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(54) **AIR DUCTING SYSTEM WITH ADSORBER, HOUSEHOLD APPLIANCE WITH AN AIR DUCTING SYSTEM AND METHOD OF OPERATING A HOUSEHOLD APPLIANCE**

LUFTFÜHRUNGSSYSTEM MIT ADSORBER, HAUSHALTSGERÄT MIT EINEM
LUFTFÜHRUNGSSYSTEM UND VERFAHREN ZUM BETREIBEN EINES HAUSHALTGERÄTES

SYSTÈME DE CONDUITE D'AIR COMPRENANT UN ADSORBEUR, APPAREIL MÉNAGER
COMPRENANT UN SYSTÈME DE CONDUITE D'AIR ET PROCÉDÉ DE FONCTIONNEMENT D'UN
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(73) Proprietor: **BSH Hausgeräte GmbH
81739 München (DE)**

(72) Inventors:

- **Baños Chetyrkin, Daniel**
29009 Malaga (ES)
- **Dolado Bielsa, Pablo**
50730 El Burgo de Ebro, Zaragoza (ES)
- **Lopez Palacios, Carlos**
50730 El Burgo de Ebro (Zaragoza) (ES)
- **Martinez Perez, Gerardo**
50015 Zaragoza (ES)
- **Perez Andres, Alejandra**
50015 Zaragoza (ES)

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Description

[0001] The present invention relates to an air ducting system with an adsorber, which can be used in a household appliance like a dishwasher and/or a washer-dryer for laundry.

[0002] In household appliances with a washing process and a drying process the process in the drying phase is often supported by conventional means like a heat pump. Such a process is generally designed at a single point of operation. This point of operation is selected so that the drying process has maximum efficiency for most of its duration. At a certain point, when most of the water has been removed, but when the laundry is still considered moist, the efficiency of such a heat-pump based drying process begins to fade. The condensation rate is lowered. In consequence, drying times become long.

[0003] Long drying times can be avoided by using a drying system with an electrical heater instead of a system based on a heat pump. However, such a drying system using only an electrical heater is not very efficient in terms of energy consumption.

[0004] Further, the drying process can also be performed in a relatively short time by using adsorptive materials like zeolites, silica-gels, substances based on metal-organic frameworks (MOF) or other hygroscopic materials. The water adsorption process in these materials releases thermal energy. When such an adsorptive drying process is combined with the drying process by a heat pump, the thermal energy released by the adsorptive material supports the drying of the air by the heat pump. Thus, energy efficiency is increased.

[0005] As the adsorptive material has only a limited capacity to absorb humidity, it has to be regenerated. For zeolite, a temperature of about 200°C is generally required to expel humidity in the regeneration cycle. The limited capacity of the adsorptive material has another drawback: the amount of adsorptive material in terms of mass and volume has to match the amount of water which is to be absorbed from e.g. a full load of laundry in the household appliance. Therefore, a huge amount of adsorptive material is often required. A commonly used material can adsorb e.g. only one third of its mass in terms of water. Therefore, the use of zeolites in drying systems for washer-dryers for laundry, as described in EP 2 935 685 A1, has not become common. On the other hand, in dishwashers, zeolite technology has been accepted as effective in terms of drying efficiency as well as energy efficiency and has found acceptance in the market.

[0006] The document DE 10 2008 032 228 A1 discloses a method and apparatus for regenerating a solid sorbent, that absorbs moisture from air flow, comprises heating the sorbent in an enclosure at above 150 °C, partially condensing water vapor desorbed from the sorbent on walls of the enclosure, desorbing a greater part of the desorbed water vapor at a vapor pressure near to the room pressure level and condensing by heating at

40-100 °C.

[0007] The document DE 3626887 A1 discloses a dehumidifier which dehumidifies the process air with simultaneous heat recovery and thus offers a particularly energy-efficient mode of operation. In a laundry drier, heated air is conducted via a fan and a heating apparatus and thus removes the moisture from the laundry. The desiccant container is connected in-between in an air conduction system, so that moisture-laden air is passed into the container and so that the desiccant adsorbs the moisture of the process air. Desiccants which are used are preferably bead-shaped adsorptive zeolite-based desiccants. The dehumidifier is particularly suitable for use in laundry driers, a more favourable efficiency being achieved by the heat recovery potential.

[0008] It is one object of the present invention to provide a technology using adsorptive materials in the drying cycle of a household appliance for washing and drying household items which uses the advantages of adsorptive materials in the drying process while reducing the drawbacks.

[0009] Accordingly, an air ducting system for a household appliance for cleaning and drying household items is described, wherein the household appliance comprises a controller, an air duct implemented to guide an air flow to a compartment for receiving items to be cleaned, wherein the air ducting system is implemented to be arranged in the air duct upstream from the compartment, wherein the air ducting system has a first ducting line and a second ducting line, which second ducting line is implemented to contain an adsorptive material, wherein the first and second ducting lines are provided with first and second blocking devices implemented to open or close the first and second ducting lines in response to a control signal from the controller, wherein the air ducting system is implemented to operate

in a normal operation state, in which the first ducting line is opened by the first blocking device and the second ducting line is closed by the second blocking device and

in an adsorption state, in which the second ducting line is opened by the second blocking device.

[0010] Such a design for the use of adsorptive materials allows the system to work in parallel with the normal operation of the drying process using e.g. a heat pump. When the compressor of the heat pump is also operative, the temperature of the air inlet of the compartment containing the household items which have been washed and are now being dried can be increased, because thermal energy is released in the adsorption process. Thus, the drying process will speed up and energy consumption can be reduced. In other words, such an air ducting system enables the use of adsorptive materials in a supporting system for the main drying system.

[0011] In embodiments the blocking device includes a valve, flap, gate or switch for shutting off an inlet of the

respective ducting line thereby preventing and/or controlling air flow into the respective ducting line.

[0012] According to an embodiment, in such an air ducting system, in the adsorption state, the first ducting line is closed at least partially by the first blocking device.

[0013] In this embodiment, the normal drying process without the use of adsorptive material can be continued as long as it is still helpful in drying or as long as it is still energy efficient. The normal drying process without the use of the adsorptive material may be completely shut off for example in the final phase of the drying cycle. If the first ducting line is closed completely, the drying process using the adsorptive material can be used as the only drying process.

[0014] According to a further embodiment, an air ducting system according to the above embodiments is described, wherein the second ducting line comprises a heater.

[0015] According to a further embodiment, the first ducting line in the air ducting system comprises a heater.

[0016] The two embodiments described above serve the purpose of supplying additional thermal energy to the compartment containing the household items which have been washed and are now being dried. The heater in the second ducting line may also be used for the regeneration of the adsorptive material.

[0017] Further, a household appliance for cleaning and drying household items is described which comprises a controller, an air duct implemented to guide an air flow to a compartment for receiving items to be cleaned, an air ducting system implemented to be arranged in the air duct upstream from the compartment, wherein the air ducting system has a first ducting line and a second ducting line, which second ducting line is implemented to contain adsorptive material, wherein the first and second ducting lines are provided with first and second blocking devices implemented to open or close the first and second ducting lines in response to a control signal from the controller, wherein the controller is arranged to operate the duct system so that there is

a normal operation state, in which the first ducting line is opened by the first blocking device and the second ducting line is closed by the second blocking device and

an adsorption state, in which the second ducting line is opened by the second blocking device.

[0018] According to an embodiment of the household appliance, the controller operates the duct system so that in the adsorption state, the first ducting line is at least partially closed by the first blocking device.

[0019] According to a further embodiment, the household appliance is a dishwasher.

[0020] According to a further embodiment, the household appliance is a washer-dryer for laundry.

[0021] Further a method of controlling a household appliance for cleaning and drying household items is

described, the household appliance comprising a controller, an air duct guiding an air flow to a compartment for items to be cleaned and an air ducting system arranged in the air duct upstream from the compartment, wherein the air ducting system has a first ducting line and a second ducting line, which second ducting line comprises adsorptive material, wherein the controller is arranged to open or close the ducting lines at least partially, the method comprising steps of moving air through the ducting system towards the compartment, the steps comprising

a normal operation step in which the controller opens the first ducting line and closes the second ducting line, whereby flowing air is passing through the first ducting line, and

an adsorption step, in which the controller opens the second ducting line, whereby flowing air is passing through the second ducting line, wherein the normal operation step takes place before the adsorption step.

[0022] According to an embodiment of the method, the adsorption step comprises the step of closing the first ducting line at least partially by the controller.

[0023] According to a further embodiment, the method comprises a step of starting of the adsorption step by the controller after the execution of the normal operation step for a first predetermined time and a step of ending of the normal operation step by the controller and after the execution of the normal operation step for a second predetermined time.

[0024] According to a further embodiment, the method comprises a step of starting of the adsorption step by the controller after the controller determined that a signal level of a sensor exceeds a first predetermined value and a step of ending of the normal operation step by the controller after the controller determined that a signal level of a sensor exceeds a second predetermined value.

[0025] According to a further embodiment, the method comprises a step of starting of the adsorption step by the controller after the controller determined that a signal level of a sensor is within a first predetermined range for a third predetermined time and a step of ending of the normal operation step by the controller after the controller determined that a signal level of a sensor is within a second predetermined range for a fourth predetermined time.

[0026] According to a further embodiment, when the household appliance is arranged to execute both a drying process and a wetting process during which water is being fed to the compartment, the method comprises a regeneration step after the adsorption step, the regeneration step comprising

a step of flowing air through the second ducting line, the second ducting line being opened by the controller, and

a step of transporting water by the flowing air, which is released from the adsorptive material by a heater, into the compartment during the wetting process, wherein the water was adsorbed in the adsorption step.

[0027] This method of integrating the regeneration step in the wetting process of the next washing cycle increases environmental friendliness of the household appliance by reducing freshwater consumption of the household appliance. Further, there is the added effect that the quantity of water going into the drainage system is reduced, because the water absorbed by the adsorptive material is retained by the adsorptive material. In the next washing cycle, this water is released from the adsorptive material and used instead of being drained. Because this water was adsorbed in the form of water vapor, it is clean and can be used in the next washing cycle.

[0028] According to a further aspect, the invention relates to a computer program product comprising instructions which, when the program is executed by a computer, cause the computer to carry out any of the described methods above.

[0029] The embodiments and features described with reference to the air ducting system of the present invention apply mutatis mutandis to the household appliance of the present invention.

[0030] The embodiments and features described with reference to the air ducting system of the present invention apply mutatis mutandis to the method of the present invention.

[0031] Further possible implementations or alternative solutions of the invention also encompass combinations - that are not explicitly mentioned herein - of features described above or below with regard to the embodiments. The person skilled in the art may also add individual or isolated aspects and features to the most basic form of the invention.

[0032] Further embodiments, features and advantages of the present invention will become apparent from the subsequent description and dependent claims, taken in conjunction with the accompanying drawings, in which:

Fig. 1 shows a conventional drying apparatus using an adsorber in a household appliance;

Fig. 2 shows a drying apparatus in a household appliance with an air ducting system containing an adsorber;

Fig. 3 is a schematic view of the air ducting system in normal operation state;

Fig. 4 is a schematic view of the air ducting system in adsorption state;

Fig. 5 is a schematic view of the air ducting system

according to a modification;

Fig. 6 is a flowchart explaining the method of operating the air ducting system;

Fig. 7 is a flowchart explaining a first modification of the method of operating the air ducting system;

Fig. 8 is a flowchart explaining a second modification of the method of operating the air ducting system; and

Fig. 9 is a flowchart of a method used in regenerating the adsorptive material.

In the Figures, like reference numerals designate like or functionally equivalent elements, unless otherwise indicated.

[0033] The drying system shown here is a heat pump. The operation of such a heat pump follows the same principles as a common refrigerator. It is possible to use other drying systems than a heat pump. One example would be a drying system containing a heater, where the air passing through the drying system is heated by means of a heating fluid which may be flowing through the drying system in a transverse direction to the air flow direction or in the reverse flow direction to the air flow direction. Such a drying system with a heater contains a receptacle or an outlet for the condensing humidity, i.e. the water which has been removed from the air coming out of the compartment for items to be cleaned. Further, an electrical heater can also be used as the drying element in the drying system.

[0034] Fig. 1 is a schematic view of air circulation in the drying system of a conventional household appliance 10, like a dishwasher or a washer-dryer for laundry. This household appliance is equipped with an adsorber. A fan 3 propels air to a heater 4 and from there into an adsorption system 5. Dry air is then fed into the compartment 6 for items which have been washed or laundered and are now being dried. This air flow effects the drying process of the household items (dishes, laundry) in the compartment. In the example of Figures 1 and 2, the compartment has a cylindrical shape typical of the drum of a washer-dryer. In the exiting air, there may be a sensor 15 for e.g. temperature, relative humidity, electrical conductivity. With a second sensor (not shown) on the side where air is being fed into the compartment it is also possible to measure temperature difference, difference in relative humidity before and after the compartment with the household items. Of course, it is also possible to use more than one sensor so that e.g. both temperature and humidity can be measured. By a connection 17, the signal of the sensor 15 is transmitted to a controller 16, which is typically a microprocessor which performs process control for the household appliance 1. From the sensor, the air goes through a filter and is returned by the air duct 8 to a drying system 2. Here, a heat pump is used as a drying

system 2. The heat pump contains a compressor 21, a first heat exchanger 22, in which the refrigerant condenses at least partially, a throttle 23, which expands the refrigerant, and a second heat exchanger 24, where the refrigerant is evaporated. The air flow passes through both heat exchangers, as it is indicated by the arrow. When the air which carries water from the compartment 6 with items to be dried passes through these heat exchangers 22 and 24, heat is transferred to the heat exchangers and the flowing air will cool down. This temperature drop will cause humidity to condense out of the air. Thereby, the air has been dried and flows from the drying system 2 back to the entry side of the fan 3. Thus, the drying cycle starts anew and can be repeated until the household items in the compartment 6 are considered dry.

[0035] Fig. 2 is a schematic view of air circulation in the drying system of a conventional household appliance 1, which is equipped with an improved arrangement for the adsorber in the air ducting system. Most of the components in this household appliance are identical to those shown in Fig. 1. The same reference numerals as in Fig. 1 have been used throughout Fig. 2. However, when the air exits the heater 4, there is a guiding and blocking system 52 for directing the air flow into a pair of ducting lines described in detail below in connection with Figs 3 - 5. This guiding and blocking 52 system is operated by the controller 16 via a second connection 18. As can be seen in Fig. 2, air passing through the first ducting line is forwarded from the heater by the guiding and blocking system 52 directly into the compartment 6 containing the items to be dried. The guiding and blocking system 52 can also send air into a second ducting line containing adsorbing material 51. From there, air passing through the second ducting line is also flowing into the compartment 6. The adsorbing materials used in such a household appliance 1 with first and second ducting lines are identical to those mentioned in the introductory part of this description.

[0036] Fig. 3 is a schematic view of the air ducting system 112 in normal operation state showing the first ducting line 110 and the second ducting line 111. The guiding/blocking system (reference numeral 52 in Fig. 2) is made by two blocking devices, shown here as gates 90 and 91, which can also be realized as dampers, valves, flaps or switches. Gate 90 is located in the first ducting line 110 and gate 91 is located in the second ducting line 111. In the normal operation state shown in Fig. 3, gate 90 is completely open and gate 91 is completely closed. Thus, all the air flowing into the air ducting system 112, as indicated by arrows 140 and 141 on the left side of Fig. 3, will pass through the first ducting line 110 and exit the air ducting system 112 as indicated by arrow 140 on the right side of Fig. 3. In the normal mode of operation, the adsorbing material is not used at all in the drying process. The drying process in the normal mode is identical to the drying process of a conventional household appliance which is not using an adsorber. Shown in Fig. 3 as in Figs

4 and 5 are further components located in the second ducting line 111 of the air ducting system 112. The adsorbing material 121 may be applied to the walls of the second ducting line 111. Alternatively or additionally, the adsorbing material 122 can be housed in a container 13, which is arranged in the second ducting line 111. In this case, the adsorbing material 122 has the form of particles like beads, pellets or granules. A heater 101 may also be arranged in the second ducting line 111. This heater 101 can serve as heater in the regeneration process and may also support heater 4 in Fig. 2.

[0037] Usually, if the drying cycle is performed in the classical manner, i.e. in the normal mode of operation, it is observed that the drying is rather effective for a certain amount of time. However, towards the end of the drying cycle when a certain amount of humidity has been removed, like 10 - 20 % of humidity still remaining in the compartment for removal, drying speed and condensation rate will decrease. Then, continuing only with the normal mode of operation will lead to a long drying time.

[0038] Fig. 4 is a schematic view of the air ducting system 112 in adsorption state showing the first ducting line 110 and the second ducting line 111. The components and reference numerals are identical to those in Fig. 3. The difference between the normal operation state and the adsorption state is that in the adsorption state, gate 90 is closed and gate 91 is opened. Gate 90 shuts off the air flow 140 entering the first ducting line 110 on the left side of Fig. 4. As gate 91 is open, air flow 141 entering the second ducting line 111 on the left side of Fig. 4 passes by adsorbing material 121 and through container 13 with adsorbing material 120 towards the exit of the second ducting line 111 on the right side of Fig. 4. From there, the air flow follows the duct to compartment 6.

[0039] This adsorption state is most helpful in alleviating the problem occurring towards the end of the drying cycle, when the drying efficiency decreases after much of the humidity has been removed from the compartment with the household items. When switching to the adsorptive state, due to the hygroscopic capacity of the adsorptive material the drying process will also become much faster as compared to the drying process when it is performed in the normal mode of operation, especially towards the end of the drying cycle.

[0040] Fig. 5 is a schematic view of the air ducting system 112 in a third state where gate 90 in the first ducting line 110 is partially closed and gate 91 in the second ducting line 111 is partially open. This third state is considered as a variation of the adsorption state, because the adsorbing material 120, 121 is exposed to the flowing air 141 in this state, like it is in the adsorption state. Thus, the adsorptive material 120, 121 is at least supporting the drying process.

[0041] Fig. 5 further shows an additional heater 100 in the first ducting line 110. This combination of heater 100 in the first ducting line 110 and heater 101 in the second ducting line 111 may support or even replace heater 4 in Fig. 2.

[0042] Fig. 6 is a flowchart explaining the method of operating the air ducting system. In step S1, the drying process starts. In step S2, the drying system is running with the air ducting system 112 in the normal operation state as it is shown in Fig. 2, i.e. without the use of the adsorbing material. In step S3, the controller determines if a first condition for beginning the adsorption step is met. An example of this first condition is that the controller determines if a first predetermined time has already passed. If this condition is not met, the drying system will continue running step S2. On the other hand, if this condition is met, the controller will continue with step S4 and open gate 91 so that humidity in the air flow 141 can be absorbed by the adsorptive material 120, 121.

[0043] In step S5, the controller determines if a second condition for ending the normal operation step is met. An example of this second condition is that the controller determines if a second predetermined time has passed. This second predetermined time can be longer than, the same as or shorter than the first predetermined time. If this condition is not met, the drying system will continue running step S4 with gate 91 open. On the other hand, if the second condition is met, the controller will continue with step S6 and close gate 91 at least partially. It is also possible to close gate 90 gradually over time in step S6. If gate 90 is closed completely in step S6, the air ducting system 112 will be in the adsorptive state of Fig. 4. When gate 90 is closed completely, the controller will also turn off the drying system 2, i.e. the compressor 21 or the corresponding heater. In this state, the drying will be effected only by the adsorptive material. The drying system 2 is no longer needed. Of course, the fan 3 will continue to operate and circulate air through the second ducting line 111, the compartment 6 and the air duct 8, thus running drying in the adsorption state. When the drying system is running in the adsorptive state towards the end of the drying cycle with the drying system 2 turned off, energy consumption of the household appliance is reduced.

[0044] In step S7 the controller 16 will determine if the drying process is completed, e.g. by determining if a third predetermined time has passed or according to the signal of a humidity sensor 15. If the drying process is completed, in step S8, the controller will terminate the drying process and continue in its program cycle by e.g. releasing the door lock of the household appliance 1. In step S9, the drying process ends.

[0045] Fig. 7 is identical to Fig. 6 with the exception of two steps. In Fig. 7, step S3 of Fig. 6 is replaced by step S31 and step S5 is replaced by step S51. All the other steps are identical for both Figs. Their description will not be repeated. In step S31, the controller determines if a signal level of sensor 15 passed a first predetermined threshold value. This passing of the first predetermined threshold value is another example of fulfilment of the first condition. If this first predetermined threshold value has not been passed yet, the drying system will continue running step S2. On the other hand, if the first predetermined

threshold value has been passed, the controller will continue with step S4.

[0046] In step S51, the controller determines if a signal level of sensor 15 passed a second predetermined threshold value. This passing of the second predetermined threshold value is another example of fulfilment of the second condition. If this predetermined threshold value has not been passed yet, the drying system will continue running step S4 with gate 91 open. On the other hand, if the second predetermined threshold value has been passed, the controller will continue with step S6.

[0047] Fig. 8 is also identical to Fig. 6 with the exception of two steps. In Fig. 8, step S3 of Fig. 6 is replaced by step S32 and step S5 is replaced by step S52. All the other steps are identical for both Figs. Their description will not be repeated. In step S32, the controller determines if a signal level of sensor 15 has been in a predetermined first range for a predetermined first time. If this is not the case, the controller 16 will continue running step S2. If the signal level of sensor 15 has been in the predetermined first range for the predetermined first time, the controller 16 will continue with step S4.

[0048] In step S52, the controller determines if a signal level of sensor 15 has been in a predetermined second range for a predetermined second time. If this is not the case, the controller 16 will continue running step S2. If the signal level of sensor 15 has been in the predetermined second range for the predetermined second time, the controller 16 will continue with step S4.

[0049] Fig. 9 is a flowchart of a method used in regenerating the adsorptive material. Basically, the method uses the water, which has been adsorbed in the last drying cycle by the adsorptive material, by releasing it, i.e. by performing the regeneration for the adsorptive material during the next washing cycle. Thus, the fresh-water consumption can be reduced. When the adsorptive material is zeolite, it has to be heated to several hundred degrees Celsius, so that the water which has been adsorbed in the drying cycle is driven out of the adsorptive material in order to prepare it for the next drying cycle.

[0050] In step S11, the next washing cycle and the regeneration cycle are being started. In step S12, the air is being streamed through the second ducting line containing the adsorbing material which is heated in step S13 to a temperature at which it will release the water which has been adsorbed. In step S13, the heater is set to regeneration, i.e. for zeolite, to a higher setting than in the drying mode. It is possible to use a different heater than the air heater which will heat mainly the absorptive material itself, and not so much the air surrounding the adsorptive material. If the adsorptive material is realized in the form of a wall coating, heating wires can be embedded into the wall coating. If the adsorptive material is realized in the form of beads, pellets or granules, the electrical wires of the heater may be arranged in close contact with the beads, pellets or granules. In step S14, the controller 16 determines if the wetting part of the washing cycle has been completed. If this is not the case,

the process continues with steps S13 and S18. In step S18, the wetting process of the washing cycle is being started by admitting freshwater from the water supply line. Step S18 may be started later than steps S12 and S13. In step S15, the wetting process from the water supply line is terminated. The controller may also start the next step in the washing cycle, like rotating the drum compartment to effect laundering in this step S15. In step S16, the controller determines if the regeneration cycle has been completed. If this is not the case, in step S19, the controller 16 switches from feeding the air to the compartment to an alternative exhaust, which may be connected to a water drain line or a condenser. In step S20, like in step S16, the controller 16 determines if the regeneration cycle has been completed. If this is not the case, the controller 16 will continue operating the heater and air flow to the alternative exhaust in step S19. Otherwise, i.e. if the controller has determined that the regeneration cycle has been completed in step S16 or in step S20, in step S17 the controller will ramp down heater and air flow. The combined wetting and regeneration process terminates in step S22.

[0051] Although the present invention has been described in accordance with preferred embodiments, it is obvious for the person skilled in the art that modifications are possible in all embodiments.

Reference Numerals:

[0052]

1, 10	household appliance	
2	drying system	
3	fan	
4	heater	
5	adsorption system	
6	compartment for items to be cleaned	
7	air filter	
8	air duct	
10	household appliance with an adsorber	
15	sensor	
16	controller	
17	sensor connection	
18	connection for guiding/blocking system	
21	compressor (dryer pump)	
22	heat exchanger (condensor)	
23	throttle (strangulation element)	
24	heat exchanger (evaporator)	
51	adsorbing material	
52	guiding and blocking system	
90	guiding and blocking first line	
91	guiding and blocking second line	
100	heater of first line	
101	heater of second line	
110	first ducting line	
111	second ducting line	
112	air ducting system	
120	adsorptive material (beads)	

121	adsorptive material (wall coating)
130	container for adsorptive material
140	air flow first line
141	air flow second line
5 CT	control signal

Claims

1. Air ducting system (112) for a household appliance (1) for cleaning and drying household items, wherein the household appliance (1) comprises a controller (16), an air duct (8) implemented to guide an air flow to a compartment (6) for receiving items to be cleaned,

wherein the air ducting system (112) is implemented to be arranged in the air duct (8) upstream from the compartment (6),
 wherein the air ducting system (112) has a first ducting line (110) and a second ducting line (111), which second ducting line is implemented to contain an adsorptive material (120, 121),
 wherein the first and second ducting lines (110, 111) are provided with first and second blocking devices (90, 91) implemented to open or close the first and second ducting lines (110, 111) in response to a control signal (CT) from the controller (16),
 wherein the air ducting system (112) is implemented to operate in a normal operation state, in which the first ducting line (110) is opened by the first blocking device (90) and the second ducting line (111) is closed by the second blocking device (91) and
 in an adsorption state, in which the second ducting line (111) is opened by the second blocking device (91),
characterized in that the air ducting system (112) is configured to perform a drying process without the use of an adsorber in the normal operation state.

2. Air ducting system (112) according to claim 1, where in the adsorption state, the first ducting line (110) is closed at least partially by the first blocking device (90).

3. Air ducting system (112) according to claim 1 or 2, wherein
 the second ducting line (111) comprises a heater (101).

4. Air ducting system (112) according to any of claims 1 - 3, wherein
 the first ducting line (110) comprises a heater (100).

5. Household appliance (1) for cleaning and drying household items comprising a controller (16), an

air duct (8) implemented to guide an air flow to a compartment (6) for receiving items to be cleaned, an air ducting system (112) implemented to be arranged in the air duct (8) upstream from the compartment (6),

wherein the air ducting system (112) has a first ducting line (110) and a second ducting line (111), which second ducting line is implemented to contain adsorptive material (120, 121), wherein the first and second ducting lines (110, 111) are provided with first and second blocking devices (90, 91) implemented to open or close the first and second ducting lines (110, 111) in response to a control signal (CT) from the controller (16),

wherein the controller (16) is arranged to operate the duct system (112) so that there is a normal operation state, in which the first ducting line (110) is opened by the first blocking device (90) and the second ducting line (111) is closed by the second blocking device (91), and

an adsorption state, in which the second ducting line (111) is opened by the second blocking device (91),

characterized in that the air ducting system (112) is configured to perform a drying process without the use of an adsorber in the normal operation state.

6. Household appliance (1) according to claim 5, wherein

the controller (16) operates the duct system (112) so that in the adsorption state, the first ducting line (110) is at least partially closed by the first blocking device (90).

7. Household appliance (1) according to claim 5 or 6, which is a dishwasher.

8. Household appliance (1) according to claim 5 or 6, which is a washer-dryer for laundry.

9. Method of controlling a household appliance (1) for cleaning and drying household items, the household appliance (1) comprising

a controller (16), an air duct (8) guiding an air flow to a compartment (6) for items to be cleaned and an air ducting system (112) arranged in the air duct (8) upstream from the compartment (6), wherein the air ducting system (112) has a first ducting line (110) and a second ducting line (111), which second ducting line comprises adsorptive material (120, 121), wherein the controller is implemented to open or close the ducting lines (110, 111) at least par-

tially,

the method comprising steps of moving air through the ducting system (112) towards the compartment (6), the steps comprising a normal operation step (S2) in which the controller (16) opens the first ducting line (110) and closes the second ducting line (111), whereby flowing air is passing through the first ducting line (110), and

an adsorption step (S4), in which the controller (16) opens the second ducting line (111), whereby flowing air is passing through the second ducting line (111), wherein

the normal operation step (S2) takes place before the adsorption step (S4),

characterized in that the normal operation step (S2) includes performing a drying process without the use of an adsorber.

10. Method according to claim 9, wherein the adsorption step (S4) comprises a step (S6) of closing the first ducting line (110) at least partially by the controller (16).

11. Method according to claim 9 or 10 comprising

a step of starting of the adsorption step (S4) by the controller (16) after the execution of the normal operation step (S2) for a first predetermined time and

a step (S6) of ending of the normal operation step (S2) by the controller (16) and after the execution of the normal operation step (S2) for a second predetermined time.

12. Method according to claim 9 or 10, comprising

a step of starting of the adsorption step (S4) by the controller (16) after the controller (16) determined that a signal level of a sensor (15) exceeds a first predetermined value and

a step (S6) of ending of the normal operation step (S2) by the controller (16) after the controller (16) determined that a signal level of a sensor (15) exceeds a second predetermined value.

13. Method according to any of claims 9 - 12 comprising

a step of starting of the adsorption step (S4) by the controller (16) after the controller (16) determined that a signal level of a sensor (15) is within a first predetermined range for a third predetermined time and

a step (S6) of ending of the normal operation step (S2) by the controller (16) after the controller (16) determined that a signal level of a sensor (15) is within a second predetermined

range for a fourth predetermined time.

14. Method according to any of claims 9 - 13, wherein the household appliance (1) is arranged to execute both a drying process and a wetting process during which water is being fed to the compartment (6), the method comprising a regeneration step (S12, S13) after the adsorption step (S4), the regeneration step comprising

a step (S12) of flowing air through the second ducting line (111), the second ducting line (111) being opened by the controller (16), and a step (S13) of transporting water by the flowing air, which water is released from the adsorptive material (120, 121) by a heater (4, 101), into the compartment during the wetting process, wherein the water was adsorbed in the adsorption step (S4).

15. A computer program product comprising instructions which, when the program is executed by a controller (16), causes the controller (16) to carry out the method of one of claims 9 - 14.

Patentansprüche

1. Luftführungssystem (112) für ein Haushaltsgerät (1) zum Reinigen und Trocknen von Haushaltsgegenständen, wobei das Haushaltsgerät (1) eine Steuerung (16) umfasst, wobei eine Luftführung (8) so umgesetzt ist, dass sie einen Luftstrom zu einer Kammer (6) zum Aufnehmen von zu reinigenden Gegenständen leitet,

wobei das Luftführungssystem (112) so umgesetzt ist, dass es der Kammer (6) in der Luftführung (8) vorgelagert ist,

wobei das Luftführungssystem (112) eine erste Leitungsstrecke (110) und eine zweite Leitungsstrecke (111) aufweist, wobei die zweite Leitungsstrecke so umgesetzt ist, dass sie ein adsorptives Material (120, 121) enthält,

wobei die erste und die zweite Leitungsstrecke (110, 111) mit einer ersten und einer zweiten Sperrvorrichtung (90, 91) versehen sind, die so umgesetzt sind, dass sie die erste und die zweite Leitungsstrecke (110, 111) als Reaktion auf ein Steuersignal (CT) aus der Steuerung (16) öffnen oder schließen,

wobei das Luftführungssystem (112) so umgesetzt ist, dass es in einem normalen Betriebszustand arbeitet, in dem die erste Leitungsstrecke (110) von der ersten Sperrvorrichtung (90) geöffnet und die zweite Leitungsstrecke (111) von der zweiten Sperrvorrichtung (91) geschlossen wird, und

in einem Adsorptionszustand, in dem die zweite Leitungsstrecke (111) von der zweiten Sperrvorrichtung (91) geöffnet wird,

dadurch gekennzeichnet, dass das Luftführungssystem (112) so ausgelegt ist, dass es ohne Benutzung eines Adsorbers im normalen Betriebszustand einen Trockenprozess durchführt.

2. Luftführungssystem (112) nach Anspruch 1, wobei die erste Leitungsstrecke (110) in dem Adsorptionszustand von der ersten Sperrvorrichtung (90) zumindest teilweise geschlossen wird.

3. Luftführungssystem (112) nach Anspruch 1 oder 2, wobei die zweite Leitungsstrecke (111) eine Heizvorrichtung (101) umfasst.

4. Luftführungssystem (112) nach einem der Ansprüche 1-3, wobei die erste Leitungsstrecke (110) eine Heizvorrichtung (100) umfasst.

5. Haushaltsgerät (1) zum Reinigen und Trocknen von Haushaltsgegenständen, das Folgendes umfasst:

eine Steuerung (16), eine Luftführung (8), die so umgesetzt ist, dass sie einen Luftstrom zu einer Kammer (6) zum Aufnehmen von zu reinigenden Gegenständen leitet, wobei ein Luftführungssystem (112) so umgesetzt ist, dass es der Kammer (6) in der Luftführung (8) vorgelagert ist,

wobei das Luftführungssystem (112) eine erste Leitungsstrecke (110) und eine zweite Leitungsstrecke (111) aufweist, wobei die zweite Leitungsstrecke so umgesetzt ist, dass sie ein adsorptives Material (120, 121) enthält,

wobei die erste und die zweite Leitungsstrecke (110, 111) mit einer ersten und einer zweiten Sperrvorrichtung (90, 91) versehen sind, die so umgesetzt sind, dass sie die erste und die zweite Leitungsstrecke (110, 111) als Reaktion auf ein Steuersignal (CT) aus der Steuerung (16) öffnen oder schließen,

wobei die Steuerung (16) so angeordnet ist, dass sie das Führungssystem (112) so betreibt, dass es

einen normalen Betriebszustand gibt, in dem die erste Leitungsstrecke (110) von der ersten Sperrvorrichtung (90) geöffnet und die zweite Leitungsstrecke (111) von der zweiten Sperrvorrichtung (91) geschlossen wird, und

einen Adsorptionszustand gibt, in dem die zweite Leitungsstrecke (111) von der zweiten Sperrvorrichtung (91) geöffnet wird,

dadurch gekennzeichnet, dass das Luftfüh-

nungssystem (112) so ausgelegt ist, dass es ohne Benutzung eines Adsorbers im normalen Betriebszustand einen Trockenprozess durchführt.

6. Haushaltsgerät (1) nach Anspruch 5, wobei die Steuerung (16) das Führungssystem (112) so betreibt, dass die erste Leitungsstrecke (110) in dem Adsorptionszustand von der ersten Sperrvorrichtung (90) zumindest teilweise geschlossen wird. 10
7. Haushaltsgerät (1) nach Anspruch 5 oder 6, bei dem es sich um einen Geschirrspüler handelt.
8. Haushaltsgerät (1) nach Anspruch 5 oder 6, bei dem es sich um einen Waschtrockner für Wäsche handelt. 15
9. Verfahren zum Steuern eines Haushaltsgeräts (1) zum Reinigen und Trocknen von Haushaltsgegenständen, wobei das Haushaltsgerät (1) Folgendes umfasst: 20
eine Steuerung (16), eine Luftführung (8), die einen Luftstrom zu einer Kammer (6) für zu reinigende Gegenstände leitet, und ein Luftführungssystem (112), das der Kammer (6) in der Luftführung (8) vorgelagert ist, 25
wobei das Luftführungssystem (112) eine erste Leitungsstrecke (110) und eine zweite Leitungsstrecke (111) aufweist, wobei die zweite Leitungsstrecke adsorptives Material (120, 121) enthält, 30
wobei die Steuerung so umgesetzt ist, dass sie die Leitungsstrecken (110, 111) zumindest teilweise öffnet oder schließt, 35
wobei das Verfahren Schritte zum Bewegen von Luft durch das Führungssystem (112) zu der Kammer (6) umfasst, die Folgendes umfassen: 40
einen Normalbetriebsschritt (S2), bei dem die Steuerung (16) die erste Leitungsstrecke (110) öffnet und die zweite Leitungsstrecke (111) schließt, wodurch Luft durch die erste Leitungsstrecke (110) hindurchströmt, und 45
einen Adsorptionsschritt (S4), bei dem die Steuerung (16) die zweite Leitungsstrecke (111) öffnet, wodurch Luft durch die zweite Leitungsstrecke (111) hindurchströmt, wobei 50
der Normalbetriebsschritt (S2) vor dem Adsorptionsschritt (S4) stattfindet, 55
dadurch gekennzeichnet, dass der Normalbetriebsschritt (S2) das Durchführen eines Trockenprozesses ohne Benutzung eines Adsorbers umfasst.

10. Verfahren nach Anspruch 9, wobei der Adsorptionsschritt (S4) einen Schritt (S6) umfasst, bei dem die erste Leitungsstrecke (110) von der Steuerung (16) zumindest teilweise geschlossen wird.

11. Verfahren nach Anspruch 9 oder 10, das Folgendes umfasst:

einen Schritt, bei dem der Adsorptionsschritt (S4) von der Steuerung (16) nach dem Ausführen des Normalbetriebsschritts (S2) für eine erste vorgegebene Zeit gestartet wird, und einen Schritt (S6), bei dem der Normalbetriebsschritt (S2) von der Steuerung (16) nach dem Ausführen des Normalbetriebsschritts (S2) für eine zweite vorgegebene Zeit beendet wird.

12. Verfahren nach Anspruch 9 oder 10, das Folgendes umfasst:

einen Schritt, bei dem der Adsorptionsschritt (S4) von der Steuerung (16) gestartet wird, nachdem sie bestimmt hat, dass ein Signalpegel eines Sensors (15) einen ersten vorgegebenen Wert übersteigt, und einen Schritt (S6), bei dem der Normalbetriebsschritt (S2) von der Steuerung (16) beendet wird, nachdem sie bestimmt hat, dass ein Signalpegel eines Sensors (15) einen zweiten vorgegebenen Wert übersteigt.

13. Verfahren nach Anspruch 9-12, das Folgendes umfasst:

einen Schritt, bei dem der Adsorptionsschritt (S4) von der Steuerung (16) gestartet wird, nachdem sie bestimmt hat, dass ein Signalpegel eines Sensors (15) für eine dritte vorgegebene Zeit innerhalb eines ersten vorgegebenen Bereichs liegt, und einen Schritt (S6), bei dem der Normalbetriebsschritt (S2) von der Steuerung (16) beendet wird, nachdem sie bestimmt hat, dass ein Signalpegel eines Sensors (15) für eine vierte vorgegebene Zeit innerhalb eines zweiten vorgegebenen Bereichs liegt.

14. Verfahren nach einem der Ansprüche 9-13, wobei das Haushaltsgerät (1) so angeordnet ist, dass es sowohl einen Trockenprozess als auch einen Befeuchtungsprozess durchführt, bei dem Wasser in die Kammer (6) geleitet wird, wobei das Verfahren nach dem Adsorptionsschritt (S4) einen Regenerationsschritt (S12, S13) umfasst, der Folgendes umfasst:

einen Schritt (S12), bei dem Luft durch die zweite Leitungsstrecke (111) geleitet wird, wobei die

zweite Leitungsstrecke (111) von der Steuerung (16) geöffnet wird, und einen Schritt (S13), bei dem von der strömenden Luft Wasser, das mit einer Heizvorrichtung (4, 101) aus dem adsorptiven Material (120, 121) freigesetzt wird, bei dem Befeuchtungsprozess in die Kammer transportiert wird, wobei das Wasser bei dem Adsorptionsschritt (S4) adsorbiert wurde.

15. Computerprogrammprodukt, das Anweisungen umfasst, die, wenn das Programm von einer Steuerung (16) ausgeführt wird, bewirken, dass die Steuerung (16) das Verfahren nach einem der Ansprüche 9-14 durchführt.

Revendications

1. Système de conduite d'air (112) pour un appareil électroménager (1) pour le nettoyage et le séchage d'articles ménagers, dans lequel l'appareil électroménager (1) comprend un contrôleur (16), une conduite d'air (8) mise en œuvre pour guider un flux d'air à un compartiment (6) pour réceptionner des articles à nettoyer,
- dans lequel le système de conduite d'air (112) est mis en œuvre pour trouver place dans la conduite d'air (8) en amont du compartiment (6), dans lequel le système de conduite d'air (112) présente une première canalisation de conduite (110) et une deuxième canalisation de conduite (111), laquelle deuxième canalisation de conduite est mise en œuvre pour contenir une matière adsorbante (120, 121), dans lequel la première et deuxième canalisations de conduite (110, 111) sont dotées de premier et deuxième dispositifs de blocage (90, 91) mis en œuvre pour ouvrir ou fermer les première et deuxième canalisations de conduite (110, 111) en réponse à un signal de commande (CT) du contrôleur (16), dans lequel le système de conduite d'air (112) est mis en œuvre pour fonctionner dans un état de marche normale, dans lequel la première canalisation de conduite (110) est ouverte par le premier dispositif de blocage (90) et la deuxième canalisation de conduite (111) est fermée par le deuxième dispositif de blocage (91) et dans un état d'adsorption, dans lequel la deuxième canalisation de conduite (111) est ouverte par le deuxième dispositif de blocage (91), **caractérisé en ce que** le système de conduite d'air (112) est configuré pour réaliser un processus de séchage sans l'utilisation d'un adsorbant dans l'état de marche normale.

2. Système de conduite d'air (112) selon la revendication 1, dans lequel à l'état d'adsorption, la première canalisation de conduite (110) est fermée au moins partiellement par le premier dispositif de blocage (90).
3. Système de conduite d'air (112) selon la revendication 1 ou 2, dans lequel la deuxième canalisation de conduite (111) comprend un dispositif de chauffage (101).
4. Système de conduite d'air (112) selon l'une quelconque des revendications 1-3, dans lequel la première canalisation de conduite (110) comprend un dispositif de chauffage (100).
5. Appareil électroménager (1) pour le nettoyage et le séchage d'articles ménagers comprenant

un contrôleur (16), une conduite d'air (8) mise en œuvre pour guider un flux d'air à un compartiment (6) pour réceptionner des articles à nettoyer, un système de conduite d'air (112) mis en œuvre pour trouver place dans la conduite d'air (8) en amont du compartiment (6), dans lequel le système de conduite d'air (112) présente une première canalisation de conduite (110) et une deuxième canalisation de conduite (111), laquelle deuxième canalisation de conduite est mise en œuvre pour contenir une matière adsorbante (120, 121), dans lequel les première et deuxième canalisations de conduite (110, 111) sont dotées de premier et deuxième dispositifs de blocage (90, 91) mis en œuvre pour ouvrir ou fermer les première et deuxième canalisations de conduite (110, 111) en réponse à un signal de commande (CT) du contrôleur (16), dans lequel le contrôleur (16) est organisé pour faire fonctionner le système de conduite (112) de sorte qu'il y a un état de marche normale, dans lequel la première canalisation de conduite (110) est ouverte par le premier dispositif de blocage (90) et la deuxième canalisation de conduite (111) est fermée par le deuxième dispositif de blocage (91) et

un état d'adsorption, dans lequel la deuxième canalisation de conduite (111) est ouverte par le deuxième dispositif de blocage (91), **caractérisé en ce que** le système de conduite d'air (112) est configuré pour réaliser un processus de séchage sans l'utilisation d'un adsorbant dans l'état de marche normale.

6. Appareil électroménager (1) selon la revendication 5, dans lequel le contrôleur (16) fait fonctionner le système de conduite (112) de sorte que dans l'état d'adsorption, la première canalisation de conduite (110) est au moins partiellement fermée par le premier dispositif de blocage (90). 5
7. Appareil électroménager (1) selon la revendication 5 ou 6, lequel est un lave-vaisselle. 10
8. Appareil électroménager (1) selon la revendication 5 ou 6, lequel est une machine à laver séchante pour du linge. 15
9. Procédé de commande d'un appareil électroménager (1) pour le nettoyage et le séchage d'articles ménagers, l'appareil électroménager (1) comprenant 20
- un contrôleur (16), une conduite d'air (8) guidant un flux d'air à un compartiment (6) pour des articles à nettoyer et un système de conduite d'air (112) agencé dans la conduite d'air (8) en amont du compartiment (6), dans lequel le système de conduite d'air (112) présente une première canalisation de conduite (110) et une deuxième canalisation de conduite (111), laquelle deuxième canalisation de conduite comprend une matière adsorbante (120, 121), dans lequel le contrôleur est mis en œuvre pour ouvrir ou fermer les canalisations de conduite (110, 111) au moins partiellement, le procédé comprenant les étapes de déplacement d'air à travers le système de conduite (112) vers le compartiment (6), les étapes comprenant une étape de marche normale (S2) dans laquelle le contrôleur (16) ouvre la première canalisation de conduite (110) et ferme la deuxième canalisation de conduite (111), ce qui fait que l'air s'écoulant passe à travers la première canalisation de conduite (110) et une étape d'adsorption (S4) dans laquelle le contrôleur (16) ouvre la deuxième canalisation de conduite (111), ce qui fait que l'air s'écoulant passe à travers la deuxième canalisation de conduite (111), dans lequel l'étape de marche normale (S2) a lieu avant l'étape d'adsorption (S4), 25 30 35 40 45 50
- caractérisé en ce que** l'étape de marche normale (S2) comprend un processus de séchage sans l'utilisation d'un adsorbant.
10. Procédé selon la revendication 9, dans lequel l'étape d'adsorption (S4) comprend une étape (S6) de fermeture de la première canalisation de conduite (110) au moins partiellement par le contrôleur (16). 55
11. Procédé selon la revendication 9 ou 10 comprenant une étape de démarrage de l'étape d'adsorption (S4) par le contrôleur (16) après l'exécution de l'étape de marche normale (S2) pour une première durée prédéterminée et une étape (S6) de fin de l'étape de marche normale (S2) par le contrôleur (16) et après l'exécution de l'étape de marche normale (S2) pour une deuxième durée prédéterminée.
12. Procédé selon la revendication 9 ou 10 comprenant une étape de démarrage de l'étape d'adsorption (S4) par le contrôleur (16) après que le contrôleur (16) a déterminé qu'un niveau de signal d'un capteur (15) excède une première valeur prédéterminée et une étape (S6) de fin de l'étape de marche normale (S2) par le contrôleur (16) après que le contrôleur (16) a déterminé qu'un niveau de signal d'un capteur (15) excède une deuxième valeur prédéterminée.
13. Procédé selon l'une quelconque des revendications 9-12 comprenant une étape de démarrage de l'étape d'adsorption (S4) par le contrôleur (16) après que le contrôleur (16) a déterminé qu'un niveau de signal d'un capteur (15) se trouve dans un premier intervalle prédéterminé pour une troisième durée prédéterminée et une étape (S6) de fin de l'étape de marche normale (S2) par le contrôleur (16) après que le contrôleur (16) a déterminé qu'un niveau de signal d'un capteur (15) se trouve dans un deuxième intervalle prédéterminé pour une quatrième durée prédéterminée.
14. Procédé selon l'une quelconque des revendications 9-13, dans lequel l'appareil électroménager (1) est organisé pour exécuter à la fois un processus de séchage et un processus de mouillage pendant lequel de l'eau est introduite dans le compartiment (6), le procédé comprenant une étape de régénération (S12, S13) après l'étape d'adsorption (S4), l'étape de régénération comprenant une étape (S12) d'afflux d'air à travers la deuxième canalisation de conduite (111), la deuxième canalisation de conduite (111) étant ouverte par le contrôleur (16) et une étape (S13) de transport de l'eau par l'afflux d'air, laquelle eau est libérée de la matière adsorbante (120, 121) par un dispositif de chauffage (4, 101), dans le compartiment pendant le processus de mouillage, dans lequel l'eau a été

adsorbée dans l'étape d'adsorption (S4).

15. Produit de programmation informatique comprenant des instructions qui, quand le programme est exécuté par un contrôleur (16), amène le contrôleur (16) à exécuter le procédé de l'une des revendications 9-14. 5

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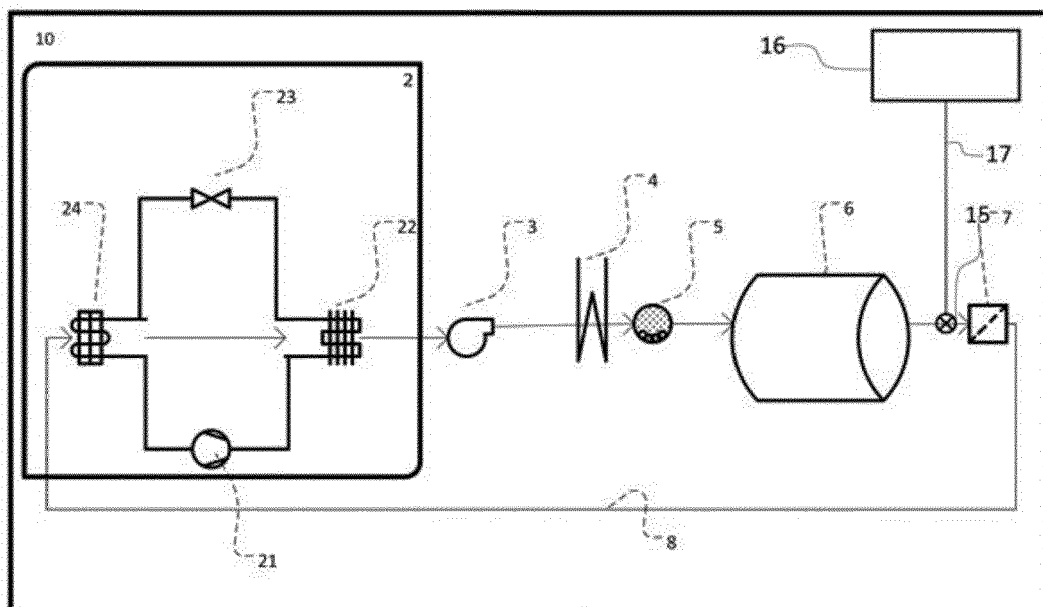


Fig. 1

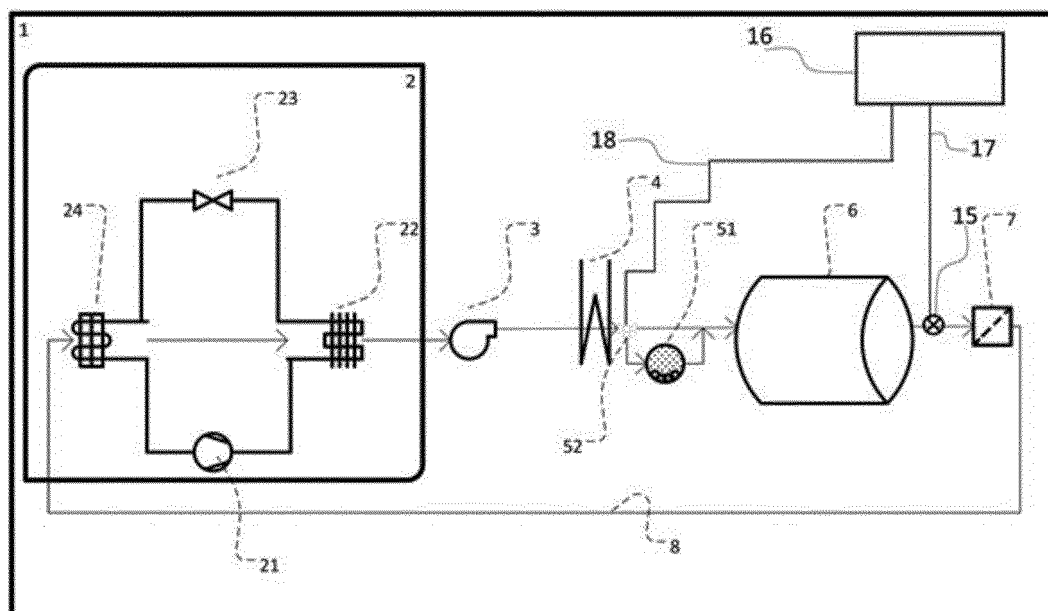


Fig. 2

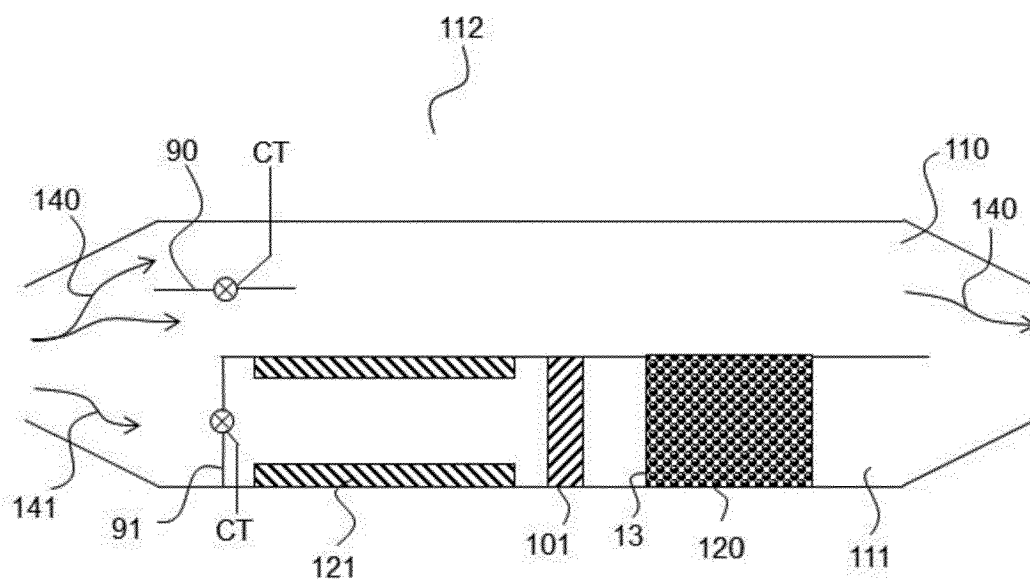


Fig. 3

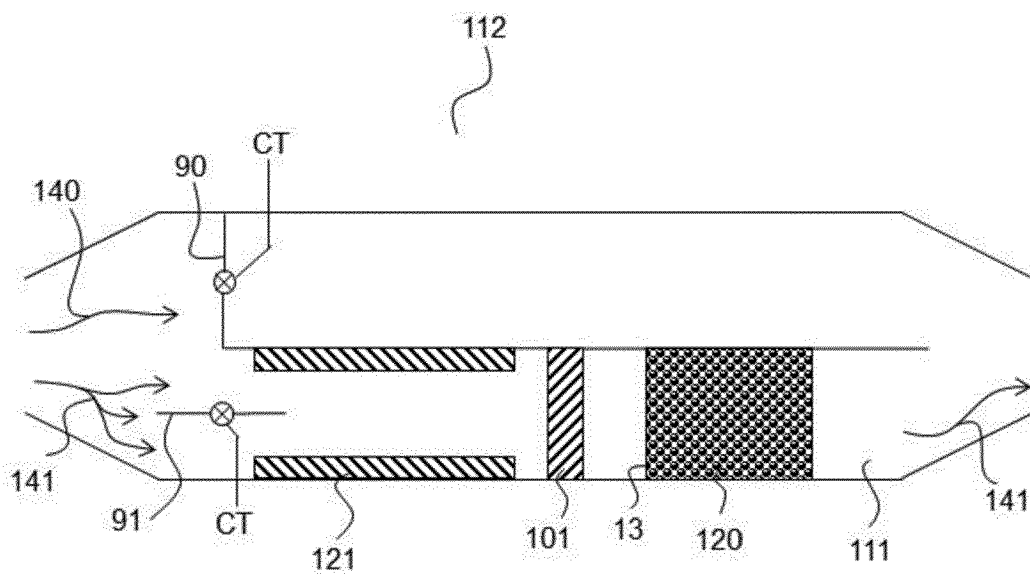


Fig. 4

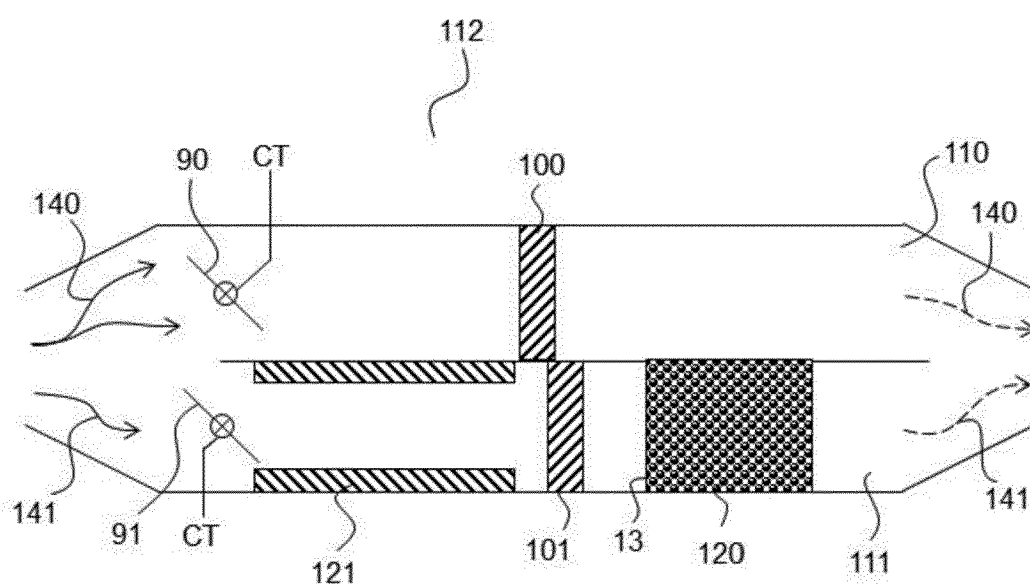


Fig. 5

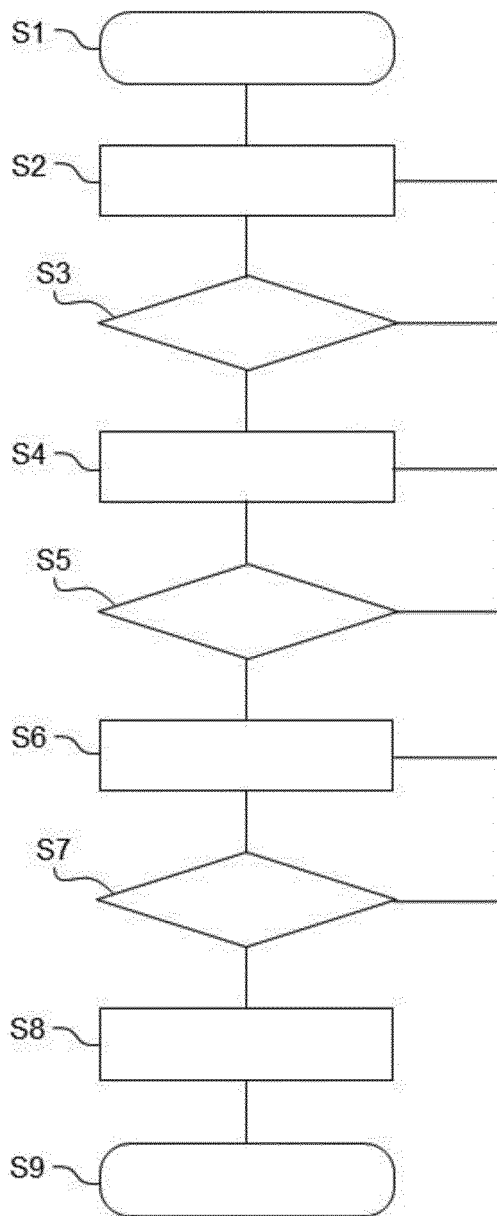


Fig. 6

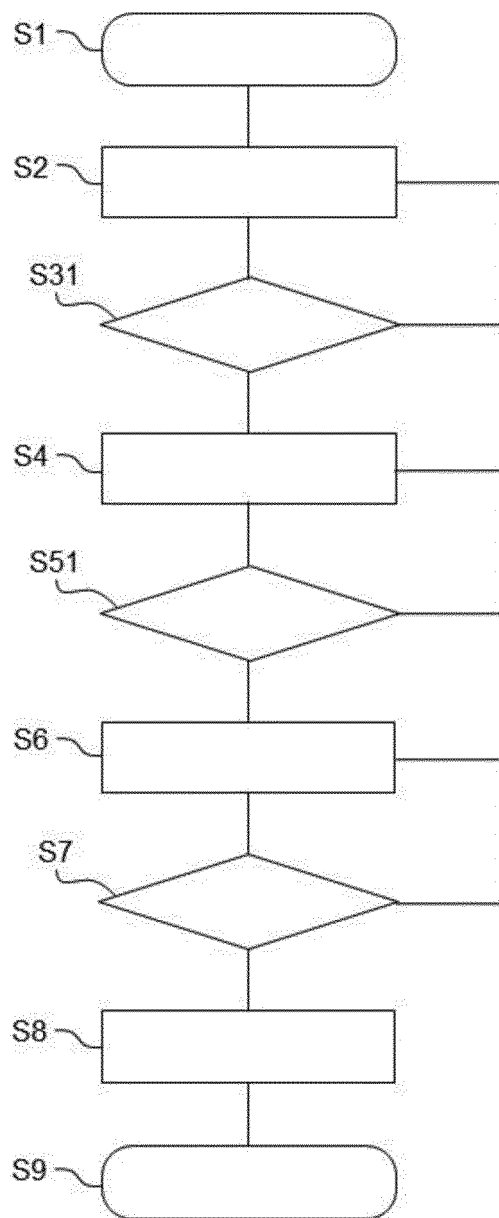


Fig. 7

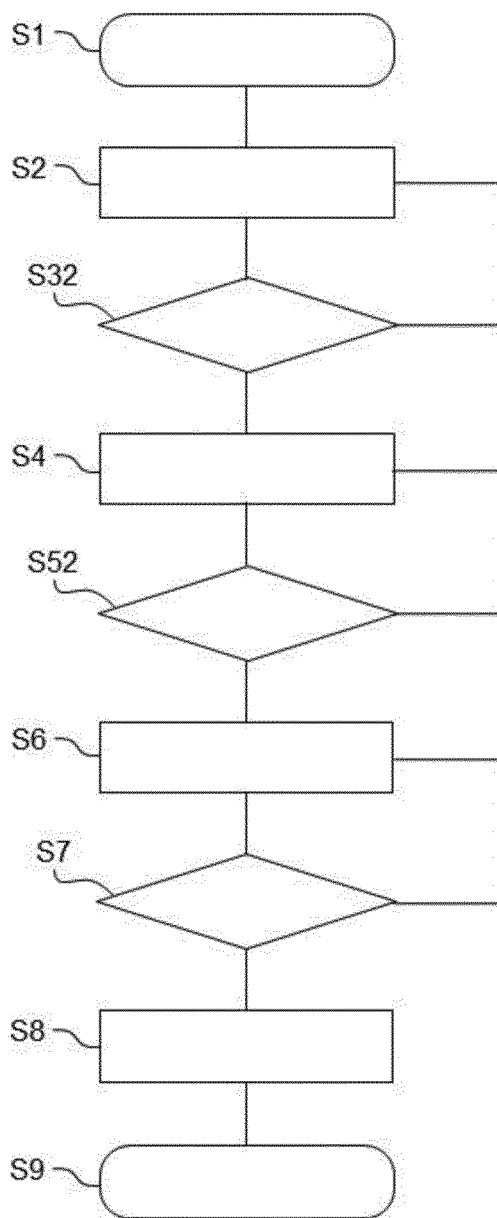


Fig. 8

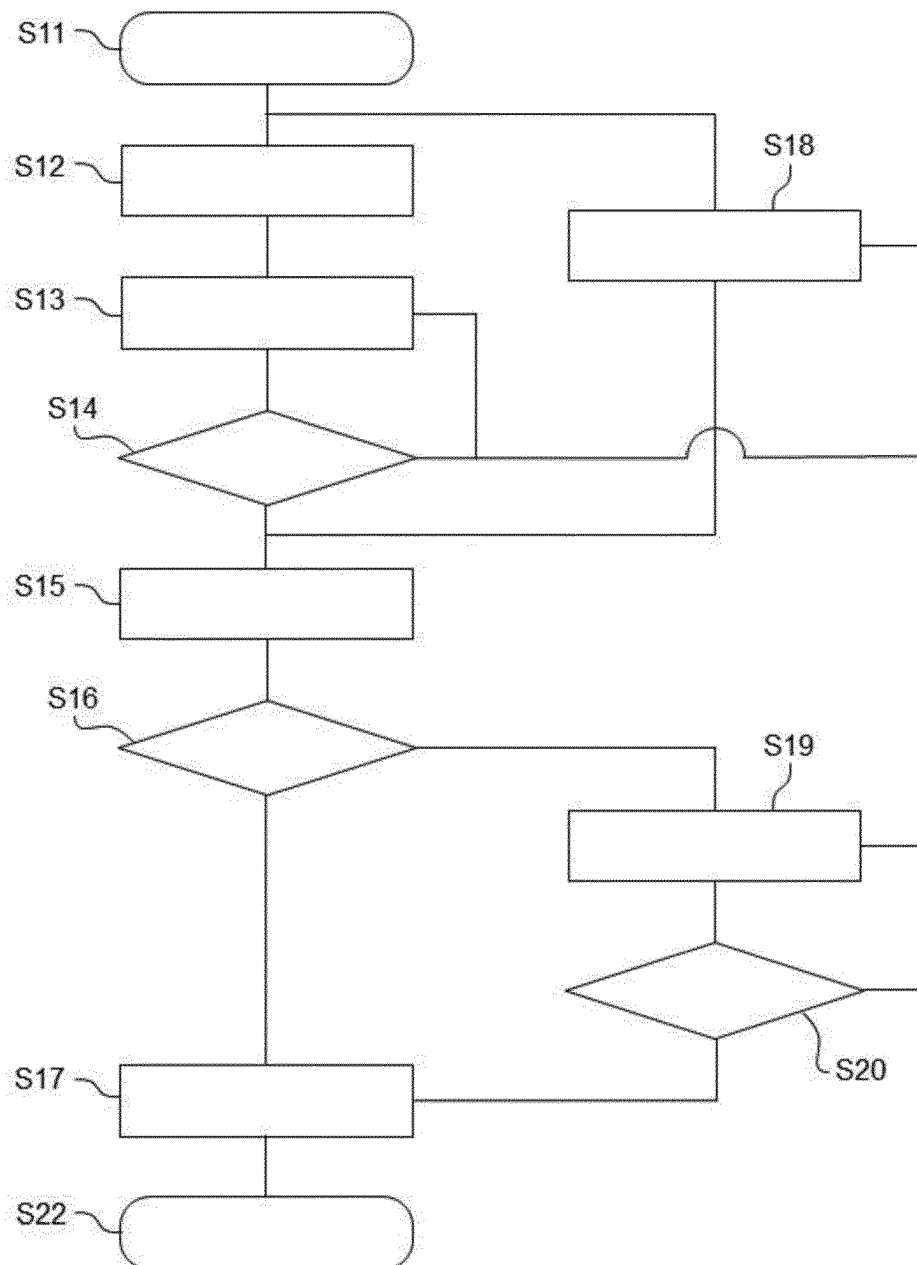


Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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