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Field of the invention

The invention relates to a household device, e.g. dish washers, washing machines, laundry driers, laundry treatment cabinets and the like, with a catalyser for cleaning the process medium guided through the device. The process medium may e.g. be exhaust air or circulating air or rinse water. Particularly, the invention relates to a laundry treatment cabinet of this type.

Background

Different household devices are known which treat, transport or use a fluid, particularly air or water, as a process medium. Dish washers, washing machines or laundry driers shall be named here as examples.

In such devices it is many times necessary to clean or treat the fluid in a certain way. Various means are provided for this task, e.g. filters, driers, perfume sources, drainers or the like.

EP 2 113 605 describes amongst others a household device for treating laundry. It has a light source by means of which laundry can be illuminated by UV-light inside the drum. The light is used to activate photocatalytic chemical reactions which remove organic contaminations on the tissues.

EP 2 241 826 describes a household device having a photo catalyser by means of which process water or process air can be treated. The photo catalyser can be arranged in an air circuit or process water circuit.

EP 2 330 247 describes a cabinet drier for laundry, inside which the process air is sucked out of the usable space through a bottom venting opening and is guided through the evaporator and the condenser of a heat pump arrangement for drying and heating up. Thereafter,

the air is guided by air transport means through a connecting channel on the rear side of the device, from where the air is again introduced into the usable space. The heat pump arrangement is located inside a machine
5 chamber below the usable space.

WO 2013/0794 62 is prior art according to article 54(3) EPC and discloses a household appliance with a circulation system for a process medium, a transport device for generating a directed flow of the
10 process medium, a steam generator, one or more contact surfaces arranged in the circulation circuit and coated with a catalyser material and a usable space arranged inside the circulation system, wherein the usable space has an evacuation opening for the process medium towards
15 the transport device and is accessible from outside for charging, wherein the steam generator has an exit which opens into the circulation system in flow direction between the evacuation opening of the usable space and the position of the one or more contact surfaces, and
20 wherein the circulation system has a heat pump for the process medium with an evaporator and a condenser.

Description of the invention

25 The objective of the present invention is to provide a device and a method of the type mentioned at the beginning, by means of which it is possible to compensate an efficiency reduction of the catalyser, particularly of a photo catalyser.

30 This objective is reached by the device according to claim 1. According to it, the device has a circulation system for circulating a process medium and a transport device for generating a guided flow of the process medium in the circulation system. A circulation
35 system is understood as a closed or open system inside which the operating medium is guided in treated form through a usable space of the device accessible from the

outside. Treated form is understood as a change of the physical or the chemical characteristics of the process medium, like heating up or cooling down or adding detergents. The process medium normally circulates multiple times at least partially in the circulation system. However, the definition of a circulation system used here also comprises systems in case of which the process medium is guided from an inlet into the device through the usable space directly into an outlet. The circulation system may therefore also comprise an outlet or an evacuation. Suitable process media are preferably water, steam and air. The transport device may be a pump, a fan or a similar device which is suitable to move the medium through the circulation system.

If the circulation system can be operated in two circumferential directions, that direction is regarded as circulation direction or flow direction, which is assumed in the sense of the present invention as the most frequent or the longest during the main operating modes or during a normal operating course.

One or more contact surfaces coated with catalyser material are also arranged in the circulation system and are in contact with the circulating process medium. The device additionally has a steam generator, the steam exit of which opens into the circulation system between the evacuation opening of the usable space and the position of the catalytic contact surfaces. Thus, the position of steam introduction into the circulation system is chosen in such a way that the contact surfaces are impinged with the steam as directly as possible. The steam and the potentially drained condensation water contribute to the cleaning of the catalysers.

The circulation system has a heat pump with an evaporator and a condenser for cooling or heating up, respectively, the process medium, wherein the exit of the steam generator opens into the circulation system after the evaporator and the condenser, in flow direction, such

that the introduction of steam into the catalyser is improved. In a particularly advantageous embodiment of the invention the outlet of the steam generator opens into the circulation system directly upstream of the catalysers or at least downstream of the transport device due to the same reason.

It is further preferred that the catalytic contact surfaces are arranged in the household device in a part of the circulation system which is separated from the usable space. Particularly, the contact surfaces may be arranged inside a vertical shaft, wherein the channel of the steam generator enters preferably close to the base point of the shaft, such that the steam can wet the catalyser surfaces during ascension.

An activator for activating the catalyser is preferably attributed to the contact surface, wherein the activator is preferably kept in operation during the cleaning in order to support the cleaning effect. When a photo catalyser is used, this activator is e.g. a UV light source, preferably a UV(C) light source. Such a light source has emissions in the wave length range of 280nm to 100nm. In cleaning operation the light source may be in operation between 1h and 12h, preferably between 5h and 10h.

In case of the method for cleaning the contact surface or surfaces the steam generated by the steam generator is introduced into the circulation system and is passed by the at least one catalytic contact surface. The steam can advantageously be introduced into the circulation system in intervals. Preferably, a period without steam introduction follows each interval.

The transport device, i.e. the fan in case of a gaseous process medium, is preferably (re)activated in order to move the process medium after the actual cleaning. During the phase of introduction of steam it advantageously stays switched off or it runs with reduced power. In this way the steam is not transported through

the circulation system or is transported only slowly through the circulation system during the cleaning and its dwell time close to the catalyser is prolonged.

In order to support the wetting of the catalyser surfaces, the household device can be operated without heating before the introduction of the steam, such that the catalyser surfaces can adapt to the ambient temperature, such that the deposition of condensation water is increased when steam is introduced. However, the drying of the device can be accelerated by switching on the device heating after the steam cleaning.

Short description of the drawings

Further embodiments, advantages and applications of the invention result from the dependent claims and from the now following description by means of the drawings. It is shown in:

Fig. 1A a vertical section through a laundry treatment cabinet,

Fig. 1B a horizontal section through the laundry treatment cabinet of Fig. 1A along the line V-V,

Fig. 2 a block diagram of the most important functional components of a device according to an example of the invention, and

Fig. 3 a schematic course of an exemplary method according to the invention.

Ways of carrying out the invention

An embodiment of the invention is described in the following by the example of a laundry treatment cabinet. It is a device in which idle laundry is treated e.g. by steam treatment and/or drying.

In the following a side of the device where the door is arranged is called front side, via which the user has access to the usable space. The rear side is the

side opposed to the front side. Terms like "in front of", "rear", "at the back" relate to this reference system, i.e. the door is e.g. in front of the usable space and the usable space is in front of the rear side.

5 The term "lateral" relates to a horizontal direction perpendicular to the direction between the front and the rear. For example, the connecting channel is arranged laterally with respect to a lateral wall of the usable space, i.e. the lateral wall of the usable
10 space and the connecting channel overlap in a horizontal viewing direction parallel to the front side.

 Terms like "top", "above", "bottom" and "below" relate to the device when mounted as required, where the machine chamber is located below the usable
15 space and the stick for receiving hangers is attached at a top end of the usable space. In the same way, terms like "horizontal" and "vertical" relate to this mounting as required, i.e. the bottom wall of the usable space, which separates the usable space from the machine
20 chamber, is e.g. arranged substantially horizontally, while the lateral walls standing approximately perpendicular to the bottom wall, the rear wall and the door of the usable space are arranged substantially vertically.

25 An advantageous embodiment of the laundry treatment cabinet is shown in Fig. 1A and 1B, wherein important functional components are shown again isolated in Fig. 2.

 As can be seen, the laundry treatment cabinet
30 10 has one substantially rectangular-shaped casing 11 with a usable space 12 which is also substantially rectangular-shaped. A machine chamber 13 is arranged below the usable space 12. A substantially vertical shaft 14 is provided laterally on the device and also laterally
35 with respect to the usable space 12 (in the present text also called connecting channel). A roof space 15 is arranged above the usable space 12.

The cabinet 10 is limited to the rear side by a rear wall 111, laterally by lateral walls 112, 113, at the top by a roof 114, at the bottom by a floor 115 and to the front by a door (not shown) for filling the usable space 12. The usable space 12 serves to receive the laundry. For this, suitable means for receiving the laundry are provided inside the usable space, like for example a stick 121 for receiving hangers, a pivotable rake 122 for hanging individual textiles or baskets 123. The usable space 12 is accessible by the user via the door.

A heat pump arrangement comprising a compressor 131, a condenser 132, an additional heat exchanger 133, an expansion valve 134 and an evaporator 135 is provided inside the machine chamber 13. A medium is guided by means of the compressor 131, as known, through the condenser 132, the additional heat exchanger 133, the expansion valve 134, the evaporator 135 and back to the compressor, such that the condenser 132 is heated up and the evaporator 135 is cooled down. The additional heat exchanger 133 serves, in the way described in EP 2 034 084, to extract heat from the system. For this, a fan 136 is provided, which guides cooling air from the environment through the additional heat exchanger 133 and via the expansion valve 134 and the compressor 131.

A steam generator 137 is provided in the machine chamber 13, by means of which steam can be generated. As for example described in EP 2 330 247, the steam can be used during normal operation of the laundry treatment cabinet 10 for freshening up and/or de-crinkeling the laundry. The steam generator 137 is connected by a channel 138, in the following also called "outlet", via an entry opening 140, to the shaft 14. In the shown example the entry opening 140 is arranged close to the bottom end of the shaft 14.

Furthermore, two containers (not shown) are arranged in the machine chamber 13, of which each one

receives a removable tank. One of these tanks is a fresh water tank for the steam generator 137, and the other one is a discharge tank for water which is pumped from a trough 139 in the bottom of the machine chamber 13.

5 In order to treat the process air inside the usable space 12, at least an upper or a lower, respectively, venting opening 124, 125 are provided at the upper end and the lower end of the usable space 12. Multiple small upper venting openings 124 and a large
10 lower venting opening 125 are shown in the present embodiment.

 In the shown preferred embodiment the air exits from the lower venting openings 125 (which are also called evacuation openings in the following) out of the
15 usable space 12, it is then passed by the heat exchangers 132, 135, treated, and then guided back into the usable space 12 via the venting openings 124 (which are also called inlet openings in the following). However, also an air circulation in opposite direction is basically
20 conceivable, however the described circulation direction in the present advantageous embodiment is regarded as the normal flow direction of the process medium.

 A channel 16 located inside the machine chamber 13 is arranged below the lower venting opening
25 125. The channel 16 is part of the circulation system guiding the air through the usable space.

 Replaceable filters are arranged in the first tapering channel section of the channel 16, in order to keep dirt away from the heat exchangers of the evaporator
30 135 and the condenser 132.

 The evaporator 135 and the condenser 132 are arranged in a following second channel section of the channel 16. The channel 16 guides the air in this section through the heat exchangers of the evaporator 135 and the
35 condenser 132.

 A third channel section of the channel 16 follows after the condenser 132 in air flow direction,

which tapers more and which opens into the sucking area of a radial fan 141 which forms the air transport means for transporting the process air.

The radial fan 141 is arranged in the lateral shaft 14 of the laundry treatment cabinet 10. The air is guided by the radial fan 141 through the vertically running shaft 14, in which it can rise to the roof space 15 of the device.

A light source 142 and at least a catalyser surface 143 for photo catalytic air treatment are arranged in the shaft 14 itself. Household devices with such catalysers are e.g. known from EP 2241826 A1. The photo catalyser is preferably a catalyser based on titanium oxide, i.e. a catalyser containing e.g. TiO_2 (titanium oxide), however catalysers based on CdS (cadmium sulphide), WO_3 (wolfram oxide) or ZnO (zinc oxide) are also conceivable. Suitable photo catalysers are e.g. described in DE 20 2004 005 677 U1 and EP 1 205 244. They generate electrons and holes in case of light absorption and induce in this way chemical reactions which can break down organic compounds and are able to kill microorganisms and viruses. Catalysers based on titanium oxide are particularly preferred due to the high efficiency and biologic compatibility of this material.

The product "Titan Shield®" of the company EcoWays Umwelt Innovationen GmbH, Jülich (DE) may for example be used as photo catalyser. It may preferably consist of nanoparticles mixed with a carrier material like plastic for extensive application in the circulation system of the process medium.

The light source 142 emits light in a wave length range which is suitable for the activation of the catalyser. The wavelength for titanium oxide based photo catalysers may lie in a range of e.g. 350 to 500 nm. Fluorescence light sources or LEDs may for example be used as light source. In the example, the light source 142 is a rod-shaped UV(C) emitter with emissions in the

range of 280nm to 100nm, which is attached vertically in the shaft 14 and which can shine on the catalyser surface 143 in full length in this way. The UV(C) light source has a longer life than light sources emitting in the
5 UV(A) range.

Undesired organic compounds in the process air can be broken down with such catalysers, as also described in EP 2 241 826. However, undesired depositions precipitate, which particularly affect the effect of the
10 catalyser of the catalyser surface 143. Due to this, a cleaning process is provided for the catalyser surface 143, which is described in more detail further down.

A heater 144 is arranged above the light source 142 in the shaft 14, by means of which the air
15 circulating in the device 10 can be heated up if necessary.

A horizontally running roof channel 151 follows the connection channel 14 at its upper end, being arranged above the usable space 12. The upper venting
20 openings 124 of the usable space 12 are connected to this roof channel 151 such that the air can stream from the roof channel 151 from the top into the usable space 12, as already described. The path through the laundry treatment cabinet 10 taken by the air forms the main part
25 of a circulation system, as described, wherein further parts of the circulation system, like potential suction openings and exhaust air openings, are not shown for the sake of a better overview.

Furthermore, the drying cabinet 10 has an
30 operating console which isn't further shown, with input and output means, which serves to control or monitor, respectively, the laundry treatment cabinet. The input and/or output means are connected to a device control 21 (Fig. 2), which controls operation of the different
35 components.

The circulation system for the heated air described above is shown in Fig. 2 in a rather schematic

view by the circumferential arrows 26. Same or equivalent elements of Fig. 1 are referenced in Fig. 2 by the same numbers. The circulation system particularly has a usable space 12, a treatment unit 22 for the process medium, which comprises the heat pump arrangement of Fig. 1, a fan 141, catalyser surfaces 143 with activators 142 and heater 144.

The outlet of the steam generator 137 is connected to the circulation system via a pipe 138 and by means of an inlet opening 140. The inlet opening 140 is arranged (in the circulation direction shown by the arrow direction which is at the same time the running direction of the process air) after the usable space 12 and the fan 141 and before the catalyser surfaces 143.

The described arrangement can be operated in a way described in the following, enabling cleaning of the catalyser surfaces 143 of depositions like lime, organic compounds like hydrocarbons, or fluffs and in this way to regenerate the catalyser at least partially. For this, firstly stream from the steam generator 137 is passed by the catalyser surfaces as directly as possible. Secondly, it is also desirable to cause a condensation of the steam with a subsequent flow down of the condensation water on the catalyser surfaces.

This may e.g. be done by selecting a cleaning mode for the controller 21. A schematic cycle of steps in cleaning mode is shown as a flow diagram in Fig. 3.

The cleaning mode may be activated automatically depending on the normal operating duration or intensity of usage or it may be selected by the operator via the input device. However, also in case of a manual initiation of the cleaning mode it is preferred to inform the user in advance by a message of the output device or a status display that a cleaning of the device is advisable.

After the cleaning mode has been selected, the device switches to an operating mode differing from

the normal operation. Particularly, in this operating mode the fan 141 is completely switched off at least in a first cleaning phase or it is operated with a reduced rotational speed as compared to the normal operation. In
5 the same way, the heater 144 for the process air is either switched off or operated with reduced power as compared to the normal operation. In this operation state the device is preferably cooled down to environment temperature and the circulation through the circulation
10 system is not supported by the fan 141 anymore.

After these steps which prepare the device for the cleaning, the activator 142 for the catalyser 143, thus in the present example the UV(C) lamp, is switched on. After switching on the lamp, the steam
15 generator 137 is activated. Before the actual putting into operation of the steam generator 137, the controller 21 may underrun a verification mode. In this verification mode it is checked if the steam generator 137 is provided with a sufficient quantity of water. If the water
20 quantity is not sufficient, the controller 21 generates for example a corresponding message or display which is shown via the output unit. The user is then requested to fill the fresh water tank.

After completing the verification mode for
25 the tank filling, the steam generator is controlled in such a way that steam is generated in time intervals and is guided into the shaft 14 through the opening 140. The intervals in which steam is introduced into the shaft are preferably shorter than the intervals in which no steam
30 is introduced into the shaft, e.g. shorter by a factor 5 to 10. According to this, the length of an interval with steam introduction amounts to e.g. 5 min, while a subsequent interval without steam introduction is of 30 min.

35 The length of the intervals is preferably dimensioned in such a way that steam can condensate on the catalyser surfaces 143 and can flow down in the

subsequent steamless interval. The condensation water is caught in a sump, e.g. in the vat 139 at the bottom of the device 10, and pumped into the discharge water tank. The filling level of the discharge water tank can also be
5 monitored by the controller 21 in order to avoid overflow during the cleaning.

After completing one or more intervals with steam generation and the subsequent steamless intervals, the UV(C) lamp 142 is switched off. The entire duration
10 of the radiation of the catalyser by the UV(C) lamp 142 during the cleaning phase may be of 8h or more. The fan 140 may be activated in a subsequent step in order to free the shaft of residues, which can arise due to the UV(C) radiation, by circulating the process medium. The
15 heater 144 and/or the heat pump arrangement can be activated parallel to the operation of the fan 140 and/or after venting the shaft in order to dry the device 10. The steam generator can also be activated again at the end of the cleaning phase, e.g. in order to reduce odours
20 of substances like ozone, which arise due to the UV(C) radiation.

In the described example the cleaning mode is only activated when the usable space 12 doesn't contain a charge. The controller 21 may display a corresponding
25 message to the user. The entire duration of the cleaning mode is preferably dimensioned for 5 to 8 hours and the cleaning mode may therefore be well carried out during a night.

While preferred embodiments of the invention
30 are described in the present application, it has to be clearly noted that the invention is not limited thereto and may also be carried out in different ways within the scope of the now following claims.

Particularly, the invention can also be used
35 for other household applications having a circulation system with catalyser and heat pump. A choice of such devices can e.g. be found in said patent application EP

2241826 A1 and comprises dish washers, washing machines and similar devices. By adding a steam generator, if it is not already required for the normal operation, and a pipe for the steam into the circulation system of the process medium at a position downstream of the usable space but upstream of the catalysers, the devices can be adapted without problems to an operation mode according to the present invention.

It may also be useful to provide the steam generator with at least two separate outlets into the circulation system of the process medium. While the first outlet is attributed to the operation according to the invention and is activated during the cleaning of the catalyser, the second outlet may be attributed to the normal operation and open e.g. directly into the usable space of the device, such that steam reaches the usable space without prior flow via the catalyser surfaces.

Patentkrav

1. Husholdningsapparat (10), især vasketøjsbehandlingsskab, med et cirkulationssystem (12,16,14,15,26) til et procesmedium, en transportindretning (141) til tilvejebringelse af en dirigeret strømning af procesmediet, en dampgenerator (137), en eller flere kontaktflader (143), der er anbragt i cirkulationssystemet og er belagt med katalysatormateriale, og et anvendelsesrum (12), der er anbragt i cirkulationssystemet, hvor anvendelsesrummet har en udtræksåbning (125) for procesmediet ud mod transportindretningen og er tilgængeligt udefra med henblik på læsning, hvor dampgeneratoren (137) har en udgang (138, 140), som udmunder i cirkulationssystemet (12,16,14,15,26) i strømningsretningen mellem anvendelsesrummets udtræksåbning (125) og positionen af den ene eller de flere kontaktflader (142), og hvor cirkulationssystemet har mindst en varmepumpe (22) for procesmediet med en fordampner (135) og en kondensator (132), og dampgeneratorens udgang (138,140) udmunder i cirkulationssystemet (12,16,14,15,26) i strømningsretningen efter fordampneren (135) og kondensatoren (132).
2. Husholdningsapparat ifølge krav 1, hvor dampgeneratorens (137) udgang (138,140) udmunder i cirkulationssystemet (12,16,14,15,26) i strømningsretningen efter transportindretningen (141).
3. Husholdningsapparat ifølge et af de foregående krav, hvor kontaktfladerne (143) er anbragt i en del (14) af cirkulationssystemet (12,16,14,15,26), der er adskilt fra anvendelsesrummet.
4. Husholdningsapparat ifølge et af de foregående krav, hvor kontaktfladerne (143) er anbragt i en skakt (14) med en indgangsåbning, der er åben ud mod transportindretningen (141), og en udgangsåbning, der er åben mod anvendelsesrummet (12), og hvor dampgeneratorens (137) udgang (138,140) udmunder i skakten (14) mellem indgangsåbningen og kontaktfladerne (143).
5. Husholdningsapparat (10) ifølge krav 4, hvor skakten (14) udgør en del af cirkulationssystemet (12,16,14,15,26), i hvilken procesmediet, der cirkulerer i strømningsretningen, stiger, inden det kommer ind i anvendelsesrummet

(12).

5 **6.** Husholdningsapparat (10) ifølge et af de foregående krav, hvor der til den ene eller de flere kontaktflader (143) er knyttet mindst en aktivator (142) til at understøtte en katalyseret reaktion.

10 **7.** Husholdningsapparat (10) ifølge krav 6, hvor den ene eller de flere kontaktflader (143) indeholder en fotokatalysator, og aktivatoren (142) omfatter en UV-lyskilde.

15 **8.** Fremgangsmåde til rengøring af husholdningsapparatet ifølge et af de foregående krav, **kendetegnet ved**, at damp, der genereres af dampgeneratoren (137), indføres i cirkulationssystemet (12,16,14,15,26) i strømningsretningen mellem anvendelsesrummets udtræksåbning (125) og positionen af den ene eller de flere kontaktflader (143) og ledes forbi den ene eller de flere kontaktflader (143).

20 **9.** Fremgangsmåde ifølge krav 8, hvor dampen indføres i cirkulationssystemet (12,16,14,15,26) i intervaller, og der efter hvert interval følger en periode uden indføring af damp.

25 **10.** Fremgangsmåde ifølge krav 8 eller 9, hvor kontaktfladerne (143), i det mindste mens dampen indføres, holdes i en aktiv tilstand af en aktivator (142), der er knyttet til katalysatoren.

30 **11.** Fremgangsmåde ifølge et af kravene 8 til 10, hvor transportindretningen (141) ikke genererer nogen strømning i cirkulationssystemet (12,16,14,15, 26), mens dampen indføres.

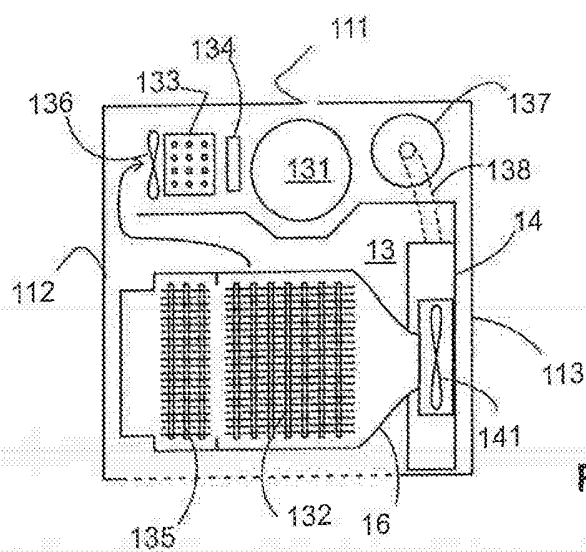
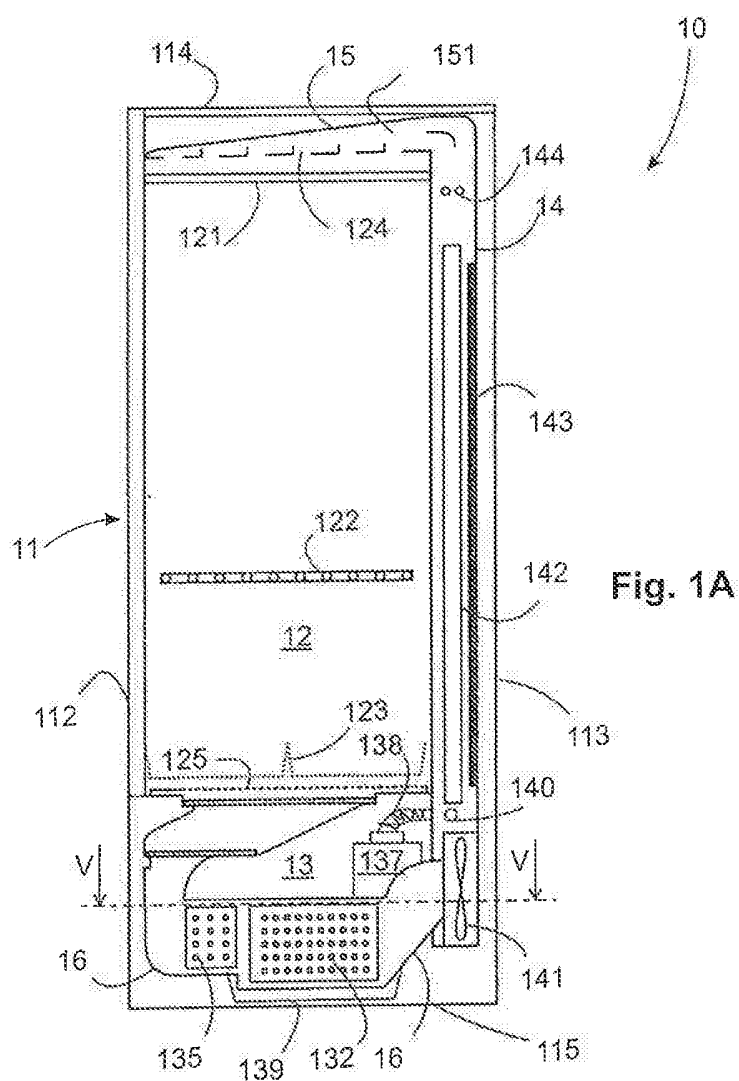
35 **12.** Fremgangsmåde ifølge krav 11, hvor transportindretningen (141) aktiveres, efter at aktivatoren (142), der er knyttet til katalysatoren, er sat i gang, og efter at indføringen af damp er afsluttet.

13. Fremgangsmåde ifølge et af kravene 8 til 12, hvor husholdningsapparatet (10) inden indføringen af dampen drives uden opvarmning for at tilpasse kon-

taktfladerne (143) til omgivelsestemperaturen.

5 **14.** Fremgangsmåde ifølge et af kravene 8 til 13, hvor kontaktfladernes (143) temperaturer og måden til indføring af dampen vælges således, at der bevirkes en kondensation på kontaktfladerne (143) og et afløb af kondensvand.

15. Fremgangsmåde ifølge et af kravene 8 til 14, hvor et tørringstrin med aktivering af en varmepumpe (22) følger umiddelbart efter rengøringstrinnene for kontaktfladerne (143).



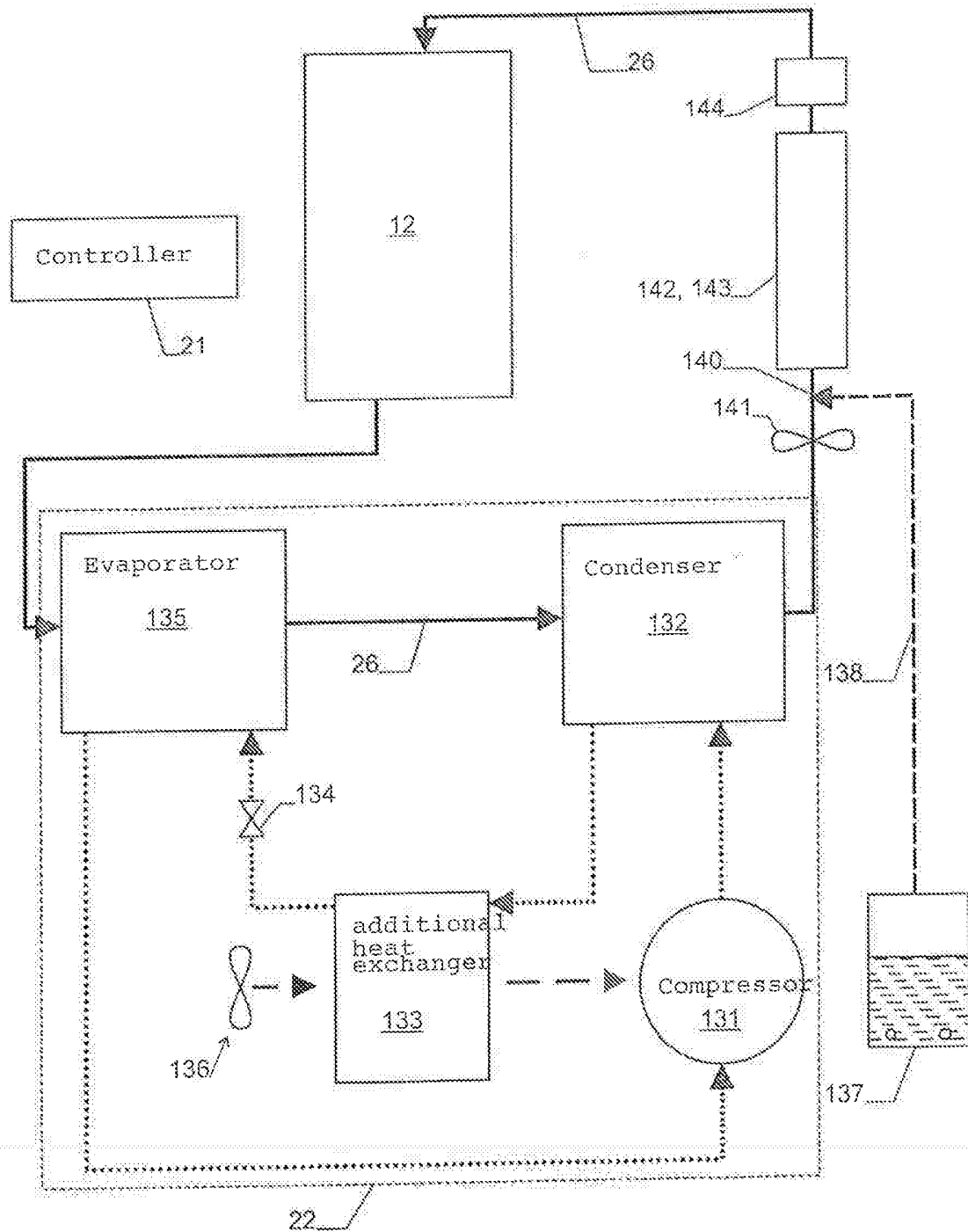


Fig. 2

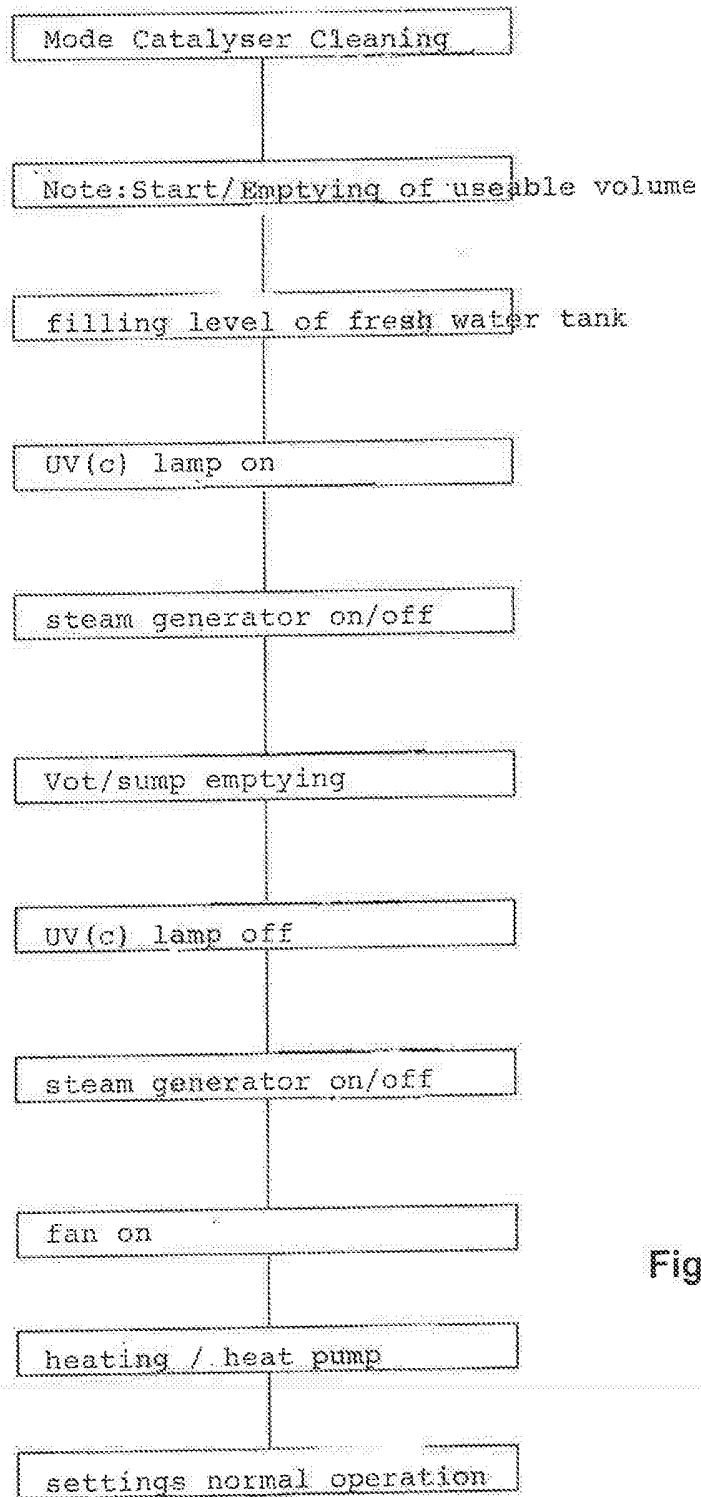


Fig. 3