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## (54) Steam generator for use in a laundry care appliance, and laundry care appliance

(57) The steam generator 11 is intended and adapted for use in a laundry care appliance D1, D2 and comprises a heated tank 12. The tank 12 at least comprises: an inlet 3 for filling the tank 12 with liquid L; a heater 14 for heating the liquid L; a steam outlet 4; and a controllable drain 8 for draining the liquid L from the tank 12 wherein an opening and closing of the drain 8 is controllable by a valve 9. The laundry care appliance D1, D2 according to the invention comprises such steam generator 11, wherein the valve 9 is connected for operation to a control unit C of the laundry care appliance D1, D2.

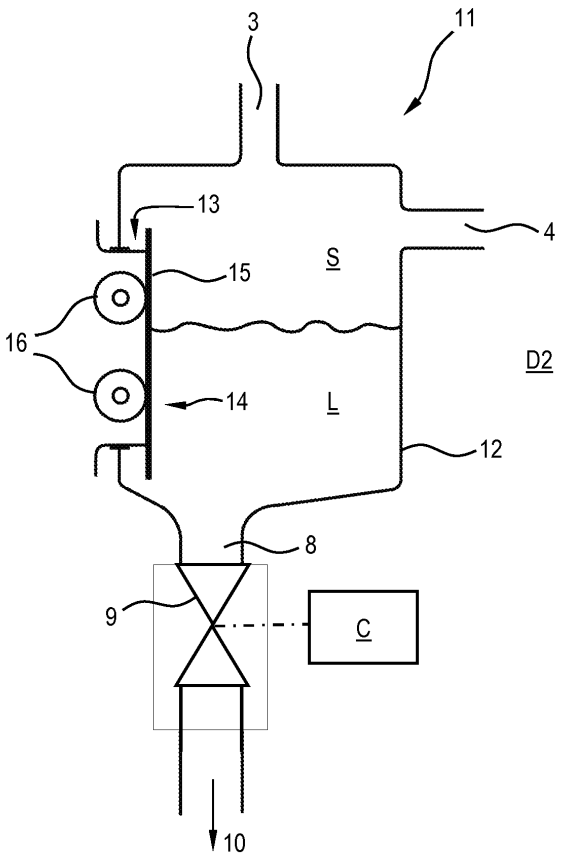


Fig.2

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## Description

**[0001]** The invention relates to a steam generator for use in a laundry care appliance, particularly a refresher dryer, the steam generator comprising a heated tank having an inlet for filling the tank with liquid, a heater for heating the liquid, and a steam outlet. The invention further relates to a laundry care appliance comprising such steam generator.

**[0002]** In such steam generator there is a need to cope with scale (mostly limestone) formed from mineral residuals dissolved in the water used for generating steam and accumulating in the tank of the steam generator itself as the water is converted into steam.

**[0003]** EP 0 821 096 B1 discloses a steam generator for clothes irons and the like, comprising: a water tank; a boiler; a water supply pipe which connects the tank to the boiler and which has inserted inside it a delivery pump and a non-return valve; electric heating means associated on the outside of the boiler and comprising at least one heating plate associated in a close-fitting manner with a bottom of the boiler; and a thermostatic switch for actuating said pump. Further, said boiler has an opening for connection to the water supply pipe; a steam delivery pipe which connects the boiler to the user apparatus and which has inserted inside it a controllable steam valve; wherein said bottom of the boiler has at least two portions including a lower portion and an upper portion, both arranged at different heights and both heated by the said heating plate. Said thermostatic switch and said opening of the boiler are arranged in the region of said upper portion. The boiler has a discharge plug arranged in the vicinity of the lower portion for removal therefrom of the scale which inevitably forms inside it with time.

**[0004]** EP 1 026 306 B1 discloses an automatic-refill steam generator for use in conjunction with steam cleaning equipment, clothes irons, fan-assisted ironing boards with refill function, coffee brewing machines and similar, provided with at least an electric heating element attached to the outside of the steam generator and equipped with a control thermostat, said steam generator being connected on one side to a water reservoir via a pump and at least a pipe, and being further connected on the other side to the steam using apparatus via a pipe provided with an electromagnetic valve and a pressure switch, said steam generator being constituted by a hollow body formed by a first and a second half-shell, and wherein said first and second half-shells are joined to each other along the peripheral edge thereof according to a substantially vertical plane, said electric heating element being externally attached to a lateral face of said first half-shell, said hollow body being provided with a water inlet aperture situated in a lateral face of said second half-shell opposing the lateral face of said first half-shell carrying said electric heating element, such that a water jet let into the steam generator through said aperture is directed against said first half-shell carrying said heating element. The reservoir is provided with a water fill aperture, which is closed by a cap, and the hollow body is provided with a bottom drain that is closed by a cap. This drain can on the other hand be also arranged in the upper portion of the body.

**[0005]** These steam generators have the disadvantage that the discharge plug or bottom drain is only useful for transportable appliances like irons, ironing boards and the like that may be drained manually over a sink or such.

**[0006]** Therefore, a steam generator for a large laundry care appliance like a clothes dryer typically does not comprise a discharge plug or bottom drain but comprises a "trash area" that provides capacity sufficient to store all the scale formed during a presumed lifetime of the steam generator or appliance. Such steam generator, however, needs to become relatively bulky since scale formation as expectable from very calciferous water and a heavy use of the clothes dryer during a presumed lifetime must be anticipated.

**[0007]** It is an object of the present invention to provide a steam generator for use in a laundry care appliance that overcomes the disadvantages of the art and in particular provides a compact steam generator that is not inhibited by accumulated scale residue.

**[0008]** The object is achieved according to the features of the independent claims. Preferred embodiments can be derived, inter alia, from the dependent claims and/or the subsequent description.

**[0009]** According to the invention, this object is achieved by a steam generator for use in a laundry care appliance, comprising a heated tank, the heated tank at least comprising: an inlet for filling the tank with liquid; a heater for heating the liquid (to produce steam from the liquid); a steam outlet; and a controllable drain for draining the liquid from the tank wherein an opening and closing of the drain is controllable by a valve.

**[0010]** By using a drain, the scale can be flushed out of the tank. Thus, there is no need to provide a trash area anymore and the steam generator can be of a very compact design. By providing the valve to be controllable, it can be operated automatically without direct user interference which makes its use practicable. Further, the controllable valve can provide additional safety measures.

**[0011]** Preferably, the laundry care appliance considered is a refresher dryer, which is a laundry dryer that is equipped for treating laundry placed therein with steam in addition to drying laundry. Such treatment with steam may be applied to remove wrinkles or undesirable odours from clothes In addition, a treatment with steam may include adding perfumes or fabric treating agents to clothes thus treated.

**[0012]** Preferably the liquid is water or mostly water, in particular condensate water obtained from a drying process applied within a laundry care appliance.

**[0013]** The steam outlet may lead to a clothes processing room of a related laundry care appliance, e.g. a clothes drum, to apply steam to clothes placed therein for treatment.

**[0014]** It is a preferred embodiment of the invention hat the valve is freely controllable or operable, i.e. the valve can be operated (opened/closed) at any point of time, e.g. depending on a program of the laundry care appliance.

**[0015]** It is another preferred embodiment of the invention that the valve is controllable by a level of the liquid (e.g. a water level) in the heated tank. In other words the valve will open if the liquid level reaches or exceeds a certain threshold level within the tank. The valve can thus act as an overflow protection means.

**[0016]** It is a special preferred embodiment of the invention that the valve comprises a mechanical spring-and-float mechanism. The float can force open a mechanically operable valve via the spring if the float reaches a certain height associated with the liquid level.

**[0017]** In an alternative preferred embodiment of the invention, the tank is equipped with a liquid level sensor that will detect if the liquid level reaches or exceeds a certain threshold level within the tank. The liquid level sensor can be communicatively coupled to a control unit of the refresher dryer. The control unit can operate (in particular open) the valve in response to the liquid level sensor detecting that the liquid level has reached or exceeded the threshold level.

**[0018]** It is yet another preferred embodiment of the invention that the valve is selected to be a pressure-relief valve. In this case the valve is opened if a pressure value within the tank reaches or exceeds a certain pressure threshold value within the tank.

**[0019]** It is even another preferred embodiment of the invention that the drain is located at a bottom of the tank. This ensures removal of most of the scale through the drain.

**[0020]** It is also a preferred embodiment of the invention that the heater is placed inside the tank. This achieves an effective heat exchange between the heater and the liquid to be heated.

**[0021]** It is an alternative preferred embodiment of the invention wherein the heater is placed outside the tank. This has the advantage that scaling of the heater is avoided.

**[0022]** Removal is further improved if the bottom is inclined towards the drain in even another embodiment.

**[0023]** The object is also achieved by a laundry care appliance comprising the steam generator, wherein the valve is connected for operation or communicatively coupled to a control unit of the appliance.

**[0024]** The drain can be connected to a fluid outlet to transport the scale out of the appliance.

**[0025]** In the following drawings embodiments of the invention are schematically described in greater detail. Equal or functionally equivalent elements may be denoted by same reference numerals.

Fig.1 shows a steam generator according to a first embodiment; and

Fig.2 shows a steam generator according to a second embodiment.

**[0026]** Fig.1 shows a steam generator 1 for use in a laundry care applianceD1 embodied as a refresher dryer D1, wherein the steam generator 1 comprises a heated tank 2 for storing liquid L to be heated. The tank 2 consists of two "half" shells, namely a lower shell 2a and an upper shell 2b. The upper shell 2b acts as a lid for the lower shell 2a and comprises a fluid inlet 3 and a steam outlet 4. Attached to the upper shell 2b is a heating element 5 that projects into the tank 2. Terminals 6 to connect the heating element 5 to a current source lead through the upper shell 2b. The lower shell 2a and the upper shell 2b are connected in a leak-proof manner. At a bottom 7 of the tank 2 and the lower shell 2a is a drain for draining the liquid L from the tank 2. The flow cross-section of the drain 8 is controllable by a valve 9.

**[0027]** During operation of the steam generator 1, firstly the liquid L, for example condensate water, is filled into the tank 2 through the fluid inlet 3. The valve 9 is closed so that the drain 8 is closed, too. Thus, the liquid L will rise within the tank 2. After having reached a sufficient liquid level (which can be detected by a respective liquid level sensor, for example), the heating element 5 may be activated by sending a current through it via the terminals 6. In effect, the liquid L heats up and produces steam S. The steam S may be pure steam or a mixture of steam and small water droplets. The steam S can leave the tank 2 via the steam outlet 4. The steam S can be transported to a clothes processing area, e.g. a clothes drum.

**[0028]** The heating of the liquid L produces a certain quantity of scale, mostly limestone. This scale is heavier than the liquid L and settles on the bottom 7 of the tank 2. In a conventional steam generator, the scale would be gathered in a 'trash area' for the lifetime of the steam generator 1 or the refresher dryer D1. In contrast to that, the steam generator 1 makes it possible to remove the scale by opening the valve 9 and with it the drain 8 so that the scale is flushed out together with the liquid L. The use of the drain 8 to remove the scale gives the advantage that there is no need to provide the bulky trash area so that a very compact steam generator 1 can be achieved. Also, with the known steam generators, turbulences within the liquid during heating may stir up the scale which then might be transported outside the steam generator by attaching to the steam and which may get into a pipe system (or any other steam channel) leading to a clothes processing area and even onto the clothes. By a regular drainage of the scale according to the present steam generator 1, this may be prevented. For example, the scale may be flushed out at the end of a steam generating cycle. In the present case, operation of the refresher dryer D1 will include drying of clothes and collecting water extracted from the clothes in the form of condensate for later disposal. Disposal of the scale flushed out of the steam generator 1 may be done in a preferred manner by concurrent disposal with such

condensate, in particular by mixing the scale into the condensate or by providing a separate container for the scale which may be emptied concurrently with a container containing the condensate.

**[0029]** To support a through removal of the scale from the tank 2, the bottom 7 of the tank is inclined towards the drain 8.

**[0030]** The valve 9 is generally not restricted to any kind of opening/closing mechanism and may constitute a general drain activator that is adapted to open and close the drain 8 by opening and closing the associated flow cross-section. The valve 9 may be a mechanical and/or electrical valve 9, for example. In particular, the valve may be operated by a mechanical means and/or an electromechanical driver. As some of the possible examples, the valves 9 may be operated by a mechanical spring-and-float mechanism, an electromechanically operated valve, a pressure driven slider, a flap etc.

**[0031]** In one variation, the valve 9 may be a freely controllable valve, i.e. a valve that can be operated (opened/closed) at any given time, for example controlled by an external control unit C of the refresher dryer D1. This control unit C may activate the valve 9 according to a certain drying/refreshing program and/or a predetermined maintenance program.

**[0032]** Alternatively or additionally, the valve 9 may be operated with reaching or exceeding a certain liquid level of the liquid L within the tank 2. In this case, if the liquid level reaches a predetermined threshold level, the valve 9 opens. The valve 9 therefore will act as an overflow protection means to prevent liquid L to flow through the steam outlet 4. The correlation between reaching the fluid level and the opening of the drain 8 and valve 9, respectively, may be achieved by a fluid level sensor (not shown) that is connected to the control unit of the refresher dryer D1 which in turn activates the valve 9. The sensor may be a Reed sensor.

**[0033]** Alternatively, the valve 9 may be a mechanically controllable valve that is mechanically connected to a float (not shown), for example by a spring (not shown). If the float rises with the liquid level, so does the force acting upon the valve 9 via the spring. If this force reaches or exceeds a certain predetermined threshold value, the valve 9 opens.

**[0034]** The valve 9 may also act as a pressure-relief valve such that, if the pressure within the tank 2 exceeds a certain threshold value, the valve 9 opens. This may be the case if the steam outlet 4 or part of the following pipe system (or any other steam channel) and/or a steam opening into the clothes processing area is blocked. This opening of the valve 9 may be achieved by the pressure forcing open the valve 9 and/or by using a pressure sensor (not shown) that is connected to the control unit such that the control unit may open the valve 9, if the pressure level reaches or exceeds the predetermined pressure threshold value.

**[0035]** The liquid L going through the drain 8 may flow through a fluid outlet 10 of the refresher dryer D1.

**[0036]** Fig.2 shows a refresher dryer D2 comprising a steam generator 11 according to a second embodiment.

**[0037]** In contrast to the steam generator 1 according to the first embodiment, the tank 12 is now made out of one piece that comprises a window 13 in one of its sides. The window 13 is filled and closed by a heating element 14 which comprises a heating plate 15 and a heating coil 16. The heating plate 15 constitutes a part of a side wall of the tank 12 and contact the liquid L for good heat transfer. The heating coil 16 is placed outside the tank 12.

**[0038]** Also, the liquid inlet 3 is still at the top of the tank 12 while the steam outlet 4 is positioned sideways.

**[0039]** During operation of the steam generator 11, the heating coil 16 heats up the heating plate 15 which in turn heats up the liquid L to generate the steam S.

**[0040]** The steam generator 11 has the advantage that the heating element 14 can be manufactured and tested separately of the tank 12. Also, no leakage can occur anymore between two or more shells of the tank.

**[0041]** The operation and use of the drain 8 and its associated valve 9 is the same as with the steam generator 1 according to the first embodiment.

**[0042]** Generally, the steam generator as described and shown has a very high immunity to the presence of scale formed from limestone and other impurities. Scale formation is flushed out of the tank together with liquid. The valve also provides additional operational safety against overpressure and/or overflow. The heat generator can be designed to be very compact and may thus be placed flexibly within the laundry care appliance, e.g. fixed to a bearing shield.

**[0043]** Of course, the invention is not restricted to the shown embodiments.

**[0044]** For example, the steam generator 1, 11 may comprise further elements like a temperature sensor to control a temperature of the liquid and/or steam and to prevent overheating.

**List of Reference Numerals**

**[0045]**

| | |
|---|---|
| 1 | steam generator |
| 2 | tank |
| 2a | lower shell of the tank |
| 2b | upper shell of the tank |
| 3 | fluid inlet |
| 4 | steam outlet |
| 5 | heating element |
| 6 | terminal |

| | |
|---|---|
| 7 | bottom of the tank |
| 8 | drain |
| 9 | valve |
| 10 | fluid outlet |
| 11 | steam generator |
| 12 | tank |
| 13 | window within the tank |
| 14 | heating element |
| 15 | heating plate |
| 16 | heating coil |
| C | control unit |
| D1 | laundry care appliance, refresher dryer |
| D2 | laundry care appliance, refresher dryer |
| L | liquid |
| S | steam |

**Claims**

**1.** A steam generator (1; 11) for use in a laundry care appliance (D1; D2), comprising a heated tank (2; 12), the heated tank (2; 12) at least comprising:

- an inlet (3) for filling the tank (2; 12) with liquid (L);
- a heater (5; 14) for heating the liquid (L);
- a steam outlet (4); and
- a controllable drain (8) for draining the liquid (L) from the tank (2; 12) wherein an opening and closing of the drain (8) is controllable by a valve (9).

**2.** The steam generator (1; 11) according to claim 1, wherein the valve (9) is freely controllable.

**3.** The steam generator (1; 11) according to one of the preceding claims, wherein the valve (9) is controllable according to a liquid level of liquid (L) present in the tank (2; 12).

**4.** The steam generator (1; 11) according to claim 3, wherein the valve (9) comprises a mechanical spring-and-float mechanism.

**5.** The steam generator (1; 11) according to one of the preceding claims, wherein the valve (9) is additionally adapted to act as a pressure relief valve.

**6.** The steam generator (1; 11) according to one of the preceding claims, wherein the drain (8) is located at a bottom (7) of the tank (2; 12).

**7.** The steam generator (1; 11) according to claim 6, wherein the bottom (7) is inclined towards the drain (8).

**8.** The steam generator (1) according to any of the preceding claims, wherein the heater (5) is placed inside the tank (2).

**9.** The steam generator (11) according to any of the claims 1 to 7, wherein the heater (14) is placed outside the tank (12).

**10.** A laundry care appliance (D1; D2) comprising the steam generator (1; 11) for use in a laundry care appliance (D1; D2), comprising a heated tank (2; 12), the heated tank (2; 12) at least comprising:

- an inlet (3) for filling the tank (2; 12) with liquid (L);
- a heater (5; 14) for heating the liquid (L);
- a steam outlet (4); and

a controllable drain (8) for draining the liquid (L) from the tank (2; 12),
wherein an opening and closing of the drain (8) is controllable by a valve (9), and wherein the valve (9) is connected for operation to a control unit (C) of the laundry care appliance (D1; D2).

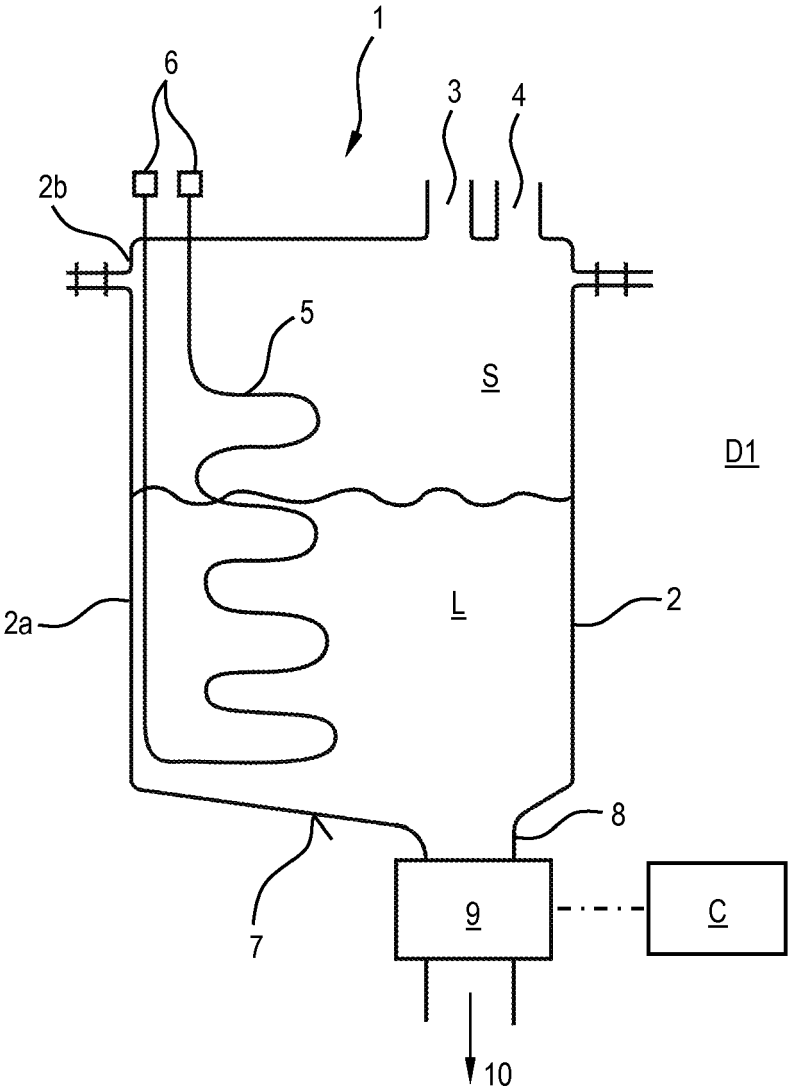


Fig.1

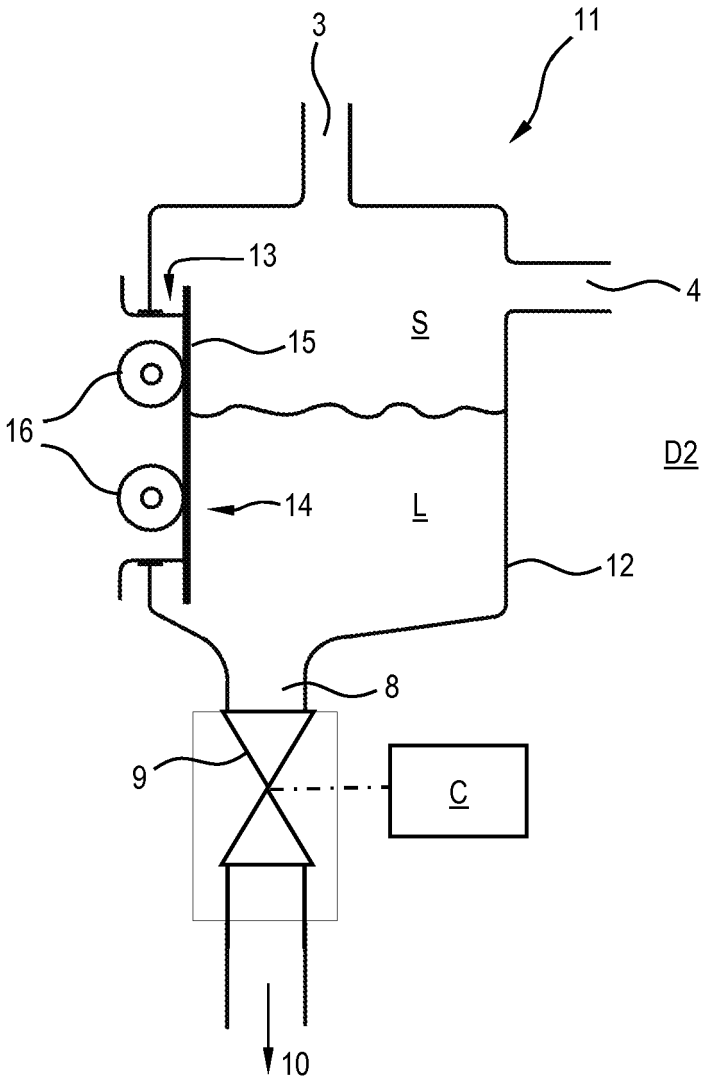


Fig.2

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# EUROPEAN SEARCH REPORT

Application Number
EP 09 17 6428

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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
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CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 17 6428

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