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(54) **Laundry care device with an air passageway**

(57) A laundry care device 1 with a drying program for realizing a drying procedure through heat exchange between heated air and clothes includes an air passageway 7, 15 for circulation or ventilation of the air, and a resonance sound reduction means 8 is disposed in the air passageway 7, 15. Since the resonance sound reduction means 8 is disposed in the air passageway 7, 15, when being ventilated in the air passageway 7, 15, the air resonates with air in a sealing cavity, sound energy formed during the air ventilation is consumed by utilizing air resonance, thereby reducing a dynamic airflow noise generated during the air ventilation.

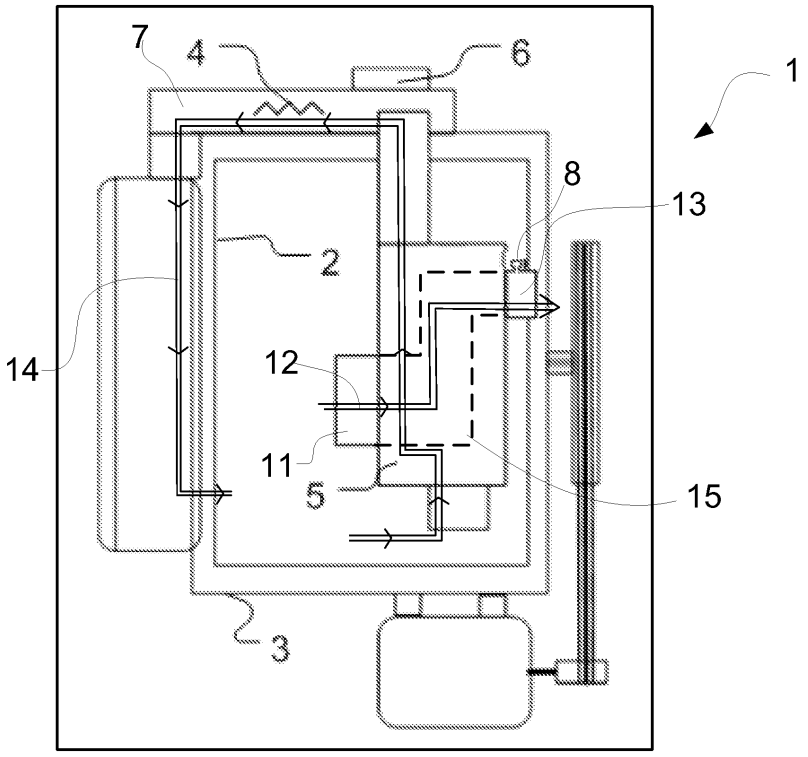

Fig. 1

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Description

[0001] The present invention relates to a laundry care device, and more particularly to a laundry care device with a drying program.

[0002] It is well-known that a drying operation procedure of a conventional laundry care device with a drying program is as follows: Firstly, air is heated through a heating device, thereby heating the air into high-temperature and low-humidity hot air; secondly, the high-temperature and low-humidity hot air is transmitted into a rotating drum where a user places clothes under the action of a circulation device, and exchanges heat with the clothes in the drum, thereby taking away moisture contained in the clothes and forming low-temperature and high-humidity hot air; thirdly, after being exhausted, the low-temperature and high-humidity air enters a condensation device, and then under the action of the condensation device, moisture contained in the low-temperature and high-humidity hot air is fully condensed into water, so that the low-temperature and high-humidity hot air becomes low-temperature low-humidity hot air; finally, the low-temperature low-humidity hot air is reheated into the high-temperature and low-humidity hot air through the heating device under the driving of the circulation device, and enters a next circulation. In this way, the circulation is continuous; the moisture contained in the clothes is continuously absorbed by the high-temperature and low-humidity hot air, the clothes being gradually dried thereby. Generally, the air used for drying clothes is circulated and ventilated in a drying air circulation loop relatively independent of a condensation device, and an air passageway separate from the drying air circulation loop also exists in a condensation device with water or air or a mixture of the both as a condensation medium, particularly as far as a condensation device with air or a mixture of air and water as a condensation medium is concerned. However, in order to increase the drying and condensation efficiency, manufacturers realize the efficiency increase by increasing the airflow amount of the air ventilation, and accordingly, the increase of the airflow amount inevitably brings a certain disadvantage, that is, the dynamic airflow noise formed by the air ventilation is also larger and larger. Therefore, the airflow noise generated by the air ventilation is also an important factor influencing the integral noise of the laundry care device, and how to control such noise is also more and more important.

[0003] Accordingly, the present invention is directed to an improved laundry care device with a drying program, which reduces an airflow noise generated by the device due to air ventilation as much as possible when the drying program is executed, thereby controlling an integral noise of the device within an allowable range.

[0004] In order to comply with the purpose, the present invention is implemented in the following manner: a laundry care device with a drying program for executing a drying procedure through heat exchange between heated air and clothes includes an air passageway for guiding the air, and a resonance sound reduction means disposed in the air passageway.

[0005] As a preferable embodiment of the invention, the air passageway is a drying air passageway for ventilating drying air for heat exchange with the clothes. More preferred, this air passageway is a closed passageway. This preferred embodiment notwithstanding, a laundry care device with an open drying air passageway is also deemed to be included in the scope of the invention.

[0006] As another preferable embodiment of the invention, the air passageway comprises a condensation device for ventilating condensation air through the condensation device, to implement a condensation procedure by heat exchange between the drying air and the condensation air. As an even more preferable embodiment of the invention, the resonance sound reduction means is disposed adjacent to the condensation device. As a still more preferable embodiment of the invention, the resonance sound reduction means is disposed at an air outlet end of the condensation device in the air passageway.

[0007] As a further preferable embodiment of the invention, the air passage is a condensation air passage provided for ventilating the condensation air through said condensation device. As a more preferred embodiment, the condensation air passage s open.

[0008] As yet another preferable embodiment of the invention, the resonance sound reduction means includes a sealing cavity and the sealing cavity is connected with the air passageway through a neck tube. This embodiment provides the resonance sound reduction means in the form of a Helmholtz resonator. As a more preferable embodiment of the invention, a cross section of the neck tube is smaller than that of the sealing cavity. As a still more preferable embodiment of the invention, a sound absorbing material is filled in the sealing cavity.

[0009] As yet another preferable embodiment of the invention, plural resonance sound reduction means are disposed in the air passageway. As a more preferable embodiment of the invention, the plural resonance sound reduction means are connected in series to each other along the air passageway. As a still more preferable embodiment of the invention, the plural resonance sound reduction means have different resonance frequencies.

[0010] Beneficial effects of the present invention include the following: Since the resonance sound reduction means is disposed in the air passageway, when being ventilated in the air passageway, the air resonates with air in a sealing cavity, sound energy formed during the air ventilation is consumed by utilizing air resonance, thereby reducing a dynamic airflow noise generated during the air ventilation.

[0011] Particularly preferred embodiments of the inventive laundry care device are now described with reference to the Figures of the attached drawing, wherein:

FIG. 1 is a schematic view of a laundry care device according to an embodiment;

FIG. 2 is a schematic view of the resonance sound reduction means in the embodiment shown in Fig. 1; and

FIG. 3 is a schematic view of an air passageway with a plurality of resonance sound reduction means attached.

[0012] Referring to FIG. 1, a laundry care device 1 with a drying program may be a clothes dryer 1 only having a drying function, or may also be a clothes washer and dryer 1 having washing and drying functions. Taking the clothes washer and dryer 1 as an example, it includes a drum 2 where a user places clothes to be washed or dried and a tub 3 accommodating the drum 2 and washing water, and further includes a heating device 4 for heating air, a condensation device 5 for condensing air completing heat exchange with the clothes and an air circulation device 6 for facilitating air circulation disposed outside the tub 3. A drying air passageway 7 is provided to guide drying air 14 in a loop substantially closed in itself. The heating device 4 and the air circulation device 6 are disposed in the drying air passageway 7. Further, the drying air passageway 7 includes the tub 3 for guiding air therethrough. Thus, the drum 2, the tub 3, the heating device 4 and the air circulation device 6 form the drying air passageway 7 for drying air circulation and ventilation. As a preferable embodiment, the laundry care device 1 with the drying program adopts air as a condensation medium, and definitely may also adopt water and air as the condensation medium, or adopt other flowing gas as the condensation medium. The condensation device 5 is a heat exchanger for exchanging heat with condensation air ventilated to the condensation device 5 through a condensation air passageway 15. The condensation air passageway 15 is relatively independent of the drying air passageway 7 but placed in heat exchanging relation with the latter through the condensation device 5. In order to facilitate circulation of condensation air 12 used to exchange heat with the drying air 14 after passing the drum 2 and to condense humidity contained therein, a condensation air circulation device not shown for simplicity is further disposed in the condensation air passageway 15. Preferably, the condensation air passageway 15 is an open passageway, that is, both an air inlet 11 and an air outlet 13 of the condensation air passageway 15 are directly in communication with outside air in the ambient of the laundry care device 1. Under the action of the condensation air circulation device, outside cool air is inhaled from the air inlet 11 of the condensation air passageway 15, enters the condensation device 5 to exchange heat with humid air in the drying air passageway 7, and then is exhausted from the air outlet 13 of the condensation air passageway 15.

[0013] When the laundry care device 1 executes the drying program, the air in the drying air passageway 7, maybe also the air in the condensation air passageway 15, inevitably generates a dynamic airflow noise during ventilation, and in order to reduce such noise, a resonance sound reduction means 8 is further disposed in the drying air passageway 7 and/or condensation air passageway 15. The drying air passageway 7 is an essentially closed isolated loop relative to the outside air, the airflow noise formed in the drying air passageway is basically constrained in a device case, while the condensation air passageway 15 is directly in communication with the outside air, so preferably, the resonance sound reduction means 8 is disposed in the condensation air passageway 15. More preferably, the resonance sound reduction means 8 is disposed on an air outlet 13 of the condensation air passageway 15.

[0014] Referring to FIG. 2, the resonance sound reduction means 8 includes a sealing cavity 9 in communication with the drying air passageway 7, and the sealing cavity 9 is in communication with the air passageway 7 through a neck tube 10, in which a cross section of the neck tube 10 is smaller than that of the sealing cavity 9. Flow directions of condensation air 12 and of drying air 14 are shown by arrows. In this way, when the resonance sound reduction means 8 is not disposed, the air is freely ventilated in the air passageway 7 to form a certain dynamic airflow noise. However, after the resonance sound reduction means 8 is disposed, and when the airflow is passing through the neck tube 10, gas with a certain density is already filled in the sealing cavity 9 and the neck tube 10; an air column in the neck tube 10 is similar to a piston and has a certain acoustic mass, while the air in the sealing cavity 9 forms an air spring and has a certain acoustic compliance, and the both form a resonance system. Therefore, when the airflow passes through the neck tube 10, the air column in the neck tube 10 generates vibration, friction damping during the vibration makes sound energy be converted into thermal energy to be dissipated, thereby enabling the total amount of the sound energy to be reduced, so as to comply with the purpose of reducing the noise. In order to provide the friction damping during the vibration, some sound absorbing materials 9a may be further filled in the sealing cavity 9.

[0015] Reference is now made to Fig. 3. In order to further reduce the airflow noise formed by the air during the ventilation, and expand the sound reduction frequency of the resonance sound reduction means, a plurality of resonance sound reduction means 8a, 8b, 8c which may have different resonance frequencies may be further connected in series and disposed in the drying air passageway 7 or condensation air passageway 15.

[0016] Definitely, the above listed embodiments are only preferable embodiments of the present invention, and the present invention may further include many other embodiments. As far as persons of ordinary skill in the art are concerned, equivalent changes on the present invention made under the teaching of the present invention still should fall within the scope of claims of the present invention.

REFERENCE NUMERALS

[0017]

1	laundry care device
2	drum
3	tub
4	heating device
5	condensation device
6	air circulation device
7	drying air passageway
8	sound reduction means
8a	sound reduction means
8b	sound reduction means
8c	sound reduction means
9	sealing cavity
9a	sound absorbing material
10	neck tube
11	air inlet
12	condensation air
13	air outlet
14	drying air
15	condensation air passageway

Claims

1. A laundry care device (1) with a drying program for executing a drying procedure through heat exchange between heated air and clothes, comprising an air passageway (7, 15), **characterized in that** a resonance sound reduction means (8) is disposed in the air passageway (7, 15).

2. Laundry care device (1) according to claim 1, **characterized in that** the air passageway (7, 15) is a drying air passageway (7) for ventilating drying air for heat exchange with the clothes.

3. Laundry care device (1) according to claim 2, **characterized in that** said drying air passageway (7) is substantially closed in itself.

4. Laundry care device (1) according to any preceding claim, **characterized in that** the air passageway (7, 15) comprises a condensation device (5) for ventilating condensation air through the condensation device (5), to implement a condensation procedure by heat exchange between the drying air and the condensation air.

5. Laundry care device (1) according to claim 4, **characterized in that** the resonance sound reduction means (8) is disposed adjacent to the condensation device (5).

6. Laundry care device (1) according to claim 5, **characterized in that** the resonance sound reduction means (8) is disposed at an air outlet end of said condensation device (5) in said air passageway (15).

7. Laundry care device (1) according to any of claims 4 to 6, **characterized in that** said air passage (7, 15) is a condensation air passage (15) provided for ventilating the condensation air through said condensation device (5).

8. Laundry care device (1) according to claim 7, **characterized in that** said condensation air passage (15) is open.

9. Laundry care device (1) according to any preceding claim, **characterized in that** the resonance sound reduction means (8) comprises a sealing cavity (9) and the sealing cavity (9) is connected with the air passageway (7, 15) through a neck tube (10).

10. Laundry care device (1) according to claim 9, **characterized in that** a cross section of the neck tube (10) is smaller than that of the sealing cavity (9).

11. Laundry care device (1) according to one of claims 9 and 10, **characterized in that** a sound absorbing material (9a) is filled in the sealing cavity (9).

12. Laundry care device (1) according to any preceding claim, **characterized in that** plural resonance sound reduction means (8a, 8b, 8c) are disposed in the air passageway (7, 15).

13. Laundry care device (1) according to claim 12, **characterized in that** the plural resonance sound reduction means (8a, 8b, 8c) are connected in series to each other along said air passageway (7, 15).

14. Laundry care device (1) according to one of claims 12 and 13, **characterized in that** the plural resonance sound reduction means (8, 8b, 8c) have dif-

ferent resonance frequencies.

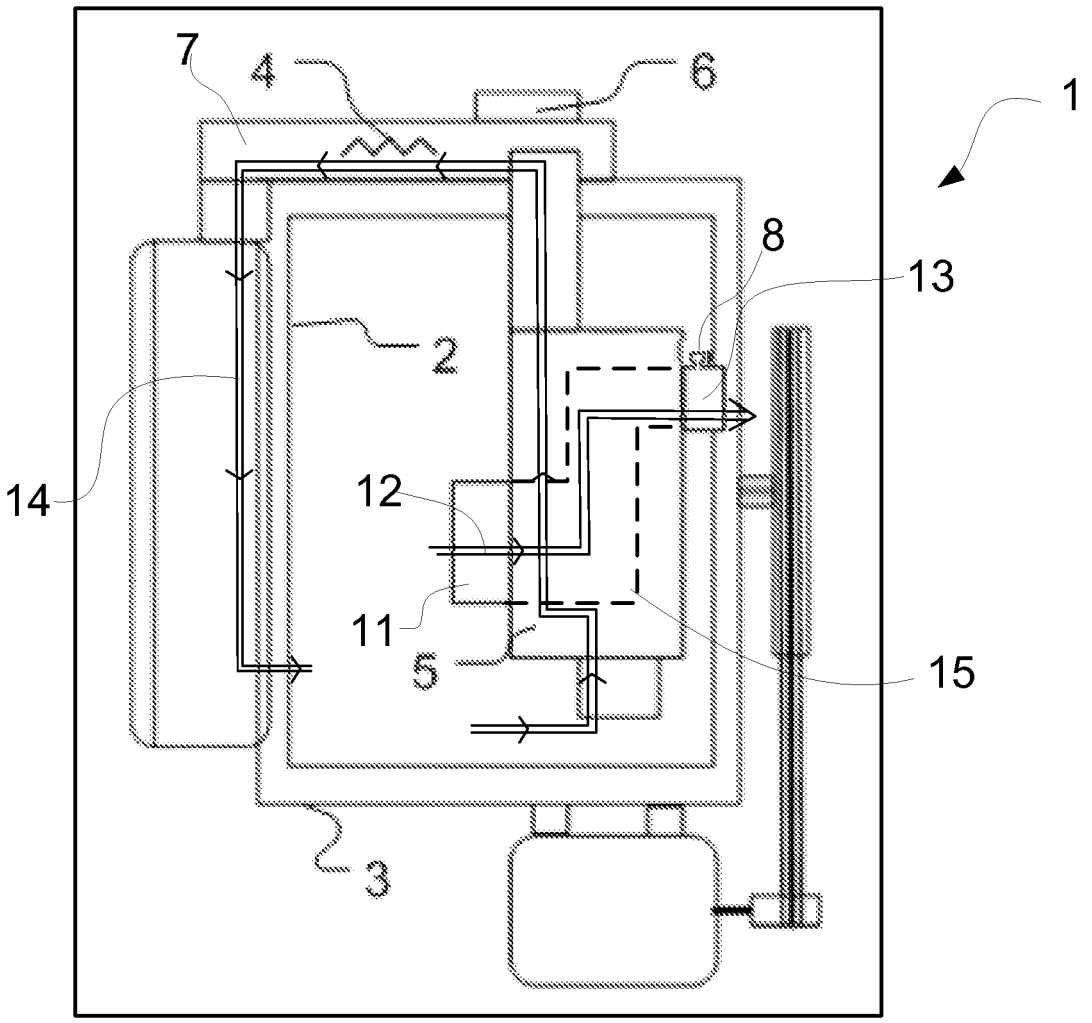

Fig. 1

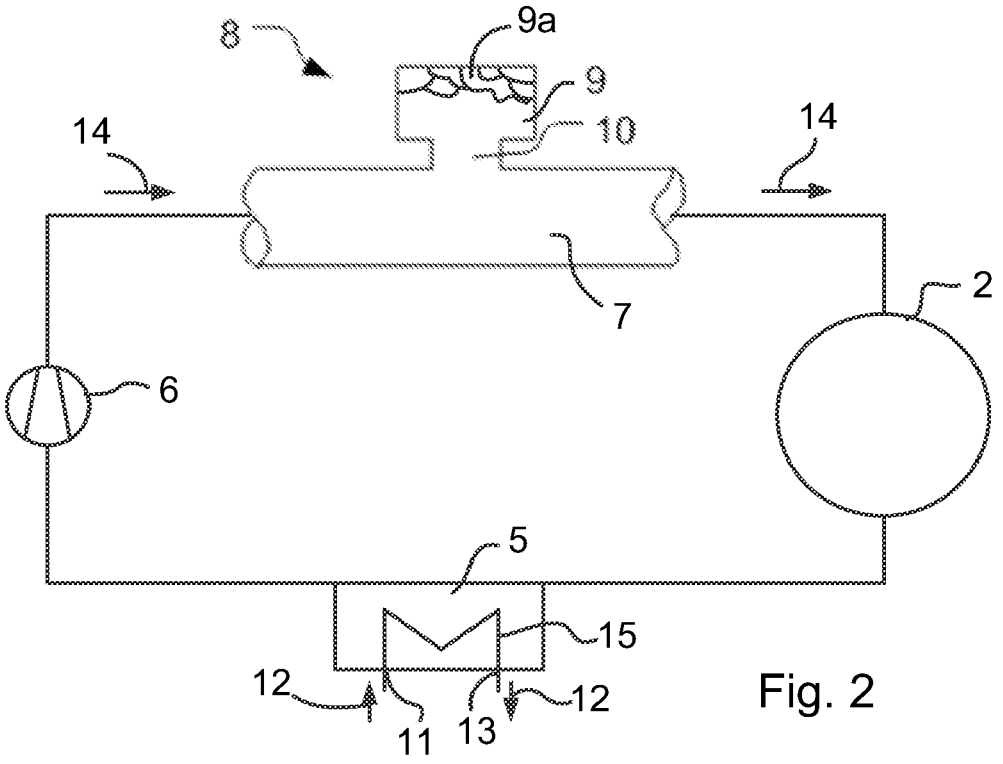

Fig. 2

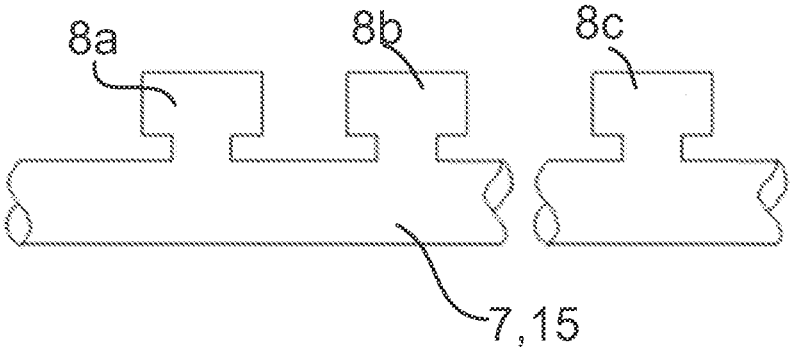

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 4888

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 2 219 849 A (ZANUSSI A SPA INDUSTRIE [IT]) 20 December 1989 (1989-12-20) * figures * -----	1	INV. D06F25/00 D06F58/04 D06F58/20
X	DE 20 2005 017277 U1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 15 March 2007 (2007-03-15) * paragraph [0017]; claim 1; figures * -----	1-5,7,12	
X	EP 1 865 103 A1 (ELECTROLUX HOME PROD CORP [BE]) 12 December 2007 (2007-12-12) * figure 1 * * paragraphs [0015], [0037]; claim 1 * -----	1,8	
A	US 2 927 380 A (OLTHUIS EUGENE G) 8 March 1960 (1960-03-08) * the whole document * -----	1-14	

TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 November 2011	Diaz y Diaz-Caneja

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 16 4888

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11-11-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2219849 A	20-12-1989	DE 8904738 U1	24-05-1989
		FR 2632985 A3	22-12-1989
		GB 2219849 A	20-12-1989
		IT 218171 Z2	08-04-1992
DE 202005017277 U1	15-03-2007	NONE	
EP 1865103 A1	12-12-2007	NONE	
US 2927380 A	08-03-1960	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82