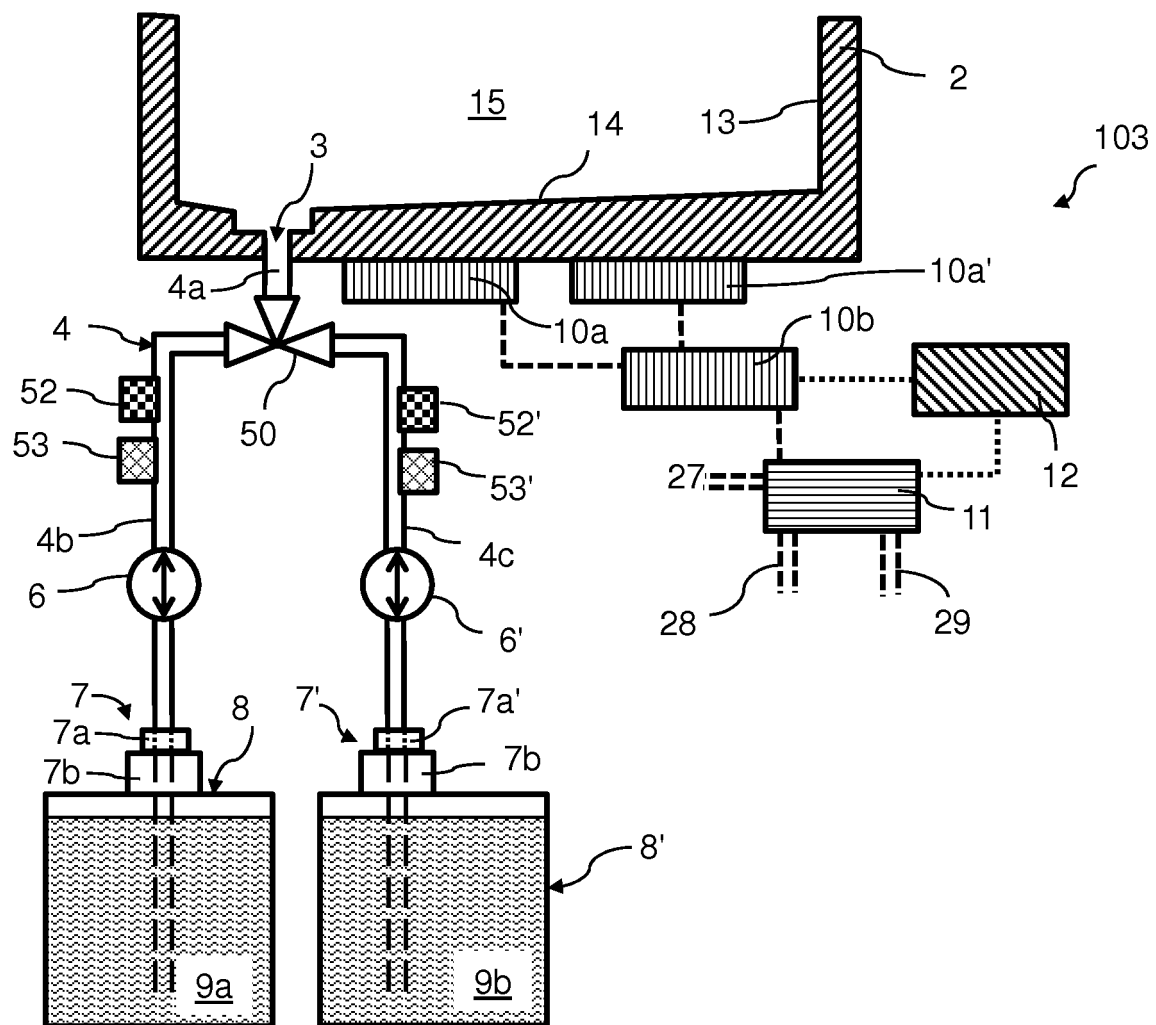


Figure 8

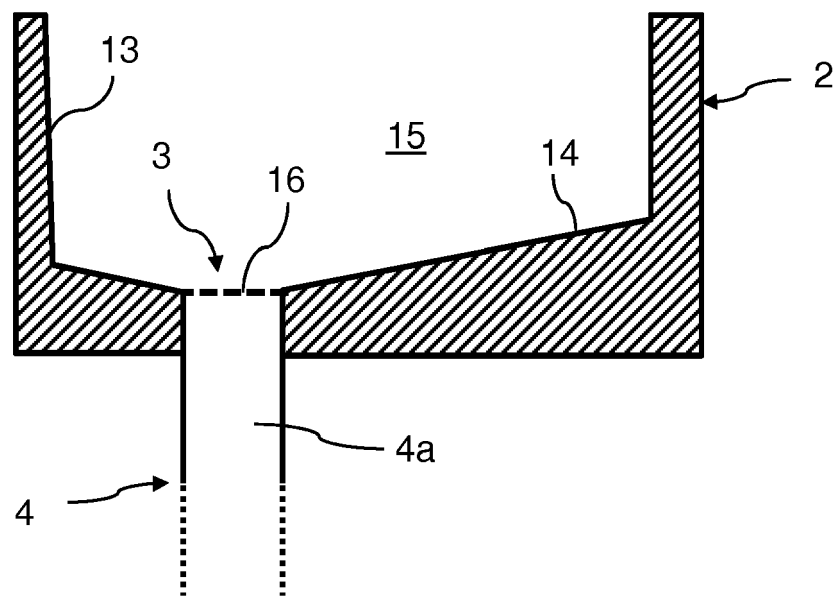


Figure 9

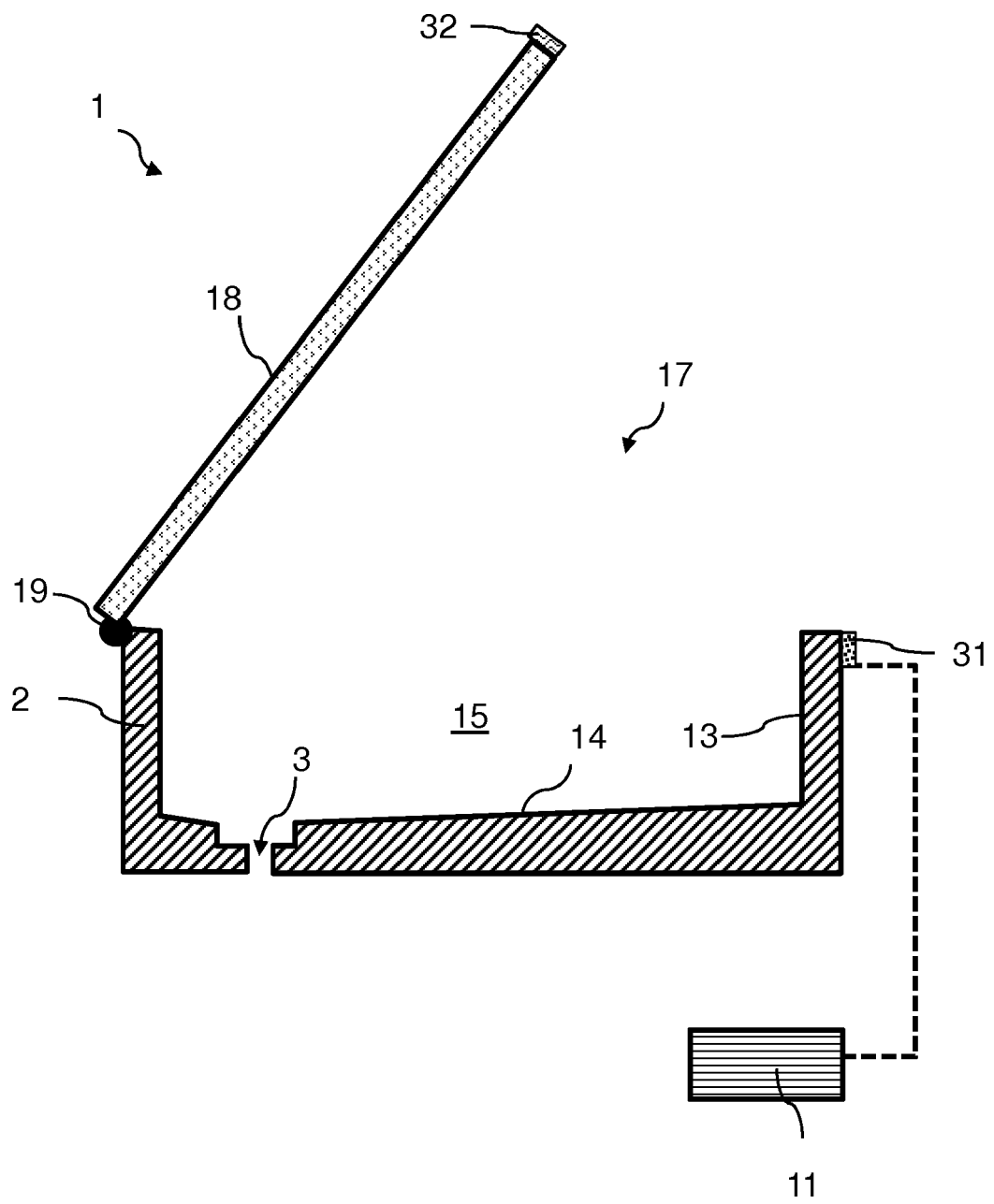


Figure 10

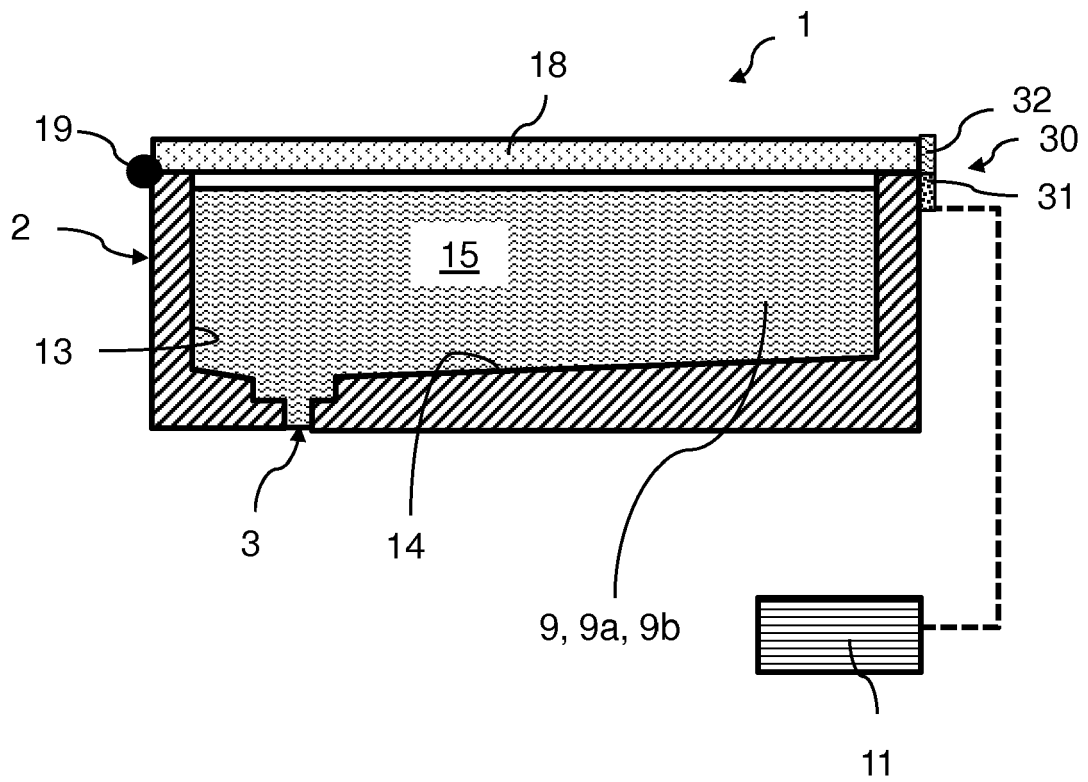


Figure 11

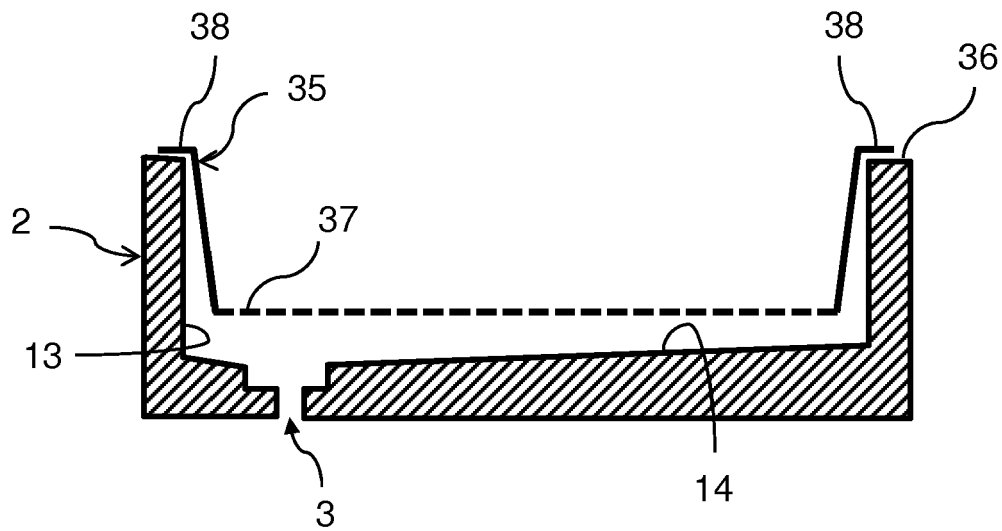


Figure 14

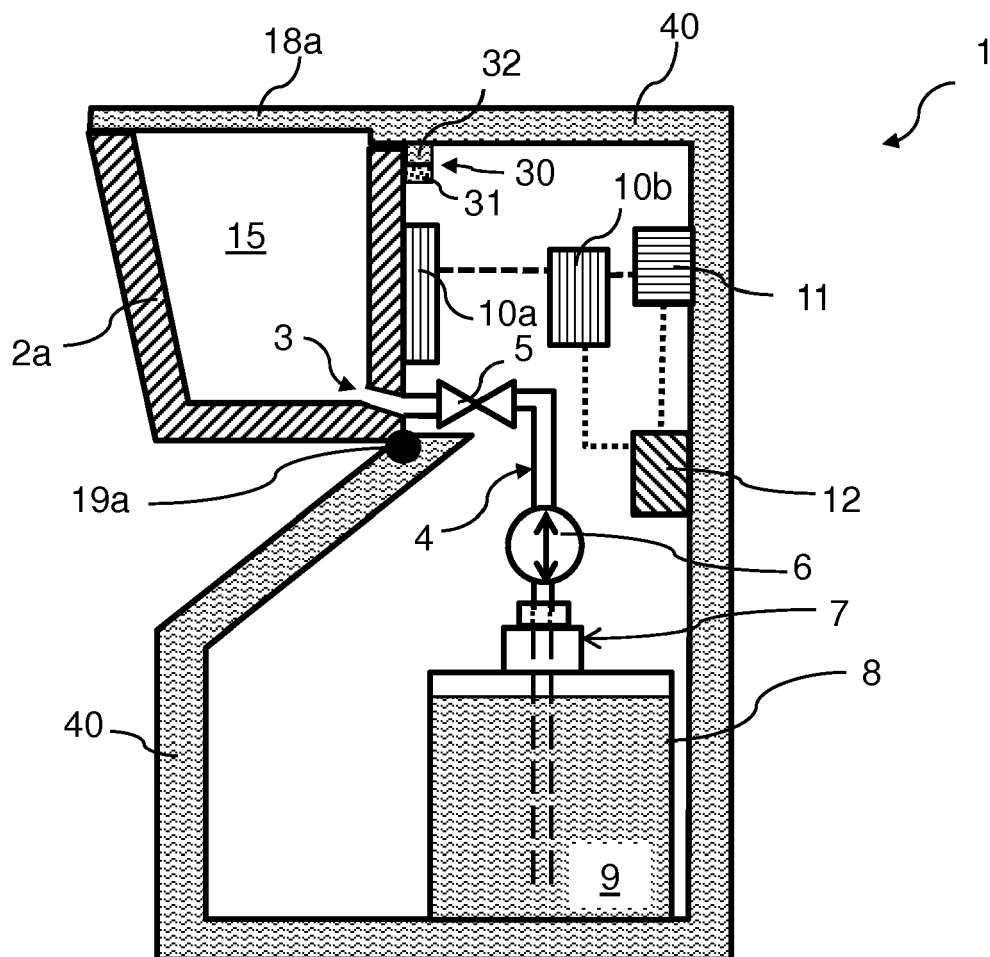


Figure 12

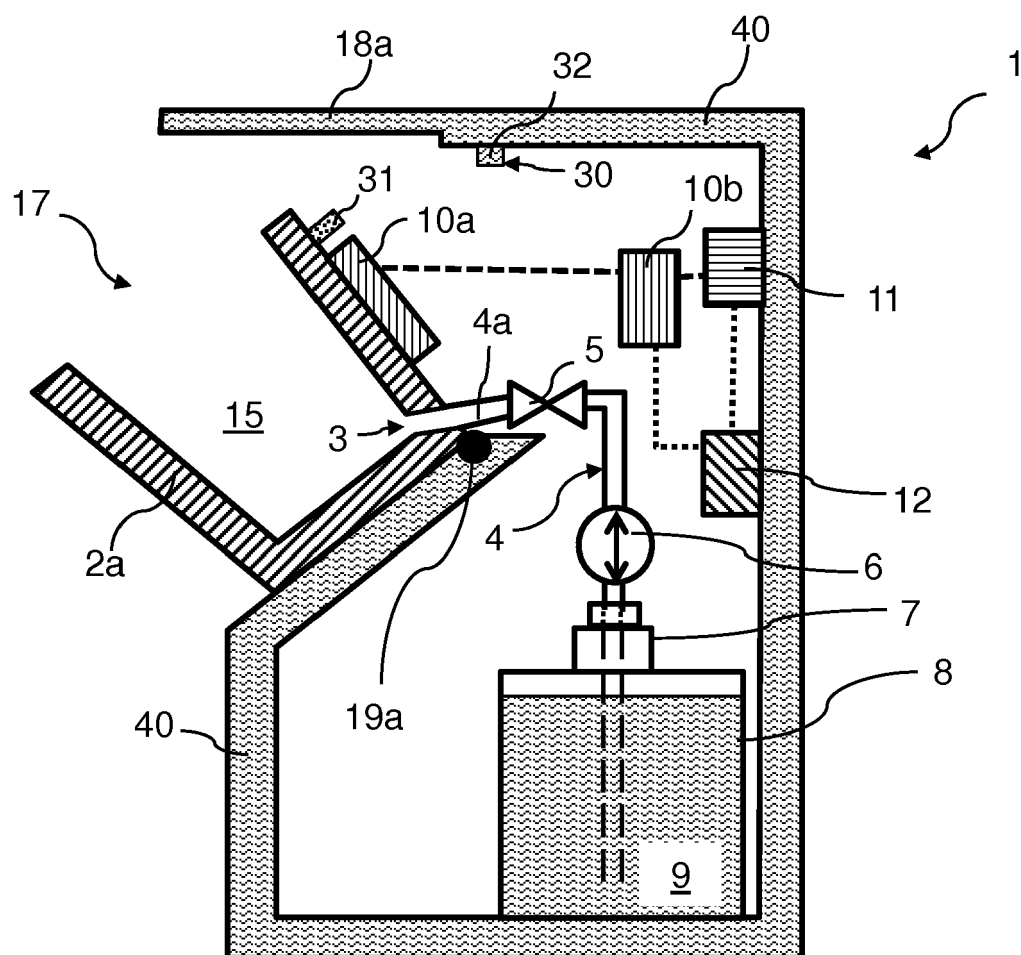


Figure 13

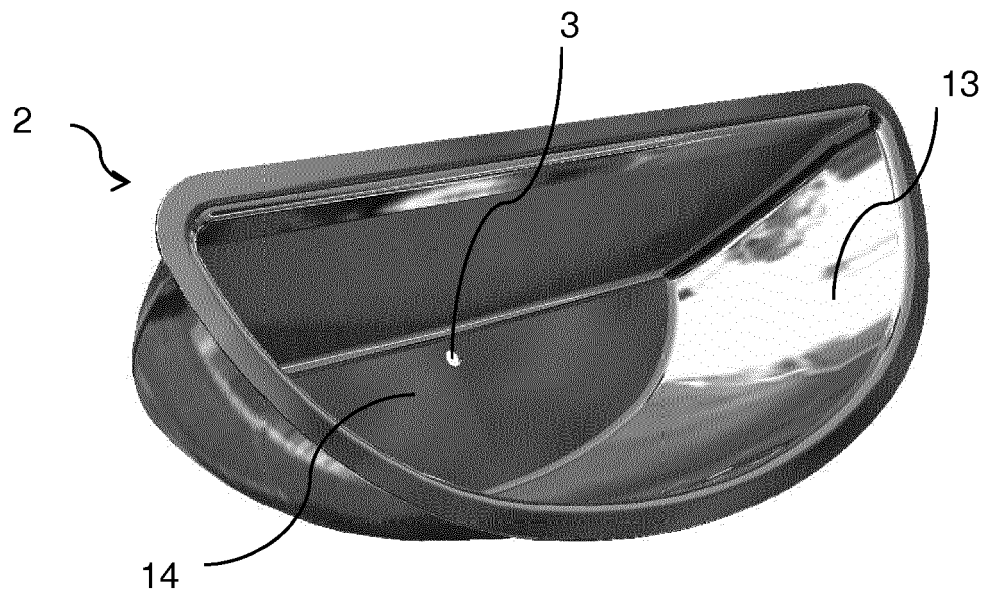


Figure 15

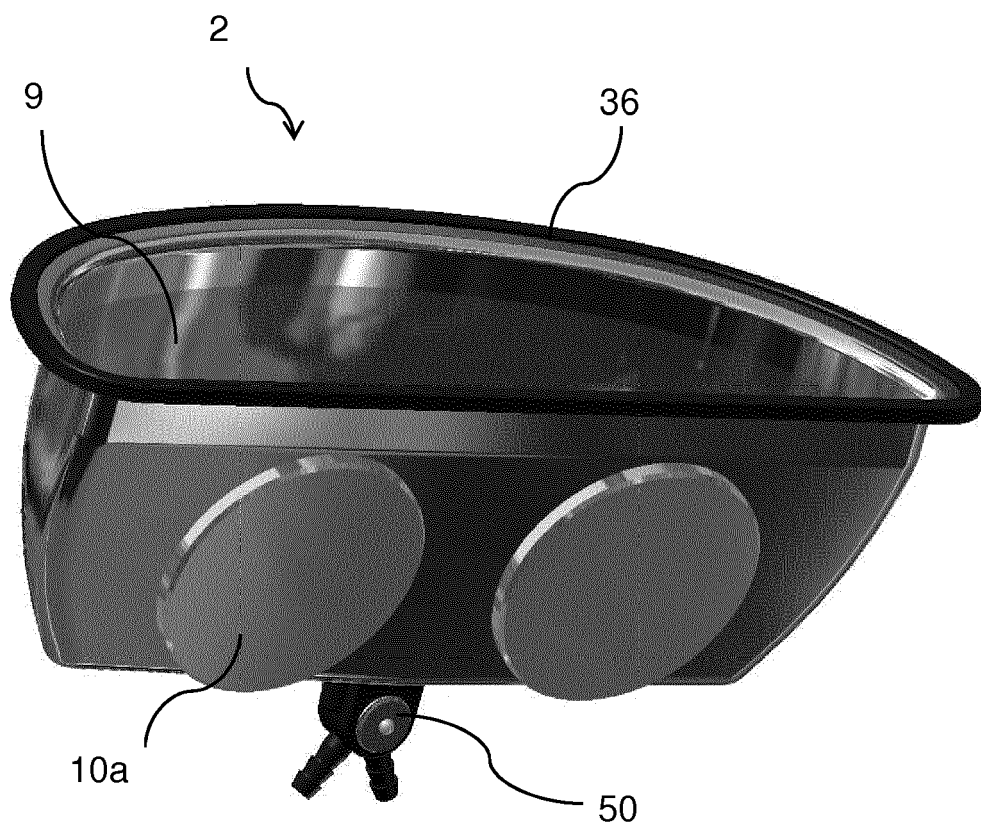


Figure 16



EUROPEAN SEARCH REPORT

Application Number
EP 13 19 0624

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Place of search The Hague		Date of completion of the search 14 January 2014	Examiner Posten, Katharina
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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