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

(57) The steam generator 4 according to the present invention is intended for use in a laundry appliance 1, in particular a refresher dryer 1, wherein the steam generator 4 is a modular unit at least comprising a heater 13 for generating steam from water, a water tank 10 and a water pump 14 for pumping water from the water tank 10 to the heater 13. The laundry appliance 1 comprises the steam generator 4.

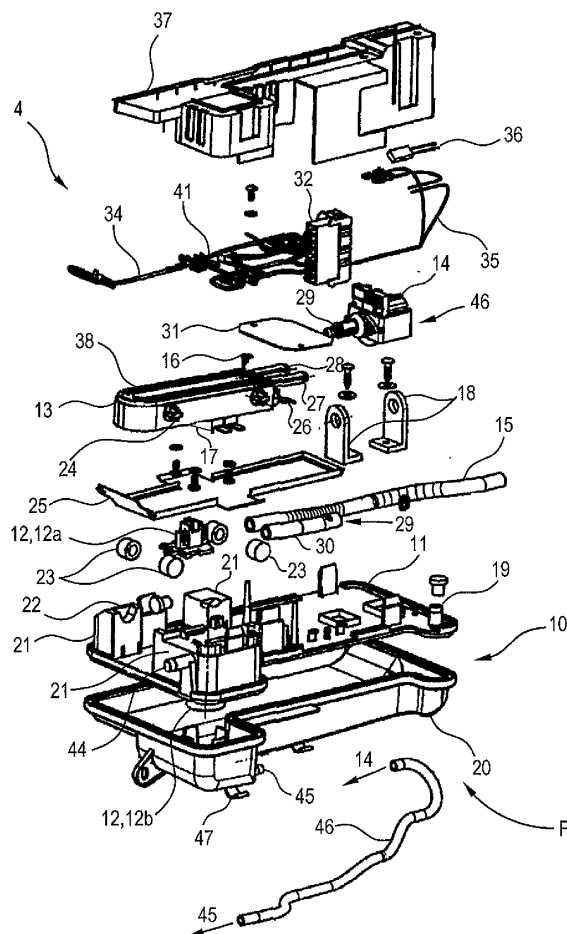


Fig. 3

Description

[0001] The invention relates to a steam generator for use in a laundry appliance and to a laundry appliance comprising such a steam generator.

[0002] U. S. Patent 3,180,037 relates to a laundry appliance embodied as a clothes dryer comprising a means for dispersing a fabric treating material into said hot air in said flow passage substantially at said surface to effect a concurrent drying and treatment of fabrics in said chamber.

[0003] U. S. Patent 3,242,584 relates to a laundry appliance embodied as a domestic clothes drying device providing the combination of a rotatable drum for tumbling damp fabric, means for producing superheated steam, means for passing a predetermined amount of said superheated steam interiorly of said drum for vaporizing the liquid contained in the fabric tumbled by said drum, means for circulating air through said drum for extracting steam and vaporized liquid therefrom, and means for heating the air circulating through said drum for providing a final drying cycle supplementing that produced by said superheated steam.

[0004] U. S. Patent 4,207,683 relates to a laundry dryer having a touch-up spray for removal of wrinkles from clothing and fabrics and permanent press clothing, in particular without removing possibly present factory set creases. The dryer may include a water heating unit for spraying water of a selected temperature or steam. The steam is applied to remove undesired wrinkles or odours from the laundry being treated and thus provides refreshment to the laundry. Accordingly, this dryer may be designated to be a "refresher dryer". It should be remarked that such nomination is not reserved to an appliance which is designed merely to dry laundry besides the refreshing function; instead, it will also be applied to a washer/dryer with a refreshing function.

[0005] DE 34 08 136 A1 relates to a tumble dryer comprising a venturi-type mixing tube which is fed with steam via a gas feeding pipe and water via an inlet. In the venturi-type mixing tube water is atomized due to the effect of the steam coming out of a nozzle, whereby a mist consisting of steam and water with extremely fine droplets is created. This mixture is sprayed into an inside of a drum as a mist cloud. Thus, textile material can be moistened and subsequently dried.

[0006] EP 1 275 767 A1 relates to a laundry appliance embodied as a clothes dryer or washer/dryer that treats laundry by introducing steam into a tub after the drainage of water to reduce creases. Steam treatment water is held in the tub at a temperature of at least 40 °C and at most 70 °C. There can be a heater to heat the water in the tub and produce the steam.

[0007] EP 1 655 408 A1 relates to a device to generate steam in a laundry appliance which is a washing machine, said device comprising a main body and means of heating the main body, wherein a flow channel is defined in the main body such that water flowing through the flow

channel is heated and converted to steam.

[0008] It is an object of the present invention to provide a steam generator for a laundry appliance, in particular a refresher dryer that is easy to assemble, install and maintain.

[0009] The object is achieved according to the features of the independent claims. Preferred embodiments can be derived, inter alia, from the dependent claims as well as from the subsequent disclosure.

[0010] The object is achieved by a steam generator for use in a laundry appliance, wherein the steam generator is a modular unit at least comprising a heater for generating steam from water, a water tank and a water pump for pumping water from the water tank to the heater. The steam generator being a modular unit achieves that it can be assembled as a co-joint or combined unit. The steam generator can then be installed into the laundry appliance and removed from the laundry appliance substantially as a single unit. This allows an efficient and cost-effective assembly, installation and maintenance.

[0011] According to one preferred embodiment, the heater is mounted on the water tank. This gives the advantage of a compact and reliable connection.

[0012] According to another preferred embodiment, an NTC sensor is attached to the heater. The NTC sensor which is characterized by including a resistor having a resistance which decreases upon increasing the temperature of the resistor (thus implying its nominative negative temperature coefficient) provides a very accurate and reliable temperature sensing. The use of a NTC sensor provides a very accurate temperature measurement. A NTC sensor is also particularly rugged. By mounting the NTC sensor on an outer surface of the heater, assembly is very easy. It may be noted that, other than prior art practice which generally relies on measuring a temperature of the water to be evaporated, the invention relies on measuring a temperature of the heater body directly. This temperature is much less affected by evaporation effects which limit the measurable temperature to the evaporation temperature of the liquid to evaporate. Accordingly, the invention guarantees a significantly higher precision in determining a true thermal overload of the heater.

[0013] According to yet another preferred embodiment, a safety switch comprising a bi-metal element and a fuse is attached to the heater. This safety switch provides a particularly reliable means to prevent overheating of the heater. The safety switch may be attached to a bottom of the heater.

[0014] According to even another preferred embodiment, the heater is horizontally inclined. This embodiment achieves an improved de-calcification of the heater.

[0015] In yet another preferred embodiment, the water pump is mounted on the water tank. This also allows a compact and reliable connection. A particularly compact steam generator can be achieved by mounting the heater and the water pump on top of the water tank.

[0016] According to a particularly preferred embodi-

ment, the water pump is a solenoid pump.

[0017] According to another preferred embodiment, the water pump is mounted on the water tank using rubber holders, in particular screwed rubber holders. This allows suppressing a transmission of vibration generated by the water pump to other components of the appliance.

[0018] It is a further preferred embodiment that a pump outlet of the water pump and a water inlet of the heater are aligned horizontally and are facing each other. This ensures a direct and linear connection between the water inlet and the pump outlet that acts against a possible pressure drop at the heater and that also prevents a connecting hose from coming off.

[0019] It is also a preferred embodiment that the steam generator comprises a water level sensor comprising a reed sensor and a float sensor. This ensures a particularly reliable measurement of the water level within the water tank.

[0020] According to even another preferred embodiment, the water level sensor is placed inside the water tank.

[0021] The object is also achieved by a laundry appliance, wherein the laundry appliance comprises the subject steam generator.

[0022] This laundry appliance can be assembled and operated in an efficient and cost-effective manner.

[0023] It is one preferred embodiment that the water tank is mounted on a heat exchanger cover of the laundry appliance. This position allows a stable positioning of the laundry appliance while at the same time allowing sufficient available space for the laundry appliance. Also, at this position the laundry appliance is easily accessible.

[0024] It is another preferred embodiment that the laundry appliance comprises a condensate container shell, the condensate container shell sitting above the steam generator, wherein the condensate container shell is connected to the water tank by a de-aeration hose and/or a filling hose. According to a further preferred embodiment, the de-aeration hose is a flexible hose.

[0025] It is yet another preferred embodiment that the steam generator comprises a metal insert placed below the heater, wherein the heater is grounded to a dryer frame of the laundry appliance via the metal insert. The metal insert may also act as a barrier against fire in case of a melting of the heater. This dual function of the metal insert leads to a reduction of components and reduces costs.

[0026] It is a further preferred embodiment that the laundry appliance comprises a steam separator to separate a mixture of water and steam output from the steam generator into the steam and water. This embodiment achieves that the refreshing and/or de-wrinkling function of the laundry appliance does not substantially deteriorate the drying effect.

[0027] The steam separator may thus comprise a combined water and steam inlet and two separate outlets for steam and water. The water may be returned to a dryer pump reservoir of the laundry appliance.

[0028] It is also a preferred embodiment that a steam outlet of the steam separator is connected to a nozzle via a flexible hose, the nozzle being adapted to inject the steam and/or a fine mist of water droplets (in the following simply called steam) into a drum of the laundry appliance. The nozzle achieves that the steam flow can be selectively orientated and injected deep into the drum. This leads to a greater efficiency of the refreshing and / or de-wrinkling function and / or to a saving of the amount of water used.

[0029] The use of a hose, in particular a flexible hose, between the steam separator and the nozzle allows a repositioning of the nozzle without a major redesign. Further, the pressure at the nozzle can easily be adjusted by altering the characteristics of the hose, e.g. a diameter.

[0030] According to yet another preferred embodiment, the nozzle is angularly shaped. This embodiment allows an inclined steam flow into the drum, in particular into a lower region of the drum and in particular directly onto the clothes, while at the same time a seat of the nozzle can remain vertical.

[0031] According to a particularly preferred embodiment, the laundry appliance is an appliance for drying laundry; even more preferred, the laundry appliance is a refresher dryer.

[0032] In the following description which in particular refers to the Figures of the attached drawing, a preferred embodiment of the invention is schematically described in greater detail.

Fig.1 shows an oblique view onto a laundry appliance comprising a steam generator;

Fig.2 shows an oblique view onto the steam generator of the laundry appliance of Fig.1; and

Fig.3 shows an exploded view of the steam generator.

[0033] Fig.1 shows a refresher dryer 1 that is a clothes dryer 1 that incorporates a clothes or laundry refreshing and de-wrinkling function applying steam to the clothes. The refresher dryer 1 is shown without housing. In particular, the refresher dryer 1 is embodied as a tumble dryer 1 comprising a rotatable drum 2 which holds the clothes to be dried and which may be operated by being rotated in reversing rotational directions. The drum 2 can be loaded and unloaded through an opening 3. The opening 3 is typically closed by a door (not shown). The operation of a tumble dryer 1 as such is well known.

[0034] To implement the refreshing function, the refresher dryer 1 comprises a steam generator 4 which is located at a bottom of the refresher dryer 1 and mounted on top of a cover 39 of a heat exchanger 40. Of the steam generator 4, a front side F (see also Fig.2) is visible. The steam generator 4 is used to generate steam from water. Water is supplied to the steam generator 4 via a condensate container shell 5 through a flexible filling hose 6. The water supplied to the steam generator 4 is thus the

condensate that is extracted from the damp clothes during the drying process. The condensate container shell 5 may additionally be filled by fresh water, e.g. at the beginning of a drying cycle if there is not yet enough condensate to supply the steam generator 4.

[0035] The output generated by the steam generator 4 usually is a mixture of steam and hot water and is led to a steam separator 7. The steam separator 7 separates the steam from the hot water. The steam is fed into the drum 2 via a hose 8 that leads to a nozzle 9. The nozzle 9 opens into the drum 2 and may inject the steam directly onto the laundry to be treated therein. The steam injection may comprise an injection of steam and/or a fine mist of water droplets. To this end, the nozzle 9 may have a shape (e.g. angular shape) that allows orientation of the steam flow. The hot water is returned to a T-connector 42 located in a dryer pump reservoir via a flexible hot water return hose. Thus, the steam separator 7 ensures that only steam with a low or very low liquid content is fed into the drum 2.

[0036] The steam generator 4 further comprises or is connected to a flexible de-aeration hose 43 that connects to a water tank (see Fig.3 for further detail) of the steam generator 4. The steam generator 4 further comprises a siphon fixation 47 for holding or fixing a siphon 48.

[0037] Fig. 2 shows the steam generator 4 in greater detail. Fig. 2 shows an elevated view onto a rear side B of the steam generator. The rear side B of the steam generator 4 borders on the drum 2 and faces to the inside of the refresher dryer 1 of Fig.1. The front side F of the steam generator 4 is shown in Fig.1.

[0038] The steam generator 4 comprises a water tank 10 for a base that is covered by an upper part 11 of a tank body of the water tank 10. A water level of the water tank 10 is measured by a water level sensor 12 that is implemented as a combined reed water level sensor 12a and float water level sensor 12b. The water level sensor 12 is placed inside the water tank 10. The water tank 10 is filled with water via a water inlet 19 that is connected to the filling hose 6 as shown in Fig. 1. The water level sensor 12 may be used to control the function of the steam generator 4 as well as the function of drying components of the refresher dryer 1; in this case the water tank also acts as a water tank for the drying components.

[0039] On top of the upper part 11 of the water tank 10 is mounted a heater 13 to heat water and subsequently produce steam, usually mixed with the hot water. The heater 13 comprises an aluminium housing and is supported on support columns 21. Further, the support columns 21 each hold a respective silicone holder 23 laterally mounted to the heater 13. This holding or supporting arrangement of the heater 13 has the advantage that vibrations from or to the heater 13 are suppressed and that a thermal flow from the heater 13 is at least partially blocked by the silicone holders 23. The heater 13 is not arranged horizontally but is angled relative to the horizontal in order to achieve an improved de-calcification.

[0040] The mixture of steam and hot water generated

within the heater 13 is led out of the heater 13 and fed to the steam separator 7 by a steam outlet pipe 15 or hose. A temperature of the heater 13 is monitored by a NTC (negative temperature coefficient) sensor 16 that is mounted on top / on an upper part of the heater 13. The NTC sensor 16 may be regarded as part of the heater 13.

[0041] The heater 13 also comprises or is connected to a safety switch 17 by which the heater 13 may be switched off to prevent overheating.

[0042] The water is supplied from the water tank 10 to the heater 13 by a water pump 14 which is implemented as a solenoid-driven vibration pump. The solenoid pump 14 is supported by a pair of screwed rubber holders 18. This reduces the propagation of vibration and thus reduces the overall noise of the steam generator. The suppression of the vibration propagation also enhances the life time of the steam generator 4.

[0043] Fig. 3 shows an exploded view of the steam generator 4 viewing its front side F. The water tank 10 comprises a tank body 20, which is covered by the upper part 11. The upper part 11 comprises the water inlet 19 and a de-aeration outlet 44 for connection with the de-aeration hose 43. The tank body comprises a water outlet 45 that can be connected to a water inlet of the water pump 14 via a water pipe 46. At a bottom of the tank body 20 there is placed a metal insert 25 that acts as a barrier against fire in the unlikely case of a melting of the heater 13. The bottom of the tank body 20 also holds the siphon fixation 47.

[0044] The upper surface of the water tank 10 further comprises the support columns 21 for supporting the heater 13. To this end, the support columns 21 each comprise an upper recess 22 for supporting the respective silicone holder 23. Each silicone holder 23 is in turn laterally mounted to the heater 13, in particular fitted onto a respective mounting column 24. This holding arrangement of the heater 13 has the advantage that vibrations from or to the heater 13 are suppressed and that a thermal flow from the heater 13 is at least partially blocked by the silicone holders 23.

[0045] Water is supplied into the heater 13 via a water inlet connection 27, is guided within the heater 13 by a water tube 38 and can then leave the heater 13 as steam or a mixture of hot water and steam by a steam outlet connection 28. The water tube 38 can be heated up by a heating element or heating elements (not visible) of the heater 13. The water tube 38 is located on a top surface of the heater 13. The water inlet connection 27 is connected to a pressure outlet 29 of the water pump 14 by a connection hose 30. The water inlet connection 27 and the pressure outlet 29 are aligned horizontally and facing each other; this ensures a direct / linear connection that acts against a possible pressure drop at the heater 13 and that also prevents the hose 30 from coming off. The steam outlet connection 28 is connected to the steam outlet pipe 15. The heater 13 is angled relative to the horizontal with the end comprising the connections 27, 28 being placed lower than the opposite end in order to

achieve an improved de-calcification.

[0046] Between the upper part 11 of the water tank and the heater 13 there is inserted metal insert 25 with soft edges, e.g. round edges. The soft edges prevent damage to electrical connections, e.g. damage to an insulation of an electrical cable. The heater 13 is grounded electrically via the metal insert 25 and from the metal insert 25 further to a dryer frame 33 shown in Fig.1. The metal insert 25 may act as a barrier against fire in the unlikely case of a melting of the heater 13.

[0047] On top of the heater 13 is mounted the NTC sensor 16. Electrical terminals 26 of a heating element of the heater 13 are located at the same side as the water inlet and outlet.

[0048] At the bottom of the heater 13 is located the safety switch 17. The safety switch 17 uses a duo pack comprising a bi-metal element and a fuse to prevent overheating of the heater 13. In case that the safety switch 17 detects an overheating condition, it switches off the heater 13. Threshold temperatures where a switching action will occur are presently set at 190°C for the bi-metal element which is reversible, and 260°C for the fuse which is irreversible. Thereby, the safety switch 17 will turn off heater 13 reversibly in case of a minor malfunction which produces a temperature rise of minor criticality, and it will turn off heater 13 irreversibly (that is, irreversibly except by action of a skilled service technician) upon a temperature rise of major criticality. It is understood that problems of less criticality include problems caused by temporary clogs of and water bubbles in the water hoses leading to heater 13 which may be expected to disappear by themselves and do not require attention by a skilled service technician. Accordingly, it is understood to be a sufficient measure to interrupt the action of the heater 13 only reversibly upon encountering such problems. The safety switch 17 may be located near the heating element (s), or the heating element(s) may at least partially be inserted into the safety switch 17.

[0049] The steam outlet pipe 15 and the connection hose 30 are placed above and may be borne on a micanite safety insert 31. The safety insert 31 provides a leakage protection. Furthermore, the safety insert 31 prevents electrical connections from getting in contact with water that may be leaking or condensing at the or between the water pump 14 and the heater 13. The use of micanite or mica provides for a high dielectric strength, excellent chemical stability, and high resistance to excess heat. Also, the plate-like micanite safety insert 31 is light-transmissive such that it does not inhibit a view onto elements located below it.

[0050] The steam generator 4 further comprises a single connection housing 32 for all electrical connections / internal wiring 41. The connection housing 32 may be produced, e.g. by AMP Inc. All electrical connections lead into the connection housing 32 all electrical connections. The electrical connections / internal wiring 41 include an earth connection line 34 and an electrical connection 35 being connected to a temperature protector 36 of the

water pump 14. The temperature protector 36 is mounted on the water pump 14. The connection housing 32 may be connected to a cover 37 of the steam generator 4 by clamping.

[0051] The steam generator 4 is in large parts covered by a plastic cover 37. The plastic cover 37 can be clamped onto the tank 10 without the need for screws or other additional fixing elements to provide easy assembly. The plastic cover 37 can be made of a flame retardant material, like a V0 material, to ensure standards for safety regulations.

[0052] Of course, the invention is not limited to the present embodiment.

15 List of Reference Numerals

[0053]

1	refresher dryer
2	drum
3	opening
4	steam generator
5	condensate container shell
6	filling hose
7	steam separator
8	hose
9	nozzle
10	water tank
11	upper part of tank body
12	water level sensor
12a	reed sensor
12b	float sensor
13	heater
14	water pump
15	steam outlet pipe
16	NTC sensor
17	safety switch
18	rubber holder

19 water inlet
 20 tank body
 21 support column
 22 upper recess
 23 silicone holder
 24 mounting column
 25 metal insert
 26 electrical terminal
 27 water inlet connection
 28 steam outlet connection
 29 pressure outlet
 30 connection hose
 31 safety insert
 32 housing
 33 dryer frame
 34 earth connection line
 35 electrical connection
 36 temperature protector
 37 plastic cover
 38 water tube
 39 cover of heat exchanger
 40 heat exchanger
 41 internal wiring
 42 T-connector
 43 de-aeration hose
 44 de-aeration outlet
 45 water outlet
 46 water pipe
 47 siphon fixation

48 siphon

Claims

- 5
1. A steam generator (4) for use in a laundry appliance (1), **characterized in that** the steam generator (4) is a modular unit at least comprising a heater (13) for generating steam from water, a water tank (10) and a water pump (14) for pumping water from the water tank (10) to the heater (13).
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2. The steam generator (4) according to claim 1, **characterized in that** the heater (13) is mounted on the water tank (10).
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3. The steam generator (4) according to claim 1 or claim 2, **characterized in that** a NTC sensor (16) is attached to the heater (13).
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4. The steam generator (4) according to any of the preceding claims, **characterized in that** a safety switch (17) comprises a bimetal element and a fuse is attached to the heater (13).
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5. The steam generator (4) according to any of the preceding claims, **characterized in that** the heater (13) is horizontally inclined.
- 30 6. The steam generator (4) according to any of the preceding claims, **characterized in that** the water pump (14) is mounted on the water tank (10).
- 35 7. The steam generator (4) according to any of the preceding claims, **characterized in that** a pressure outlet (29) of the water pump (14) and a water inlet (19) of the heater (13) are aligned horizontally and are facing each other.
- 40 8. The steam generator (4) according to any of the preceding claims, **characterized in that** the steam generator (4) comprises a water level sensor (12) comprising a reed sensor (12a) and a float sensor (12b).
- 45 9. A laundry appliance (1), **characterized in that** the laundry appliance (1) comprises the steam generator (4) according to any of the preceding claims.
- 50 10. The laundry appliance (1) according to claim 9, **characterized in that** the water tank (10) is mounted on a heat exchanger cover (39) of the laundry appliance (1).
- 55 11. The laundry appliance (1) according to any of the claims 9 or 10, **characterized in that** the laundry appliance (1) comprises a condensate container shell (5), the condensate container shell (5) sitting above the steam generator (4), wherein the conden-

sate container shell (5) is connected to the water tank (10) by a de-aeration hose (43) and/or a filling hose (6).

12. The laundry appliance (1) according to any of the claims 9 to 11, **characterized in that** the steam generator (4) comprises a metal insert (25) placed below the heater (13), wherein the heater (13) is grounded to a dryer frame (33) of the laundry appliance (1) via the metal insert (25). 5 10
13. The laundry appliance (1) according to any of the claims 9 to 12, **characterized in that** the laundry appliance (1) comprises a steam separator (7) to separate a mixture of water and steam output from the steam generator (4) into the steam and water. 15
14. The laundry appliance (1) according claim 13, **characterized in that** a steam outlet of the steam separator (7) is connected to a nozzle (9) via a flexible hose (8), the nozzle (9) being adapted to inject the steam into a drum of the laundry appliance (1). 20
15. The laundry appliance (1) according to any of the claims 9 to 14, **characterized in that** the laundry appliance (1) is an appliance (1) for drying laundry; in particular a refresher dryer (1). 25

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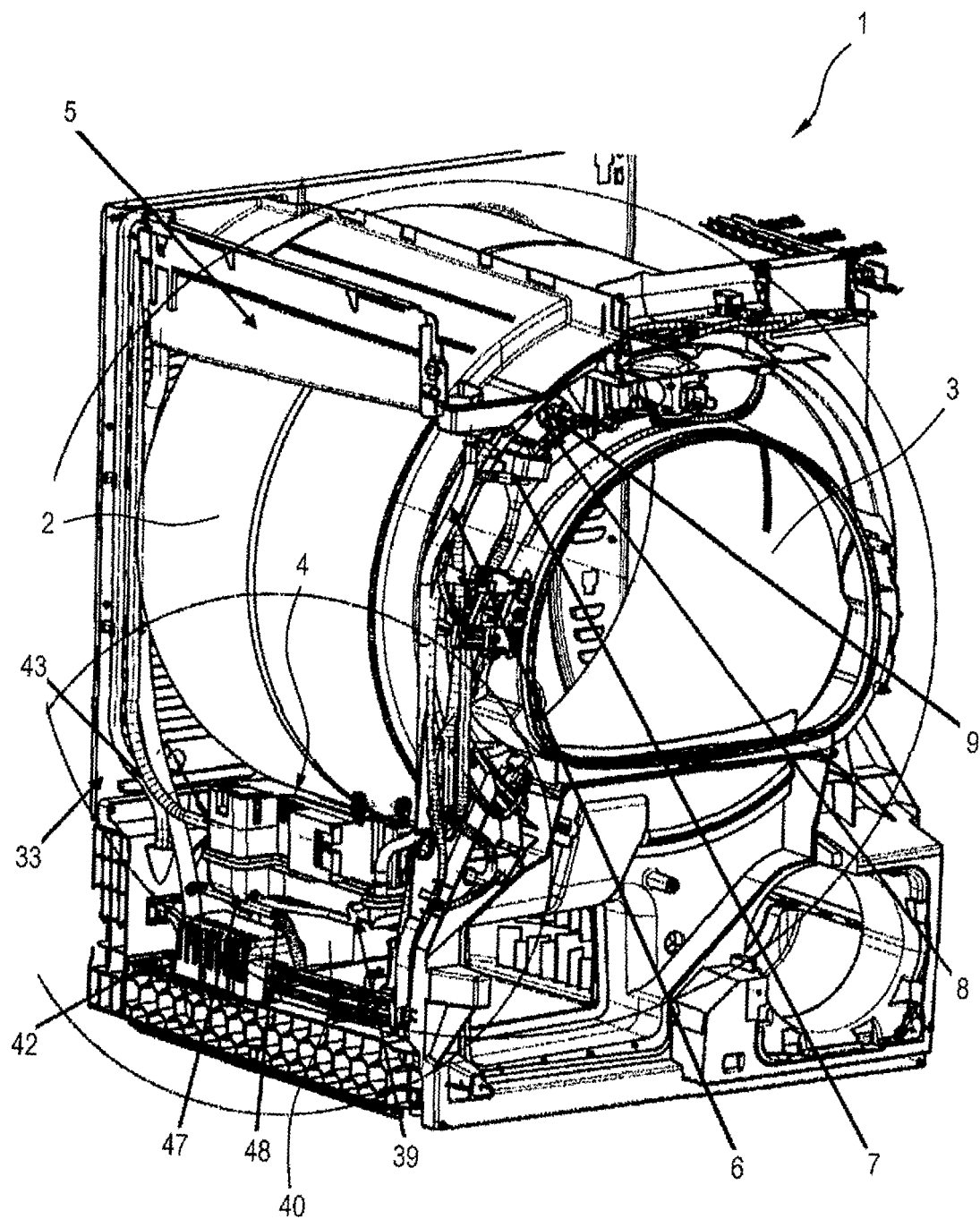


Fig. 1

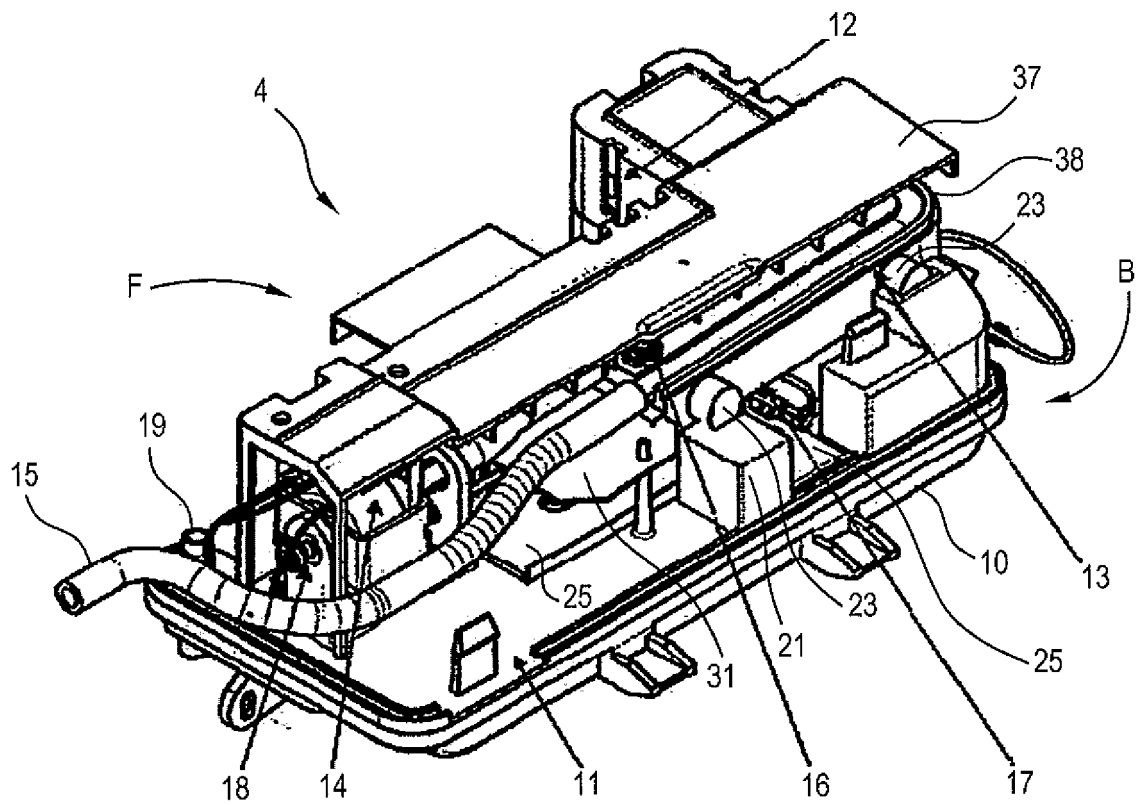


Fig. 2

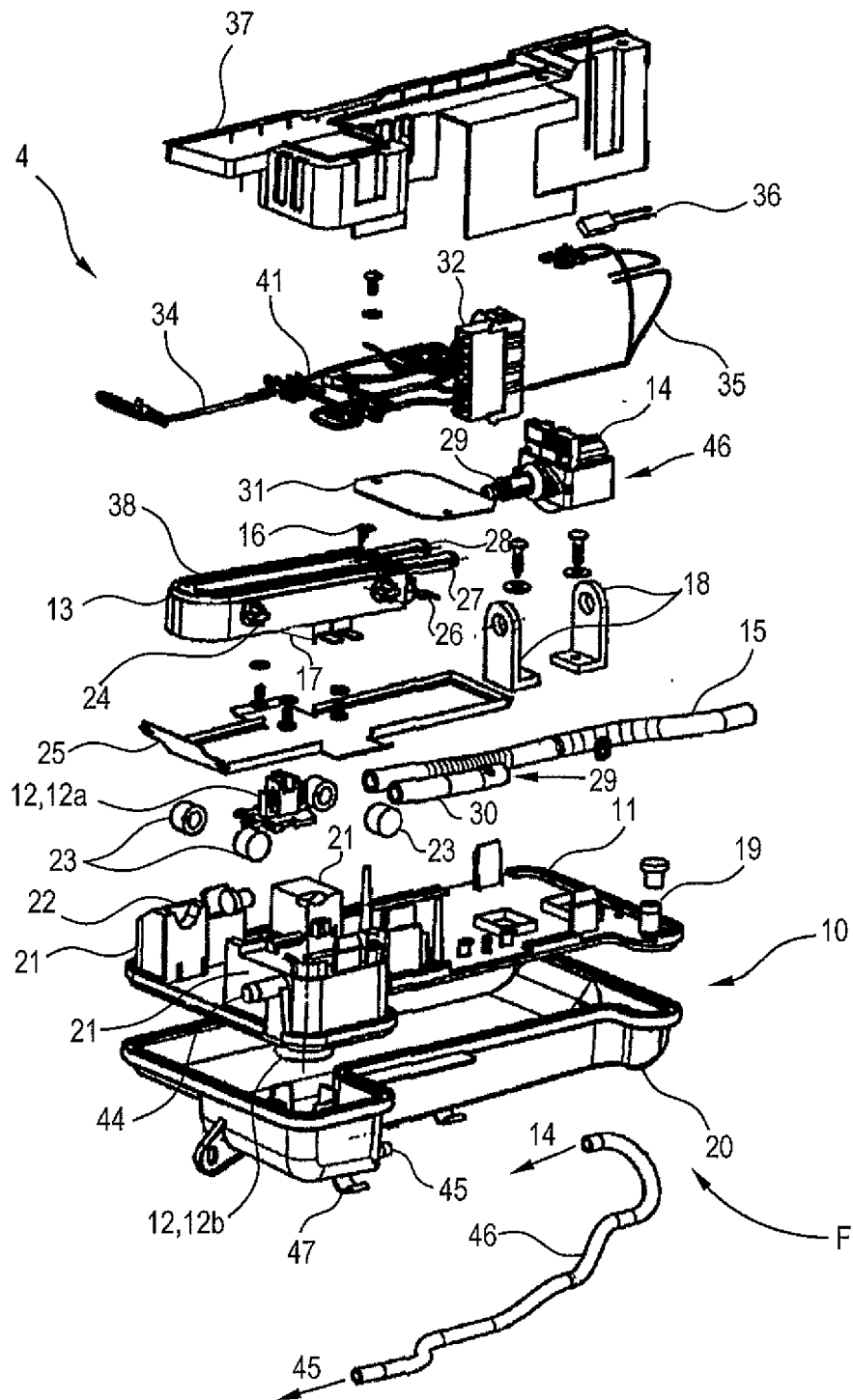


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 09 16 8008

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 22 January 2010	Examiner Spitzer, Bettina
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EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

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<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 16 8008

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