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(54) **A HOUSEHOLD APPLIANCE HAVING A DESSICANT**

HAUSHALTSGERÄT MIT TROCKENMITTEL

APPAREIL ÉLECTROMÉNAGER AVEC UN DESSICCATIF

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(56) References cited:

**DE-A1- 3 626 887 DE-A1-102005 004 097
DE-A1-102008 043 933 GB-A- 2 284 164**

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Description

[0001] The present invention relates to a household appliance wherein the drying efficiency is increased and the energy consumption is reduced.

[0002] In household appliances like the dishwasher and dryer, the use of zeolite as the desiccant material, especially as the reversible desiccant material, is known for the aim of increasing the drying efficiency and providing energy saving.

[0003] In these state of the art embodiments, the dishwasher comprises a receptacle housing the zeolite and that is connected to the washing tub with an inlet and an outlet. In these embodiments, the wash water is heated by operating the heater disposed in the vicinity of the receptacle in the main washing step. At this moment, the fan is operated and the air received from inside the washing tub is passed over the receptacle. In the main washing step, the zeolite releases the retained moisture and thus completes its regeneration. In the drying step, the humid air sucked from the washing tub by means of the fan, is confined by the zeolite that has completed its regeneration in the main washing step while passing through the receptacle and that has become usable again. The dehumidified processing air is directed to the washing tub again, thus creating an air circulation.

[0004] The zeolite must be heated to high temperatures (200°C) by means of an additional heater disposed inside or in the vicinity thereof so as to become usable again in the next drying step by completing its regeneration. The heater operated during this process results in the increase of energy consumption. When a super absorbent polymer is used instead of zeolite, the regeneration time shortens and thermal energy required for the regeneration decreases since the super absorbent polymer can be regenerated at low temperatures. However, the structure of the super absorbent polymer easily deteriorates at high temperatures.

[0005] In the state of the art British Patent Application No. GB2284164, regeneration of hygroscopic material in a laundry drying appliance is disclosed.

[0006] In the state of the art German Patent Application No. DE3626887, an appliance in which an adsorptive desiccant (5) is used to dehumidify the process air and the use of thermal energy is described.

[0007] In the state of the art German Patent Application No. DE102008043933, a dishwasher is explained wherein control of the sorption material realized using electronic components.

[0008] In the state of the art German Patent Application No. DE102005004097, a dishwasher is explained wherein the data of a sensing means which monitors the status of the sorption material influences the rinsing program.

[0009] In the state of the art German Patent Application No. DE10353774, a dishwasher is explained wherein the air is passed over the desiccant in the drying step.

[0010] The aim of the present invention is the realization of a household appliance wherein the drying efficiency is increased and the energy consumption is decreased.

cy is increased and the energy consumption is decreased.

[0011] The household appliance realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises a tub wherein the drying and/or washing processes are performed, an inlet port providing the entry of air into the tub, an outlet port providing the exit of the air from the tub, a channel extending between the inlet port and the outlet port so as to be outside the tub, a fan situated on the channel, a receptacle disposed on the channel, a heater placed in the receptacle or within its vicinity, and a desiccant that is situated inside the receptacle and that is super absorbent polymer. Thanks to the thermophysical property of the super absorbent polymer, the humid air is dehumidified by the super absorbent polymer and then directed into the tub again. By means of this process, an effective drying process is realized by evaporating the water on the dishes. The super absorbent polymer reaching the saturation point during moisture retaining is regenerated in the next washing step by means of a heater disposed in the vicinity thereof and becomes usable again. The household appliance of the present invention comprises a temperature sensor that enables the temperature inside the receptacle to be measured and a control unit that controls the temperature inside the receptacle. By comparing a regeneration temperature upper value predetermined by the producer with the receptacle temperature, the control unit prevents the receptacle temperature from exceeding the regeneration temperature upper value. Thus, the temperature is prevented from increasing more than required and from deteriorating the structure of the super absorbent polymer. Since the heat requirement for the endothermic regeneration process of the super absorbent polymer is low, energy saving is provided by operating the heater in a controlled manner.

[0012] In an embodiment of the present invention, the control unit enables the temperature inside the receptacle to be kept above the regeneration temperature lower value. Thus, the regeneration temperature lower value required for the regeneration process to start is provided.

[0013] In an embodiment of the present invention, the control unit deactivates the heater when the temperature inside the receptacle exceeds the regeneration temperature upper value predetermined by the producer. Thus, the structure of the super absorbent polymer is prevented from deteriorating due to high temperatures and the moisture retaining capacity thereof is maintained.

[0014] In an embodiment of the present invention, the control unit activates the heater in order to increase the temperature inside the receptacle to the regeneration temperature lower value predetermined by the producer. Thus, temperature values required for the realization of the regeneration process are reached.

[0015] In an embodiment of the present invention, the control unit increases the rotational speed of the fan when the temperature inside the receptacle reaches the regen-

eration temperature upper value predetermined by the producer. Swept from over the surface of the heater, the air, the speed of which is increased by means of the fan, passes over the super absorbent polymer without getting too hot and the temperature, the super absorbent polymer is subject to, is decreased. Thus, the thermal degradation of the super absorbent polymer is prevented. According to the present invention, the regeneration temperature of the desiccant is between 50°C and 100°C. The regeneration duration and the thermal energy required for regeneration decrease thanks to the property of the desiccant being able to be regenerated at low temperatures. Furthermore, the need for using high temperature resistant components is eliminated and thus material cost is reduced. According to the present invention, the glass transition temperature of the desiccant is between 20°C and 40°C. The moisture retaining capacity of the desiccant with high flexibility and low glass transition temperature is high.

[0016] In an embodiment of the present invention, the receptacle is produced from a material with high thermal conductivity. Consequently, heat loss during heat transfer from the heater situated in the vicinity of the receptacle to the desiccant is decreased.

[0017] In an embodiment of the present invention, the heater is disposed at a place in the vicinity of the receptacle, in a direction perpendicular to the air flow. Thus, almost all desiccant particles are facilitated to be regenerated since a homogeneous heat distribution is provided inside the receptacle. The total desiccation capacity of the desiccant increases in the next drying step and hence a more effective drying is provided.

[0018] The household appliance realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

Figure 1 - is the schematic view of the household appliance of the present invention.

[0019] The elements illustrated in the figure are numbered as follows:

1. Household appliance
2. Tub
3. Inlet port
4. Outlet port
5. Channel
6. Fan
7. Heater
8. Receptacle

9. Desiccant

10. Temperature sensor

11. Control unit

[0020] The following symbols are used for explicating the household appliance (1) of the present invention:

- $rt_{üst}$: a regeneration temperature upper value predetermined by the producer
- rt_{alt} : a regeneration temperature lower value predetermined by the producer
- T_H : temperature inside the receptacle

[0021] The household appliance (1) comprises a tub (2) wherein the washing and/or the drying process is performed, an inlet port (3) providing the entry of air into the tub (2), an outlet port (4) enabling the air in the tub (2) to be discharged outside, a channel (5) extending between the inlet port (3) and the outlet port (4) so as to remain outside the tub (2), a fan (6) disposed on the channel (5), a receptacle (8) situated on the channel (5), a heater (7) disposed inside or in the vicinity of the receptacle (8), and a desiccant (9) that is situated inside the receptacle (8) and that is a super absorbent polymer. The humid air received from the tub (2) by means of the inlet port (3) is carried inside the channel (5) and directed to the receptacle (8) containing the desiccant (9) by means of the fan (6). Heat is emanated while moisture, carried by air, is bonded with the desiccant (9) due to the thermophysical property of the desiccant (9). The air, that is dehumidified and the temperature of which increases due to the heat emanated during dehumidification, is again directed into the tub (2). By means of this process, an effective drying process is realized by evaporating the water on the dishes. The desiccant (9) reaching the saturation point during moisture retaining is regenerated by means of the heater (7) disposed in the vicinity thereof in the next washing step and becomes usable again.

[0022] The household appliance (1) of the present invention comprises a temperature sensor (10) that is situated inside or in the vicinity of the receptacle (8) and that enables the temperature (T_H) inside the receptacle (8) to be measured, the desiccant (9) having a regeneration temperature upper value ($rt_{üst}$) predetermined by the producer and a regeneration temperature lower value (rt_{alt}) predetermined by the producer, and a control unit (11) enabling the temperature (T_H) inside the receptacle (8) to be kept below the regeneration temperature upper value ($rt_{üst}$). The control unit (11) operates the heater (7) in a manner that the temperature (T_H) inside the receptacle (8) does not exceed the regeneration temperature upper value ($rt_{üst}$). The heat requirement for the endothermic regeneration process of the super absorbent polymer is low and by means of the controlled operation of

the heater (7), thermal energy is used as much as required and energy saving is provided.

[0023] In an embodiment of the present invention, the control unit (11) enables the temperature (T_H) inside the receptacle (8) to be kept above the regeneration temperature lower value (rt_{alt}). Thus, the regeneration temperature lower value (rt_{alt}) required for the regeneration process to start is provided and the temperature is prevented from increasing and deteriorating the structure of the super absorbent polymer.

[0024] In an embodiment of the present invention, the control unit (11) deactivates the heater (7) when the temperature (T_H) inside the receptacle (8) reaches the regeneration temperature upper value (rt_{ust}) predetermined by the producer. Thus, the heat required for the regeneration process is provided, the structure of the super absorbent polymer is prevented from deteriorating due to high temperatures, the moisture retaining capacity thereof is maintained and energy saving is provided.

[0025] In an embodiment of the present invention, the control unit (11) activates the heater (7) in order to increase the temperature (T_H) inside the receptacle (8) to the regeneration temperature lower value (rt_{alt}) predetermined by the producer. Thus, temperature values required for the realization of the regeneration of the desiccant (9) are reached. The efficiency of the moisture retaining process is improved.

[0026] In an embodiment of the present invention, the control unit (11) increases the rotational speed of the fan (6) when the temperature (T_H) inside the receptacle (8) reaches the regeneration temperature upper value (rt_{ust}) predetermined by the producer. With the operation of the fan (6), the air is swept from over the surface of the heater (7) and passes over the super absorbent polymer without getting too hot and the temperature, the super absorbent polymer is subject to, is decreased. The regeneration temperature of the desiccant (9), which is a super absorbent polymer, is between 50°C and 100°C. The requirement for a powerful heater (7) is eliminated since the desiccant (9) is regenerated at low temperatures. The need for using high temperature resistant materials is eliminated and material cost is decreased since the temperature the components near the heater (7) are subjected to during the regeneration process decreases.

[0027] In an embodiment of the present invention, the desiccant (9) is a super absorbent polymer with a moisture retaining capacity that is approximately fifty percent of its mass. Thus, the use of a low weight desiccant (9) is sufficient and the material occupies less volume inside the receptacle (8). The glass transition temperature of the desiccant (9) is between 20°C and 40°C. The desiccant (9) with low glass transition temperature has high flexibility and thus the porous structure can retain more moisture by expanding.

[0028] In an embodiment of the present invention, the receptacle (8) is produced from a material with high thermal conductivity. Thus, the heat transfer between the heater (7) situated in the vicinity of the receptacle (8) and

the desiccant (9) inside the receptacle (8) is realized with less energy loss and the regeneration efficiency of the desiccant (9) increases.

[0029] In an embodiment of the present invention, the heater (7) is disposed near the receptacle (8) and in a direction perpendicular to the air flow. The heater (7) starts operating simultaneously with the fan (6) during the regeneration process. Heat transfer occurs by means of convection between the receptacle (8) and the heater (7) which is disposed perpendicular to the fan (6) and near the receptacle (8). Thus, the heat is enabled to be distributed homogeneously inside the receptacle (8), the regeneration efficiency of the desiccant (9) and hence moisture retaining capacity in the next drying step increase by means of the homogeneous heat distribution.

[0030] By means of the present invention, the desiccant (9) is prevented from being deteriorated by means of the controlled operation of the heater (7) and the fan (6). Thus, the drying efficiency of the household appliance (1) is improved by maintaining the moisture retaining performance of the desiccant (9). Thus, by preventing the heater (7) from being operated unnecessarily, energy saving is provided.

Claims

1. A household appliance (1) **comprising** a tub (2) wherein the washing and/or the drying process is performed, an inlet port (3) providing the entry of air into the tub (2), an outlet port (4) enabling the air in the tub (2) to be discharged outside, a channel (5) extending between the inlet port (3) and the outlet port (4) so as to remain outside the tub (2), a fan (6) disposed on the channel (5), a receptacle (8) situated on the channel (5), a heater (7) disposed inside or in the vicinity of the receptacle (8), and a desiccant (9) that is situated inside the receptacle (8) and that is a super absorbent polymer,

- a temperature sensor (10) that is situated inside or in the vicinity of the receptacle (8) and that enables the temperature (T_H) inside the receptacle (8) to be measured, and the desiccant (9) having a regeneration temperature upper value (rt_{ust}) predetermined by the producer and a regeneration temperature lower value (rt_{alt}) predetermined by the producer, and
- a control unit (11) designed to enable the temperature (T_H) inside the receptacle (8) to be kept below the regeneration temperature upper value (rt_{ust}).
- the desiccant (9), the regeneration temperature of which is between 50°C to 100°C.
- and the desiccant (9) the glass transition temperature of which is between 20°C and 40°C

2. A household appliance (1) as in Claim 1, **character-**

ized by the control unit (11) designed to enable the temperature (T_H) inside the receptacle (8) to be kept above the regeneration temperature lower value (rt_{alt}).

3. A household appliance (1) as in Claim 1 or 2, **characterized by** the control unit (11) designed to deactivate the heater (7) when the temperature (T_H) inside the receptacle (8) reaches the regeneration temperature upper value ($rt_{üst}$) predetermined by the producer.
4. A household appliance (1) as in any one of the above claims, **characterized by** the control unit (11) designed to activate the heater (7) in order to increase the temperature (T_H) inside the receptacle (8) to the regeneration temperature lower value (rt_{alt}) predetermined by the producer.
5. A household appliance (1) as in any one of the above claims, **characterized by** the control unit (11) designed to increase the rotational speed of the fan (6) when the temperature (T_H) inside the receptacle (8) reaches the regeneration temperature upper value ($rt_{üst}$) predetermined by the producer.
6. A household appliance (1) as in any one of the above claims, **characterized by** the receptacle (8) that is produced from a material with high thermal conductivity.
7. A household appliance (1) as in any one of the above claims, **characterized by** the heater (7) that is disposed near the receptacle (8) and in a direction perpendicular to the air flow.

Patentansprüche

1. Haushaltsgerät (1) **umfassend** eine Wanne (2) wobei der Wasch- und / oder Trocknungsprozess durchgeführt wird, eine Einlassöffnung (3), die den Eintritt von Luft in die Wanne (2) ermöglicht, eine Auslassöffnung (4), die es ermöglicht, dass die Luft in der Wanne (2) nach außen abgegeben wird, ein Kanal (5), der sich zwischen der Einlassöffnung (3) und der Auslassöffnung (4) erstreckt, um außerhalb der Wanne (2) zu bleiben, einen Lüfter (6), der auf dem Kanal (5) angeordnet ist, eine Aufnahme (8), die sich auf dem Kanal (5) befindet, ein Heizgerät (7) innerhalb oder in der Nähe der Aufnahme (8) angeordnet ist, und ein Trocknungsmittel (9), das sich innerhalb der Aufnahme (8) befindet und das ein superabsorbierendes Polymer ist,
 - einen Temperatursensor (10), der innerhalb oder in der Nähe der Aufnahme (8) angeordnet ist und der es ermöglicht, die Temperatur (T_H)

innerhalb der Aufnahme (8) zu messen und wobei das Trocknungsmittel (9) einen vom Hersteller vorgegebenen oberen Wert der Regenerierungstemperatur ($rt_{üst}$) und einen vom Hersteller vorgegebenen unteren Regenerierungstemperatur (rt_{alt}) aufweist und

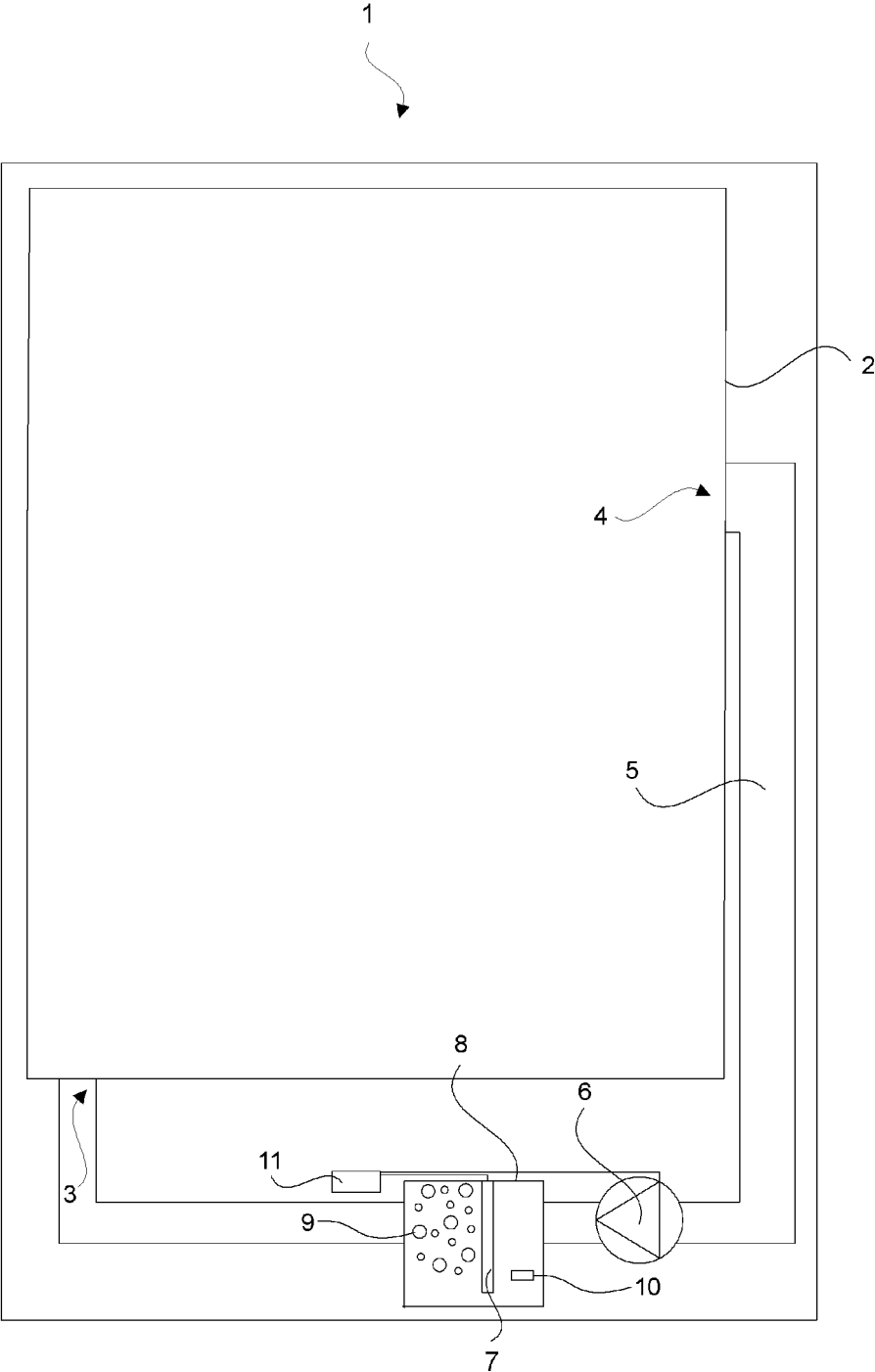
- eine Steuereinheit (11), die dazu ausgebildet ist, die Temperatur (T_H) innerhalb der Aufnahme (8) unter dem oberen Wert der Regenerierungstemperatur ($rt_{üst}$) zu halten.
- das Trocknungsmittel (9), das eine Regenerierungstemperatur von 50°C bis 100°C aufweist,
- und das Trocknungsmittel (9), das eine Glasübergangstemperatur von 20°C und 40°C aufweist.

2. Haushaltsgerät (1) nach Anspruch 1, **gekennzeichnet durch** die Steuereinheit (11), die dazu ausgebildet ist, die Temperatur (T_H) innerhalb der Aufnahme (8) über dem unteren Wert der Regenerierungstemperatur (rt_{alt}) zu halten.
3. Haushaltsgerät (1) nach Anspruch 1 oder 2 **gekennzeichnet durch** die Steuereinheit (11), die dazu ausgebildet ist, das Heizgerät (7) zu deaktivieren, wenn die Temperatur (T_H) im Inneren der Aufnahme (8) den vom Hersteller vorgegebenen oberen Wert der Regenerierungstemperatur ($rt_{üst}$) erreicht.
4. Haushaltsgerät (1) nach einem der vorangehenden Ansprüche **gekennzeichnet durch** die Steuereinheit (11), die dazu ausgebildet ist, das Heizgerät (7) zu aktivieren, um die Temperatur (T_H) im Inneren der Aufnahme (8) auf den vom Hersteller vorgegebenen unteren Wert der Regenerierungstemperatur (rt_{alt}) zu erhöhen.
5. Haushaltsgerät (1) nach einem der vorangehenden Ansprüche **gekennzeichnet durch** die Steuereinheit (11), die dazu ausgebildet ist, die rotationale Geschwindigkeit des Lüfters (6) zu erhöhen, wenn die Temperatur (T_H) im Inneren der Aufnahme (8) den vom Hersteller vorgegebenen oberen Regenerierungstemperatur ($rt_{üst}$) erreicht.
6. Haushaltsgerät (1) nach einem der vorangehenden Ansprüche **gekennzeichnet durch** die Aufnahme (8), die aus einem Material mit hoher Wärmeleitfähigkeit hergestellt ist.
7. Haushaltsgerät (1) nach einem der vorangehenden Ansprüche **gekennzeichnet durch** ein Heizgerät (7), das in der Nähe der Aufnahme (8) und in einer Richtung senkrecht zur Luftströmung angeordnet ist.

Revendications

1. Appareil ménager (1) **comportant** une cuve (2) dans laquelle le processus de lavage et / ou de séchage est effectué, un orifice d'entrée (3) fournissant l'entrée d'air dans la cuve (2), un orifice de sortie (4) permettant d'évacuer l'air extérieur de la cuve (2), un canal (5) s'étendant entre l'orifice d'entrée (3) et l'orifice de sortie (4) pour rester à l'extérieur de la cuve (2), un ventilateur (6) disposé sur le canal (5), un réceptacle (8) situé sur le canal (5), un dispositif de chauffage (7) disposé à l'intérieur ou à proximité du réceptacle (8) et un déshydratant (9) situé à l'intérieur du réceptacle (8) et qui est un polymère super absorbant,
 - un capteur de température (10) qui est situé à l'intérieur ou à proximité du récipient (8) et qui permet de mesurer la température (T_H) à l'intérieur du récipient (8), et le déshydratant (9) ayant une valeur de température de régénération supérieure ($rt_{üst}$) prédéterminée par le producteur et une valeur de température de régénération inférieure (rt_{alt}) prédéterminée par le producteur, et
 - une unité de commande (11) conçue pour permettre de maintenir la température (T_H) à l'intérieur du récipient (8) en dessous de la valeur supérieure de la température de régénération ($rt_{üst}$).
 - le déshydratant (9) dont la température de régénération est comprise entre 50°C et 100°C.
 - et le déshydratant (9) dont la température de transition vitreuse est comprise entre 20°C et 40°C
2. Appareil ménager (1) selon la revendication 1, **caractérisé par** l'unité de commande (11) est conçue pour permettre de maintenir la température (T_H) à l'intérieur du récipient (8) au-dessus de la valeur de température de régénération inférieure (rt_{alt}).
3. Appareil ménager (1) selon la revendication 1 ou 2, **caractérisé par** l'unité de commande (11) conçue pour désactiver le dispositif de chauffage (7) lorsque la température (T_H) à l'intérieur du récipient (8) atteint la valeur supérieure de température de régénération ($rt_{üst}$) prédéterminé par le producteur.
4. Appareil ménager (1) selon l'une quelconque des revendications précédentes, **caractérisé par** l'unité de commande (11) conçue pour activer le dispositif de chauffage (7) afin d'augmenter la température (T_H) à l'intérieur du récipient (8) à la température de régénération valeur inférieure (rt_{alt}) prédéterminée par le producteur.
5. Appareil ménager (1) selon l'une quelconque des revendications précédentes, **caractérisé par** l'unité de commande (11) conçue pour augmenter la vitesse de rotation du ventilateur (6) lorsque la température (T_H) à l'intérieur du réceptacle (8) atteint la régénération température valeur supérieure ($rt_{üst}$) prédéterminée par le producteur.
6. Appareil ménager (1) selon l'une quelconque des revendications précédentes, **caractérisé par** le réceptacle (8) est fabriqué à partir d'un matériau à haute conductivité thermique.
7. Appareil ménager (1) selon l'une quelconque des revendications précédentes, **caractérisé par** dispositif de chauffage (7) qui est disposé à proximité du réceptacle (8) et dans une direction perpendiculaire au flux d'air.

Figure 1



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- GB 2284164 A [0005]
- DE 3626887 [0006]
- DE 102008043933 [0007]
- DE 102005004097 [0008]
- DE 10353774 [0009]