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A SIPHON DEVICE AND RELATED METHOD

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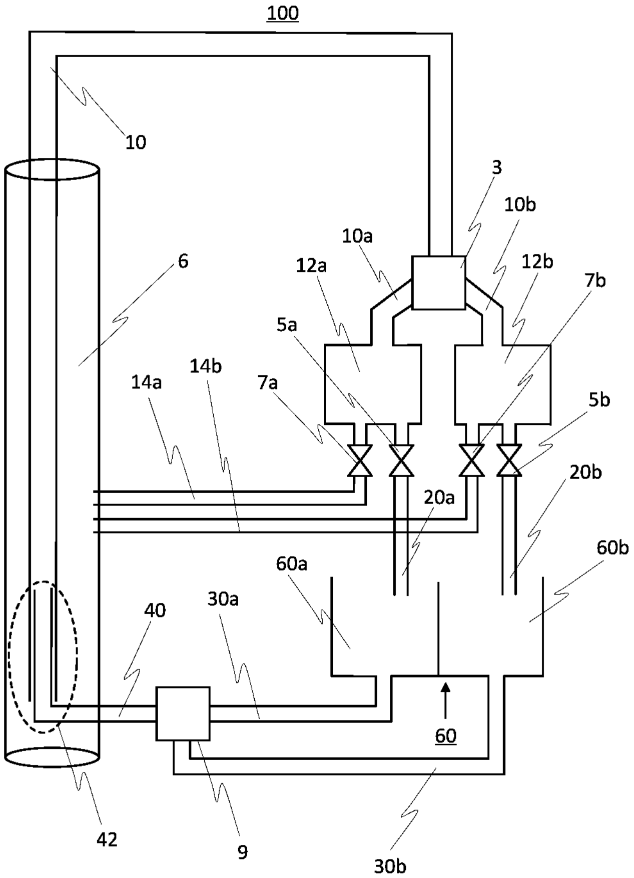
(57) Tiivistelmä - Sammandrag - Abstract

Tässä on esitetty lappolaitteisto, joka on konfiguroitu ja/tai kykenevä kierrättämään nestettä laitteiston sisällä, jolloin laitteistoon voi kuulua astia (6), ensimmäinen (12a) ja toinen säiliö (12b), ensimmäinen (60a) ja toinen varasto (60b) ja tarvittavat putket ja venttiilit näiden osien yhdistämiseksi. Laitteisto voidaan konfiguroida kierrättämään nestettä toimitettavaksi laitteiston sisälle siten, että laitteisto toimii vuorotellen kahden kierron välillä, joissa neste virtaa jatkuvasti astiaan (6) ja siitä pois. Tässä on esitetty myös menetelmä tässä kuvatun laitteiston käyttämiseksi.

Described herein is a siphon device that can be configured to and/or capable of circulating liquid inside the device, where the device can include a reservoir (6), a first (12a) and a second tank (12b), a first (60a) and a second reservoir (60b) and necessary conduits and valves to connect these parts. The device can be configured to circulate liquid to being provided inside the device so that the device functions between two alternating cycles, where the liquid continuously flows into and out from the container (6). Also described herein is a method of using the device described herein.



A SIPHON DEVICE AND RELATED METHOD

Technical field

The present disclosure generally relates to siphon devices and more particularly to a siphon device and method for circulating liquid.

Background

There are a wide variety of siphon devices that involve the flow of liquids through tubes. Generally, in siphon devices liquid is arranged to flow upward in a tube introduced to a container, above the level of the liquid in the container, with no pump, but powered by the fall of the liquid as it flows down the tube under the pull of gravity, discharging at a level lower than the level of the container from which it came.

JP2012255446A discloses a method where water in a plurality of water tanks is circulated to perform hydroelectric-power generation. In the method, water is moved continuously from a water tank 1 to a hydroelectric generator 19 by the siphon effect due to a height difference of water. The water discharged from the hydroelectric generator 19 is moved alternately to a water tank 4 and water tank 5 creating a change of air pressure inside these water tanks. By using the change of air pressure, the water inside the water tank 4 or the water tank 5 is moved into the water tank 1 to circulate the water, and thereby performing the continuous water circulation and power generation.

However, the present siphon devices lack necessary functioning needed to continuously circulate the liquid within the device. As such, there exists a need for improved siphon devices and techniques.

Summary

An object of the invention is to present a siphon device and method for circulating liquid so that at least deficiencies related to prior art can be reduced. The objects of the invention are obtained with a siphon device and method, which are characterized in what is presented in the independent claims. Some advantageous embodiments of the invention are presented in the dependent claims.

Described herein are aspects of a siphon device for continuous circulating liquid. The siphon device comprises a container and a first conduit, wherein the proximal end of the first conduit is introduced to the container and the distal end of the first

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conduit comprises a first branch and a second branch, which first branch is connected to a first tank and the second branch is connected to a second tank, wherein the device comprises a first valve configured to introduce the container though the first valve and via the first conduit to either the first tank or the second tank at a time.

The siphon device further comprises reservoiring means, which reservoiring means comprise a first reservoir and a second reservoir and are configured to change the height position of the first and second reservoir to maintain the levels of the liquid in the first and second reservoir at substantially the same when the liquid to be circulated within the device flows into one of said reservoirs and flows out from the other of said reservoirs at a time.

The siphon device further comprises a second valve and a third valve configured to introduce either the first tank through the second valve and via a second conduit to the first reservoir or the second tank through a third valve and via a third conduit to the second reservoir at a time.

The siphon device further comprises a fourth valve and a fifth valve configured to introduce either the first tank through the fourth valve and via a fourth conduit to the container or the second tank through the fifth valve and via a fifth conduit to the container at a time.

The siphon device further comprises a sixth valve and a sixth conduit, wherein the distal end of the sixth conduit is introduced to the container and the proximal end of the sixth conduit is introduced to the sixth valve, wherein the sixth valve is configured to introduce either the first reservoir via a seventh conduit, through the sixth valve and via the sixth conduit to the container or the second reservoir via an eight conduit, through the sixth valve and via the sixth conduit to the container at a time.

In the siphon device the distal end of the sixth conduit elongates inside the proximal end of the first conduit, wherein the sixth conduit, the first conduit and the container form an interjunction configured to locate below the liquid level in the container, which liquid is being circulated within the device, and allow the liquid flow into the proximal end of the first conduit from both of the sixth conduit and the container.

The siphon device is configured to continuously circulate the liquid to be placed into the device into and out from the container within the liquid flow, and maintain the liquid level in the container below the levels of the liquid in the fourth conduit and fifth conduit and above the levels of the liquid in the first reservoir and second reservoir by changing between two cycles so that in the first cycle:

– the container is introduced to the first tank by the first valve allowing the liquid

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flow from the interjunction into the first tank;

– the first tank is introduced to the first reservoir by the second valve allowing the liquid flow from the first tank into the first reservoir;

– the second reservoir is introduced to the container by the sixth valve allowing the liquid flow from the second reservoir into the interjunction; and

– the second tank is introduced to the container by the fifth valve allowing the liquid flow from the second tank into the container so that the liquid flow into and out from the container is balanced,

and in the second cycle:

–the container is introduced to the second tank by the first valve allowing the liquid flow from the interjunction into the second tank;

– the second tank is introduced to the second reservoir by the third valve allowing the liquid flow from the second tank into the second reservoir;

– the first reservoir is introduced to the container by the sixth valve allowing the liquid flow from the first reservoir into the interjunction; and

– the first tank is introduced to the container by the fourth valve allowing the liquid flow from the first tank to the container so that the liquid flow into and out from the container is balanced.

The reservoiring means can further comprise a rocking mechanism. The rocking mechanism may comprise two different position areas such that in the first position area the first reservoir is at a higher height position compared to the second reservoir and that in the second position area the second reservoir is at a higher height position compared to the first reservoir.

The reservoiring means can further comprise a position sensor configured indicate height positions of the first reservoir and second reservoir.

The siphon device can be configured to change into said second cycle when the second reservoir is at a predetermined distance above the first reservoir indicated by said position sensor and said first cycle when the first reservoir is at a predetermined distance above the second reservoir indicated by said position sensor. It can be appreciated by the skilled person that the predetermined distance can be found from said different position areas and the predetermined distance can be varied depending on the setup of the siphon device.

The siphon device can further comprise a first liquid level sensor configured to indicate the liquid level in the container.

The siphon device can be configured to balance the liquid flow into and out from the container to maintain said liquid level in the container, wherein:

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– during the first cycle the fifth valve is configured to adjust the liquid flow from the second tank into the container based on the indication of said first liquid level sensor; and

– during the second cycle the fourth valve is configured to adjust the liquid flow from the first tank into the container based on the indication of said first liquid level sensor.

The siphon device can comprise a second liquid level sensor configured to indicate the liquid level in the first tank and a third liquid level sensor configured to indicate the liquid level in the second tank.

The siphon device can be configured to change into said second cycle when the liquid level in the second tank is below a predetermined level indicated by said third liquid level sensor and first cycle when the liquid level in the first tank is below a predetermined level indicated by said second liquid level sensor. It can be appreciated by the skilled person that the predetermined level is such that an airlock is prevented.

The siphon device can comprise a fourth liquid level sensor configured to indicate the liquid level in the first reservoir and a fifth liquid level sensor configured to indicate the liquid level in the second reservoir.

The siphon device can be configured to change into said second cycle when the liquid level in the second reservoir is below a predetermined level indicated by said fifth liquid level sensor and first cycle when the liquid level in the first reservoir below a predetermined level indicated by said fourth liquid level sensor. It can be appreciated by the skilled person that the predetermined level is such that an airlock is prevented.

The siphon device may comprise at least one turbine generator configured to convert energy of the circulating liquid into electricity.

Also described herein are aspects of a method for continuous circulating liquid inside the siphon device disclosed in this document. The method comprises:

– providing liquid into the device; and

– changing between said first cycle and said second cycle to circulate the liquid continuously into and out from the container and maintain the liquid level in the container 6 below the levels of the liquid in the fourth and fifth conduit and above the levels of the liquid in the first and second reservoir.

An advantage of the invention is that it may allow to circulate the liquid continuously inside the siphon device.

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An advantage of the invention is further that it may enable the production of mechanical energy and further electricity from energy of the circulating liquid.

An advantage of the invention is further that it may enable the production of mechanical energy and further electricity from energy of the circulating liquid. The performance of power generation may be improved by exploiting external like renewable energies like solar energy.

An advantage of the invention is further that it may enable raising other liquids that are not intended to circulate within the device or solid items from the container to a higher position, flown along the liquid being circulated within the device. For example, the device may enable raising other liquids or solid items along the liquid being circulated from the container 6 to the first tank or the second tank from where these other liquids or solid items can be removed.

Exemplifying and non-limiting embodiments are mutually freely combinable unless otherwise explicitly stated.

The novel features which are considered as characteristic of the invention are set forth in particular in the depended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific example embodiments when read in connection with the accompanying drawings.

The previously presented considerations concerning the various embodiments of the device may be flexibly applied to the embodiments of the method mutatis mutandis, and vice versa, as being appreciated by a skilled person.

The embodiments in the following detailed description are given as examples only and someone skilled in the art can carry out the basic idea of the invention also in some other way than what is described in the description. Most embodiments can be actualised in a variety of combinations with other embodiments. Though the description may refer to a certain embodiment or embodiments in several places, this does not imply that the reference is directed towards only one described embodiment or that the described characteristic is usable only in one described embodiment. The individual characteristics of a plurality of embodiments may be combined and new embodiments of the invention may thus be provided.

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Brief Description of the Drawings

Further aspects of the present disclosure will be readily appreciated upon review of the detailed description when taken in conjunction with the accompanying drawings, in which:

Figure 1 shows schematically an embodiment of a siphon device for circulating liquid as described herein;

Figure 2 shows schematically reservoiring means comprising rocking mechanism utilised in an embodiment of a siphon device as described herein;

Figure 3 is a flow diagram disclosing an embodiment of a method for circulating liquid.

Detailed Description

Figure 1 shows an embodiment 100 of a siphon device for continuous circulating liquid. The device has a container 6 and a first tank 12a and a second tank 12b, which first tank 12a and second tank 12b are connected together with the container 6 with a first conduit 10. The proximal end of the first conduit 10 is introduced to the container 6 and the distal end of the first conduit 10 comprises a first branch 10a that is introduced to the first tank 12a and a second branch 10b that is introduced to the second tank 12b. The first conduit 10 extends upwardly from the container 6 and comprises an upwardly extending hump, which hump is the highest position of the device, being the position wherein the potential energy of the liquid to being circulated inside the device is at the highest level. At the location where the first conduit 10 is branched into the first branch 10a and the second branch 10b the first conduit 10 has a first valve 3, through which and via the first conduit 10 the container 6 is introduced to either the first tank 12a or the second tank 12b at a time. Advantageously the first valve 3 is a three-way valve.

The first tank 12a and the container 6 are connected together with a fourth conduit 14a. The second tank 12b and the container 6 are connected together with a fifth conduit 14b. The fourth conduit 14a has a fourth valve 7a and the fifth conduit 14b has a fifth valve 7b, which fourth valve 7a and fifth valve 7b are configured to introduce either the first tank 12a to the container 6 or the second tank 12b to the container 6 at a time. The fourth conduit 14a and the fifth conduit 14b are introduced to the container 6 above the proximal end of the first conduit 10. Advantageously the fourth valve 7a and the fifth valve 7b are both two-way valves.

The device has reservoiring means 60 below the first tank 12a and the second tank12b. The reservoiring means 60 has a first reservoir 60a and a second reservoir 60b. The first tank 12a and the first container 60a are connected with a second conduit 20a. The second tank 12b and the second container 60b are connected with a third conduit 20b.The second conduit 20a has a second valve 5a and the third conduit 20b has a third valve 5b, which second valve 5a and third valve 5b are configured to introduce the either the first tank 12a to the first reservoir 60a or the

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second tank 12b to the second reservoir 60b at a time. Advantageously the second valve 5a and the third valve 5b are both two-way valves.

The reservoiring means 60 is configured to change the height positions or the volumes (i.e. capacity) of the first reservoir 60a and second reservoir 60b to maintain the levels of the liquid in the first reservoir 60a and second reservoir 60b at substantially the same when the liquid to be circulated within the device flows into one of said reservoirs 60a, 60b and flows out from the other of said reservoirs 60a, 60b at a time.

In an embodiment the reservoiring means 60 comprises a rocking mechanism. Figure 2 shows an example of a rocking mechanism which has a plane 60c in which one side locates the first reservoir 60a and other side locates the second reservoir 60b. There is a shoulder 60d below the plane 60c at the central area of the plane 60c, which shoulder 60d is configured to allow rocking of the reservoiring means 60 and hence to allow changing of height positions of the first reservoir 60a and second reservoir 60b depending on the mass of said reservoirs 60a, 60b.

The device has a seventh conduit 30a which proximal end is introduced at the bottom section of the first reservoir 60a and the distal end is introduced to a sixth valve 9, through which the first reservoir 60a, via the seventh conduit 30a and a sixth conduit 40, is connected to the bottom section of the container 6. Correspondingly, the device has an eight conduit 30b which proximal end is introduced to the bottom section of the second reservoir 60b and the distal end is introduced to a sixth valve 9, through which the second reservoir 60b, via the eight conduit 30b and a sixth conduit 40, is connected to the bottom section of the container 6. The sixth valve 9 is configured to introduce either the first reservoir 60a or the second reservoir 60b to the container 6 at a time. Advantageously the sixth valve 9 is a three-way valve.

The proximal end of the sixth conduit 40 is connected to the sixth valve 9. The distal end of the sixth conduit 40 elongates inside the proximal end of the first conduit 10, wherein the sixth conduit 40, the first conduit 10 and the container 6 form an interjunction, denoted with 42 in Figure 1. The interjunction 42 is configured to locate at lower section of the container 6. Advantageously, when the liquid to be circulated is provided inside the device, the interjunction 42 locates below the liquid level in the container 6, and allow the liquid flow into the proximal end of the first conduit 10 from both of the sixth conduit 40 and the container 6.

In one embodiment the interjunction 42 is arranged so that there is a gap of approximately 1 to 10 millimeters (mm) between the inner diameter of the first conduit 10 and the outer diameter of the sixth conduit 40 in that length where the sixth conduit 40 is extended inside the first conduit 10.

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The length of the sixth conduit 40 inside the first conduit 10 defines the length of the interjunction 42. The skilled person is appreciated that the length of the interjunction 42 depends on the diameters of the first conduit 10 and the sixth conduit 40. Advantageously the length of the interjunction 42 and the gap between the first conduit 10 and sixth conduit 40 in the interjunction 42 are such the interjunction 42 allows the liquid flow into the proximal end of the first conduit 10 from the both of the sixth conduit 40 and the container 6.

In one embodiment the gap between the first conduit 10 and sixth conduit 40 in the interjunction 42 is advantageously between 1 mm and 100 mm, more advantageously between 5 mm and 75 mm, even more advantageously between 10 mm and 50 mm, and most advantageously between 15 mm and 20 mm. The skilled person is appreciated that the gap between the first conduit 10 and sixth conduit 40 may depend on sizes of the first conduit 10 and the sixth conduit 40 and that the interjunction 42 and said gap therein are scalable.

The device is configured to continuously circulate the liquid to be placed into the device into and out from the container 6 within the liquid flow, and maintain the liquid level in the container 6 below the levels of the liquid in the fourth 14a and fifth conduit 14b and above the levels of the liquid in the first 60a and second reservoir 60b by changing between two cycles. In the first cycle the device is configured to:

– introduce the container 6 to the first tank 12a by the first valve 3, allowing the liquid flow when the liquid is provided inside the device, from the interjunction 42 into the first tank 12a;

– introduce the first tank 12a to the first reservoir 60a by the second valve 5a, allowing the liquid flow from the first tank 12a into the first reservoir 60a;

– introduce the second reservoir 60b to the container 6 by the sixth valve 9, allowing the liquid flow from the second reservoir 60b into the interjunction 42; and

– introduce the second tank 12b to the container 6 by the fifth valve 7b, allowing the liquid flow from the second tank 16b into the container 6 so that the liquid flow into and out from the container 6 is balanced.

In the second cycle the device is configured to:

– introduce the container 6 to the second tank 12b by the first valve 3, allowing the liquid flow when the liquid is provided inside the device, from the interjunction 42 into the second tank 12b;

– introduce the second tank 12b to the second reservoir 60b by the third valve 5b, allowing the liquid flow from the second tank 12b into the second reservoir 60b;

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– introduce the first reservoir 60a to the container 6 by the sixth valve 9, allowing the liquid flow from the first reservoir 60a into the interjunction 42; and
– introduce the first tank 12a to the container 6 by the fourth valve 7a, allowing the liquid flow from the first tank 12a to the container 6 so that the liquid flow into and out from the container 6 is balanced.

Figure 3 shows a flowchart of a method according to an embodiment 300 of the usage of the siphon device for circulating liquid. The method comprises the following steps:

– step 302: provide liquid into the device; and
– step 304: change between said first cycle and said second cycle to circulate the liquid continuously into and out from the container 6 and maintain the liquid level in the container 6 below the levels of the liquid in the fourth 14a and fifth conduit 14b and above the levels of the liquid in the first 60a and second reservoir 60b.

When liquid is provided into the device the liquid is provided advantageously into the reservoir 6, first 12a and second tank 12b, first 60a and second reservoir 60b so that when the liquid starts to circulate inside the device, starting whether with said first or second cycle, air locks in the liquid flow are prevented.

Some advantageous embodiments of the siphon device and method and apparatus according to the invention have been described above. The invention is not limited to the embodiments described above, but the inventive idea can be applied in numerous ways within the scope of the claims.

The features recited in dependent claims are mutually freely combinable unless otherwise explicitly stated.

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Claims

1. A siphon device for continuous circulating liquid, **characterised** in that the siphon device comprises a container (6) and a first conduit (10), wherein the proximal end of the first conduit (10) is introduced to the container (6) and the distal end of the first conduit (10) comprises a first branch (10a) and a second branch (10b), which first branch (10a) is connected to a first tank (12a) and the second branch (10b) is connected to a second tank (12b), wherein the device comprises a first valve (3) configured to introduce the container (6) though the first valve (3) and via the first conduit (10) to either the first tank (12a) or the second tank (12b) at a time,

in that the siphon device comprises reservoiring means (60), which reservoiring means (60) comprise a first reservoir (60a) and a second reservoir (60b) and are configured to change the height position of the first (60a) and second reservoir (60b) to maintain the levels of the liquid in the first (60a) and second reservoir (60b) at substantially the same when the liquid to be circulated within the device flows into one of said reservoirs (60a, 60b) and flows out from the other of said reservoirs (60a, 60b) at a time,

in that the device comprises a second valve (5a) and a third valve (5b) configured to introduce either the first tank (12a) through the second valve (5a) and via a second conduit (20a) to the first reservoir (60a) or the second tank (12b) through a third valve (5b) and via a third conduit (20b) to the second reservoir (60b) at a time,

in that the device comprises a fourth (7a) and a fifth valve (7b) configured to introduce either the first tank (12a) through the fourth valve (7a) and via a fourth conduit (14a) to the container (6) or the second tank (12b) through the fifth valve (7b) and via a fifth conduit (14b) to the container (6) at a time, in that the siphon device comprises a sixth valve (9) and a sixth conduit (40), wherein the distal end of the sixth conduit (40) is introduced to the container (6) and the proximal end of the sixth conduit (40) is introduced to the sixth valve (9), wherein the sixth valve (9) is configured to introduce either the first reservoir (60a) via a seventh conduit (30a), through the sixth valve (9) and via the sixth conduit (40) to the container (6) or the second reservoir (60b) via an eight conduit (30b), through the sixth valve (9) and via the sixth conduit (40) to the container (6) at a time,

in that the distal end of the sixth conduit (40) elongates inside the proximal end of the first conduit (10), wherein the sixth conduit (40), the first conduit (10) and the container (6) form an interjunction (42) configured to locate below the liquid level in the container (6), which liquid is being circulated within the device, and allow the

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liquid flow into the proximal end of the first conduit (10) from both of the sixth conduit (40) and the container (6), and

in that the siphon device is configured to continuously circulate the liquid to be placed into the device into and from the container (6) within the liquid flow, and maintain the liquid level in the container (6) below the levels of the liquid in the fourth (14a) and fifth conduit (14b) and above the levels of the liquid in the first (60a) and second reservoir (60b) by changing between two cycles so that in the first cycle:

– the container (6) is introduced to the first tank (12a) by the first valve (3) allowing the liquid flow from the interjunction (42) into the first tank (12a);

– the first tank (12a) is introduced to the first reservoir (60a) by the second valve (5a) allowing the liquid flow from the first tank (12a) into the first reservoir (60a);

– the second reservoir (60b) is introduced to the container (6) by the sixth valve (9) allowing the liquid flow from the second reservoir (60b) into the interjunction (42); and

– the second tank (12b) is introduced to the container (6) by the fifth valve (7b) allowing the liquid flow from the second tank (16b) into the container (6) so that the liquid flow into and from the container (6) is balanced,

and that in the second cycle:

– the container (6) is introduced to the second tank (12b) by the first valve (3) allowing the liquid flow from the interjunction (42) into the second tank (12b);

– the second tank (12b) is introduced to the second reservoir (60b) by the third valve (5b) allowing the liquid flow from the second tank (12b) into the second reservoir (60b);

– the first reservoir (60a) is introduced to the container (6) by the sixth valve (9) allowing the liquid flow from the first reservoir (60a) into the interjunction (42); and

– the first tank (12a) is introduced to the container (6) by the fourth valve (7a) allowing the liquid flow from the first tank (12a) to the container (6) so that the liquid flow into and from the container (6) is balanced.

2. The siphon device according to claim 1, **characterised** in that said reservoiring means (60) comprise a rocking mechanism.

3. The siphon device according to claim 1 or 2, **characterised** in that said reservoiring means (60) comprise a position sensor configured indicate height positions of the first reservoir (60a) and second reservoir (60b).

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4. The siphon device according to claim 3, **characterised** in that the siphon device is configured to change into said second cycle when the second reservoir (60b) is at a predetermined distance above the first reservoir (60a) indicated by said position sensor and said first cycle when the first reservoir (60a) is at a predetermined distance above the second reservoir (60b) indicated by said position sensor.

5. The siphon device according to one of the preceding claims, **characterized** in that the siphon device comprises a first liquid level sensor configured to indicate the liquid level in the container (6).

6. A siphon device of claim 5, **characterised** in that the siphon device is configured to balance the liquid flow into and from the container (6) to maintain said liquid level in the container (6), wherein:

– during the first cycle the fifth valve (7b) is configured to adjust the liquid flow from the second tank (12b) into the container (6) based on the indication of said first liquid level sensor; and

– during the second cycle the fourth valve (7a) is configured to adjust the liquid flow from the first tank (12a) into the container (6) based on the indication of said first liquid level sensor.

7. The siphon device according to one of the preceding claims, **characterized** in that the siphon device comprises a second liquid level sensor configured to indicate the liquid level in the first tank (12a) and a third liquid level sensor configured to indicate the liquid level in the second tank (12b).

8. The siphon device according to claim 7, **characterised** in that the siphon device is configured to change into said second cycle when the liquid level in the second tank (12b) is below a predetermined level indicated by said third liquid level sensor and first cycle when the liquid level in the first tank (12a) is below a predetermined level indicated by said second liquid level sensor.

9. The siphon device according to one of the preceding claims, **characterized** in that the siphon device comprises a fourth liquid level sensor configured to indicate the liquid level in the first reservoir (60a) and a fifth liquid level sensor configured to indicate the liquid level in the second reservoir (60b).

10. The siphon device according to claim 9, **characterised** in that the siphon device is configured to change into said second cycle when the liquid level in the

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second reservoir (60b) is below a predetermined level indicated by said fifth liquid level sensor and first cycle when the liquid level in the first reservoir (60a) is below a predetermined level indicated by said fourth liquid level sensor.

11. The siphon device according to one of the preceding claims, **characterized** in that the siphon device comprises at least one turbine generator configured to convert energy of the circulating liquid into electricity.

12. A method for continuous circulating liquid inside the siphon device according to one of the preceding claims 1–11, **characterised** in that the method comprising:
– providing liquid into the device; and
– changing between said first cycle and said second cycle to circulate the liquid continuously into and out from the container (6) and maintain the liquid level in the container (6) below the levels of the liquid in the fourth (14a) and fifth conduit (14b) and above the levels of the liquid in the first (60a) and second reservoir (60b).

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LAPPOLAITTEISTO JA VASTAAVA MENETELMÄ

Patenttivaatimukset

1. Lappolaitteisto nesteen jatkuvaksi kierrättämiseksi, **tunnettu** siitä, että lappolaitteisto käsittää astian (6) ja ensimmäisen putken (10), jolloin ensimmäisen putken (10) proksimaalipää on yhdistetty astiaan (6) ja ensimmäisen putken (10) distaalipää käsittää ensimmäisen haaran 10a) ja toisen haaran (10b), joka ensimmäinen haara (10a) on yhdistetty ensimmäiseen säiliöön (12a) ja toinen haara (10b) on yhdistetty toiseen säiliöön (12b), jolloin laitteisto käsittää ensimmäisen venttiilin (3) konfiguroituna yhdistämään astia (6) ensimmäisen venttiilin (3) kautta ja ensimmäisen putken (10) välityksellä joko ensimmäiseen säiliöön (12a) tai toiseen säiliöön (12b) kerrallaan,

siitä, että lappolaitteisto käsittää varastointivälineet (60), jotka varastointivälineet (60) käsittävät ensimmäisen varaston (60a) ja toisen varaston (60b) ja ovat konfiguroituina muuttamaan ensimmäisen (60a) ja toisen varaston (60b) korkeusasemaa nestetasojen pitämiseksi ensimmäisessä (60a) ja toisessa varastossa (60b) olennaisesti samana silloin kun laitteistossa kierrätettävä neste virtaa toiseen mainituista varastoista (60a, 60b) ja virtaa ulos toisesta mainituista varastoista (60a, 60b) kerrallaan,

siitä, että laitteisto käsittää toisen venttiilin (5a) ja kolmannen venttiilin (5b) konfiguroituina yhdistämään joko ensimmäinen säiliö (12a) toisen venttiilin (5a) kautta ja toisen putken (20a) välityksellä ensimmäiseen varastoon (60a) tai toinen säiliö (12b) kolmannen venttiilin (5b) kautta ja kolmannen putken (20b) välityksellä toiseen varastoon (60b) kerrallaan,

siitä, että laitteisto käsittää neljännen (7a) ja viidennen venttiilin (7b) konfiguroituina yhdistämään joko ensimmäinen säiliö (12a) neljännen venttiilin (7a) kautta ja neljännen putken (14a) välityksellä astiaan (6) tai toinen säiliö (12b) viidennen venttiilin (7b) kautta ja viidennen putken (14b) välityksellä astiaan (6) kerrallaan, siitä, että lappolaitteisto käsittää kuudennen venttiilin (9) ja kuudennen putken (40), jolloin kuudennen putken (40) distaalipää on yhdistetty astiaan (6) ja kuudennen putken (40) proksimaalipää on yhdistetty kuudenteen venttiiliin (9), jolloin kuudes venttiili (9) on konfiguroitu yhdistämään joko ensimmäinen varasto (60a) seitsemännen putken (30a) välityksellä, kuudennen venttiilin (9) kautta ja kuudennen putken (40) välityksellä astiaan (6) tai toinen varasto (60b) kahdeksannen putken (30b) välityksellä, kuudennen venttiilin (9) kautta ja kuudennen putken (40) välityksellä astiaan (6) kerrallaan,

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siitä, että kuudennen putken (40) distaalipää jatkuu ensimmäisen putken (10) proksimaalipään sisäpuolelle, jolloin kuudes putki (40), ensimmäinen putki (10) ja astia (6) muodostavat keskinäisliitännän (42), joka on konfiguroitu sijoittumaan nestepinnan alapuolelle astiassa (6), jota nestettä ollaan kierrättämässä laitteistossa, ja sallimaan nesteen virrata ensimmäisen putken (10) proksimaalipäähän sekä kuudennesta putkesta (40) että astiasta (6), ja

siitä, että lappolaitteisto on konfiguroitu kierrättämään laitteistoon sijoitettava neste jatkuvasti astiaan (6) ja siitä pois nestevirtauksen rajoissa ja säilyttämään nestetaso astiassa (6) neljännessä (14a) ja viidennessä putkessa (14b) olevien nestetasojen alapuolella ja ensimmäisessä (60a) ja toisessa varastossa (60b) olevien nestetasojen yläpuolella vaihtelemalla kahden kierron välillä siten, että ensimmäisessä kierrossa:

– astia (6) on yhdistettynä ensimmäiseen säiliöön (12a) ensimmäisen venttiilin (3) kautta sallien nesteen virtaus keskinäisliitännästä (42) ensimmäiseen säiliöön (12a);
– ensimmäinen säiliö (12a) on yhdistettynä ensimmäiseen varastoon (60a) toisen venttiilin (5a) kautta sallien nesteen virtaus ensimmäisestä säiliöstä (12a) ensimmäiseen varastoon (60a);
– toinen varasto (60b) on yhdistettynä astiaan (6) kuudennen venttiilin (9) kautta sallien nesteen virtaus toisesta varastosta (60b) keskinäisliitäntään (42); ja
– toinen säiliö (12b) on yhdistettynä astiaan (6) viidennen venttiilin (7b) kautta sallien nesteen virtaus toisesta säiliöstä (16b) astiaan (6) siten, että nesteen virtaus astiaan (6) ja siitä pois on tasapainossa,

ja että toisessa kierrossa:

– astia (6) on yhdistettynä toiseen säiliöön (12b) ensimmäisen venttiilin (3) kautta sallien nesteen virtaus keskinäisliitännästä (42) toiseen säiliöön (12b);
– toinen säiliö (12b) on yhdistettynä toiseen varastoon (60b) kolmannen venttiilin (5b) kautta sallien nesteen virtaus toisesta säiliöstä (12b) toiseen varastoon(60b);
– ensimmäinen varasto (60a) on yhdistettynä astiaan (6) kuudennen venttiilin (9) kautta sallien nesteen virtaus ensimmäisestä varastosta (60a) keskinäisliitäntään (42); ja
– ensimmäinen säiliö (12a) on yhdistettynä astiaan (6) neljännen venttiilin (7a) kautta sallien nesteen virtaus ensimmäisestä säiliöstä (12a) astiaan (6) siten, että nesteen virtaus astiaan (6) ja siitä pois on tasapainossa.

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2. Patenttivaatimuksen 1 mukainen lappolaitteisto, **tunnettu** siitä, että mainitut varastointivälineet (60) käsittävät keinumekanismin.

3. Patenttivaatimuksen 1 tai 2 mukainen lappolaitteisto, **tunnettu** siitä, että mainitut varastointivälineet (60) käsittävät asentoanturin, joka on konfiguroitu ilmaisemaan ensimmäisen varaston (60a) ja toisen varaston (60b) korkeusasemat.

4. Patenttivaatimuksen 3 mukainen lappolaitteisto, **tunnettu** siitä, että lappolaitteisto on konfiguroitu siirtymään mainittuun toiseen kiertoon silloin kun toinen varasto (60b) on mainitun asentoanturin ilmaisemalla ennalta määrätyllä etäisyydellä ensimmäisen varaston (60a) yläpuolella ja mainittuun ensimmäiseen kiertoon silloin kun ensimmäinen varasto (60a) on mainitun asentoanturin ilmaisemalla ennalta määrätyllä etäisyydellä toisen varaston (60b) yläpuolella.

5. Jonkin edellä olevan patenttivaatimuksen mukainen lappolaitteisto, **tunnettu** siitä, että lappolaitteisto käsittää ensimmäisen nestetason anturin, joka on konfiguroitu ilmaisemaan nestetaso astiassa (6).

6. Patenttivaatimuksen 5 mukainen lappolaitteisto, **tunnettu** siitä, että lappolaitteisto on konfiguroitu tasapainottamaan nesteen virtaus astiaan (6) ja siitä pois mainitun nestetason säilyttämiseksi astiassa (6), jossa:

- ensimmäisen kierron aikana on viides venttiili (7b) konfiguroituna säätämään nesteen virtausta toisesta säiliöstä (12b) astiaan (6) mainitun nestetason anturin näyttämän perusteella; ja
- toisen kierron aikana on neljäs venttiili (7a) konfiguroituna säätämään nesteen virtausta ensimmäisestä säiliöstä (12a) astiaan (6) mainitun nestetason anturin näyttämän perusteella.

7. Jonkin edellä olevan patenttivaatimuksen mukainen lappolaitteisto, **tunnettu** siitä, että lappolaitteisto käsittää toisen nestetason anturin, joka on konfiguroitu ilmaisemaan nestetaso ensimmäisessä säiliössä (12a), ja kolmannen nestetason anturin, joka on konfiguroitu ilmaisemaan nestetaso toisessa säiliössä (12b).

8. Patenttivaatimuksen 7 mukainen lappolaitteisto, **tunnettu** siitä, että lappolaitteisto on konfiguroitu siirtymään mainittuun toiseen kiertoon silloin kun nestetaso toisessa säiliössä (12b) on mainitun kolmannen nestetason anturin ilmaiseman ennalta määrätyn tason alapuolella ja ensimmäiseen kiertoon silloin kun nestetaso ensimmäisessä säiliössä (12a) on mainitun toisen nestetason anturin ilmaiseman ennalta määrätyn tason alapuolella.

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9. Jonkin edellä olevan patenttivaatimuksen mukainen lappolaitteisto, **tunnettu** siitä, että lappolaitteisto käsittää neljännen nestetason anturin, joka on konfiguroitu ilmaisemaan nestetaso ensimmäisessä varastossa (60a), ja viidennen nestetason anturin, joka on konfiguroitu ilmaisemaan nestetaso toisessa varastossa (60b).

10. Patenttivaatimuksen 9 mukainen lappolaitteisto, **tunnettu** siitä, että lappolaitteisto on konfiguroitu siirtymään mainittuun toiseen kiertoon silloin kun nestetaso toisessa varastossa (60b) on mainitun viidennen nestetason anturin ilmaiseman ennalta määrätyn tason alapuolella ja ensimmäiseen kiertoon silloin kun nestetaso ensimmäisessä varastossa (60a) on mainitun neljännen nestetason anturin ilmaiseman ennalta määrätyn tason alapuolella.

11. Jonkin edellä olevan patenttivaatimuksen mukainen lappolaitteisto, **tunnettu** siitä, että lappolaitteisto käsittää vähintään yhden turbiinigeneraattorin, joka on konfiguroitu muuntamaan kiertävän nesteen energiaa sähköksi.

12. Menetelmä nesteen jatkuvaksi kierrättämiseksi jonkin patenttivaatimuksen 1–11 mukaisen lappolaitteiston sisällä, **tunnettu** siitä, että menetelmässä:

– toimitetaan nestettä laitteistoon; ja

– vaihdellaan mainitun ensimmäisen kierron ja mainitun toisen kierron välillä nesteen kierrättämiseksi jatkuvasti astiaan (6) ja siitä pois ja nestetason säilyttämiseksi astiassa (6) neljännessä (14a) ja viidennessä putkessa (14b) olevien nestetasojen alapuolella ja ensimmäisessä (60a) ja toisessa varastossa (60b) olevien nestetasojen yläpuolella.

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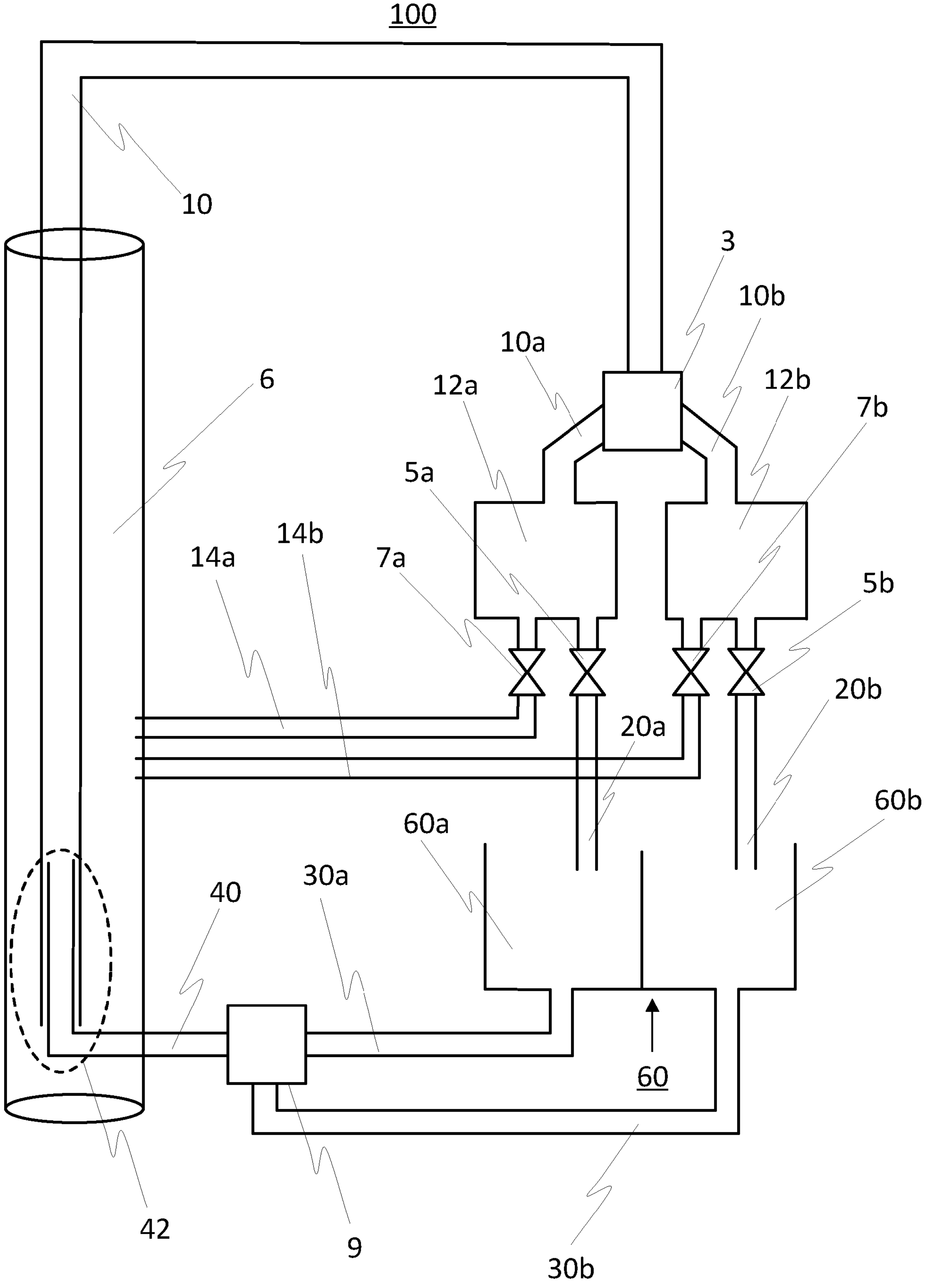

Fig. 1

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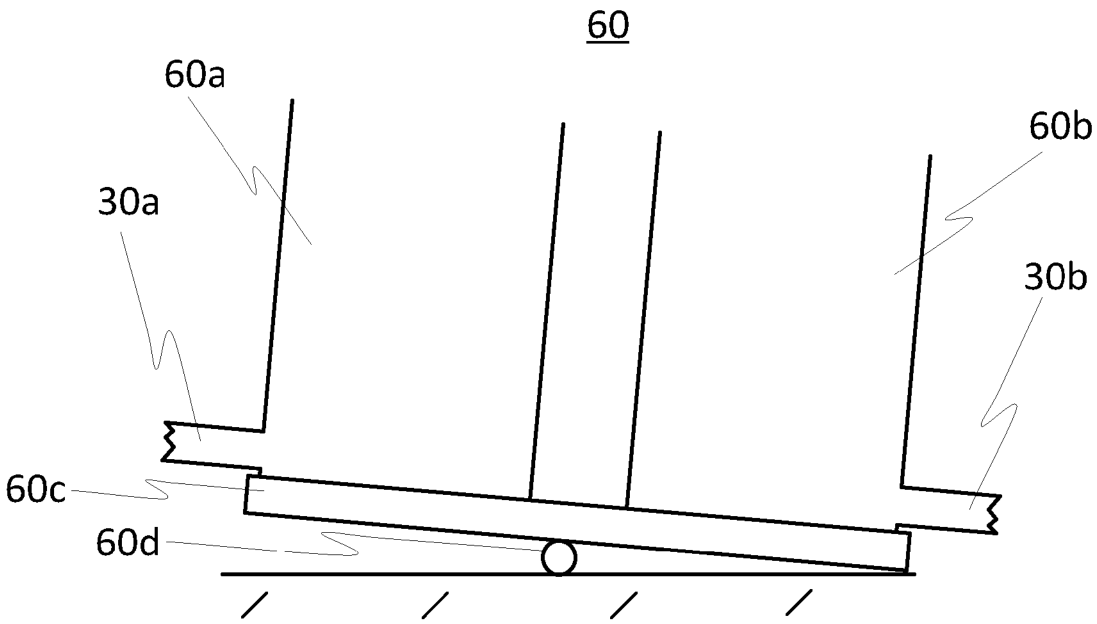

Fig. 2

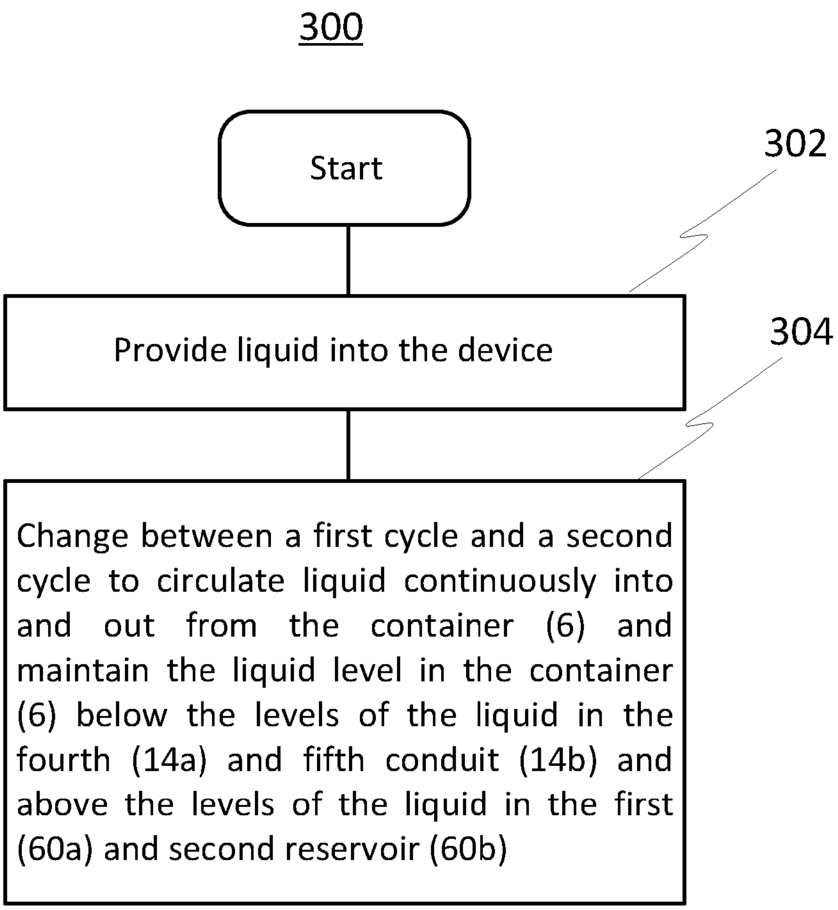

Fig. 3

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