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(54) **LAUNDRY DRYER HAVING A CONDENSING APPARATUS AND CONTROL METHOD FOR SAID CONDENSING APPARATUS**

(57) The present invention discloses a control method for a condensing apparatus (7) of a laundry dryer (1), wherein the laundry dryer (1) comprises a drying drum (6) and a condensing apparatus (7), wherein the condensing apparatus (7) has an air channel (9), a water supply apparatus (20) connected to the air channel (9), and a fan (11) for forcing wet hot air to pass through the air channel (9); and a control apparatus (100) for controlling running of the fan (11). The control method comprises: Supplying, by the water supply apparatus (20), water to the air channel (9), and setting, by the control apparatus (100), a first parameter and a second parameter to control the running of the fan (11), wherein the first parameter is set to controlling a lifting force that is generated when the fan (11) drives an airflow to move upward, so that most of the water remains in the air channel (9), and the second parameter is set to controlling the fan (11) to reduce a rotational speed, to reduce the lifting force that is generated when the airflow is driven to move upward, so that most of the water is discharged from the air channel (9). The invention also discloses a laundry dryer (1) implementing such method. By means of the invention it is ensured that cooling water is efficiently used, so that water resource is saved. Moreover, noise of a machine is also reduced because of reduction of an average air volume of a fan (11).

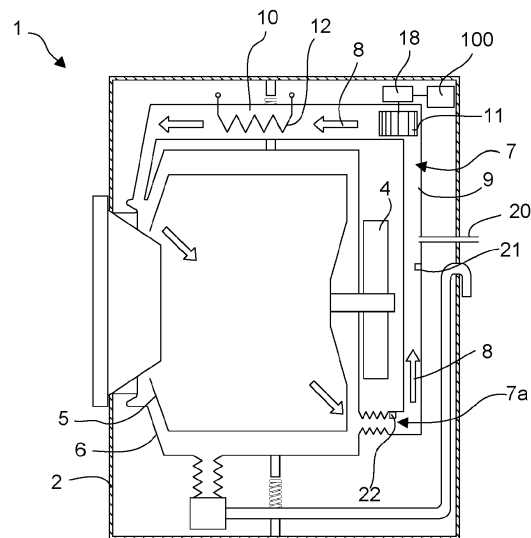


FIG. 1

Description

[0001] The present invention relates to a machine for drying laundry, and in particular, to a condensing apparatus of such machine and a control method of same.

[0002] Laundry dryers generally include machines having only a laundry drying function, and machines integrating a laundry washing function and a laundry drying function and designated "washer-dryers" in general. A drying principle of the laundry dryer may be basically summarized as follows: With a heating apparatus, dry air is heated into dry hot air, then enters a drying drum to exchange heat with wet laundry, takes moisture away from the laundry, and becomes relatively wet hot air. The wet hot air subsequently passes through a condensing apparatus. By condensation of the condensing apparatus, moisture in the wet hot air is condensed into water and is discharged through a drainage tube. After the condensation, the air becomes relatively dry cold air, is guided into the heating apparatus again by a fan, becomes dry hot air after heating, and enters another circle. The circle repeats until a drying program ends. In a washer-dryer the drying drum may consist of a tub for holding washing liquid or drying process air and a drum rotationally disposed in the tub for holding laundry to be processed.

[0003] However, in a drying process, especially at the end of drying, water after heat exchange still has relatively low temperature when the water is discharged, which indicates that a cooling capability of cooling water is not fully used; therefore, waste of a water resource is caused.

[0004] For a problem in the prior art that utilization of cooling water is low because the cooling water cannot be fully used during heat exchange, no effective resolution has been proposed up to now.

[0005] The present invention provides a laundry dryer having a condensing apparatus and a control method for a condensing apparatus of same, to resolve at least a problem in the prior art that utilization of cooling water is low because the cooling water cannot be fully used during heat exchange.

[0006] To achieve the foregoing objective, a control method for a condensing apparatus of a laundry dryer and a laundry dryer implementing such control method in accordance with the respective independent claim attached are provided. Facultative and preferred embodiments are defined in dependent claims as attached, are described in the subsequent description, or are shown in the drawing attached.

[0007] To achieve the foregoing objective, according to an aspect of the present invention, a control method for a condensing apparatus of a laundry dryer is provided, where the laundry dryer includes a drying drum and a condensing apparatus, where the condensing apparatus

trolling running of the fan. The control method includes: Supplying, by the water supply apparatus, water to the air channel; and setting, by the control apparatus, a first parameter and a second parameter to control the running of the fan, where the first parameter is set to controlling a lifting force that is generated when the fan drives an airflow to move upward, so that most of the water remains in the air channel, and the second parameter is set to controlling the fan to reduce a rotational speed, to reduce the lifting force that is generated when the airflow is driven to move upward, so that most of the water is discharged from the air channel.

[0008] The laundry dryer may be various machines having a laundry drying function, for example, a machine used only to dry laundry, or a washer-dryer.

[0009] Compared with the prior art, cooling efficiency of water can be improved in the present invention by adjusting the rotational speed of the fan and without changing a structure feature. When the fan runs according to the first parameter, because the fan drives the airflow to move upward, the generated lifting force makes most of the water remain in the air channel, and in this case, a large amount of water fully exchanges heat with air. Therefore, efficiency of condensed water is improved. When a temperature of the foregoing cooling water becomes higher after the heat exchange, and accordingly, a cooling effect is reduced, in this case, the fan runs according to the second parameter, and controls the fan to reduce the rotational speed, to reduce the lifting force that is generated when the airflow is driven to move upward, so that most of the water is discharged from the air channel, so as to achieve an objective of fully using the cooling water.

[0010] Preferably, when the fan runs according to the first parameter, the water supply apparatus supplies a particular amount of water and then stops, and the fan continues to run according to the first parameter for at least a period of time and then changes into running according to the second parameter. The foregoing water supply apparatus may be set to supplying water stage by stage. When the fan runs according to the first parameter, the water supply apparatus may be stopped from supplying water, which aims to fully use current cooling water. After a period of time of running, the cooling water fully achieves a heat exchange effect, and then the fan further runs according to the second parameter.

[0011] Preferably, the fan runs according to the second parameter for at least a period of time and then changes into running according to the first parameter, and the water supply apparatus restarts to supply a particular amount of water. In the foregoing solution, the fan runs according to the second parameter, to discharge the water after the heat exchange, and changes into running according to the first parameter again after a period of time of running, that is, returns to a normal heat exchange process. In this case, the water supply apparatus restarts to supply water once again. In this manner, new cooling water is not mixed with the water after the heat exchange,

which reduces waste of a water resource.

[0012] Preferably, the control apparatus periodically controls, at a fixed frequency, the fan to run between according to the first parameter and according to the second parameter. As can be known from the above, in the foregoing solution, the fan alternatively runs according to the first parameter and the second parameter. A running time may be set, and a time for periodically controlling the fan to run according to the first parameter or the second parameter may be set by changing a frequency such as a voltage or a current, to facilitate accurate control of a condensing process by the control apparatus.

[0013] Preferably, the control apparatus triggers, by determining a temperature value of water in the air channel, the fan to change from running according to the first parameter into running according to the second parameter. For more accurate control of the condensing process, and improvement of utilization of the cooling water, a temperature within the air channel, that is, a temperature value of water in a heat exchange area may be detected to determine whether the heat exchange process is fully implemented, thereby controlling and triggering the fan to change from running according to the first parameter into running according to the second parameter.

[0014] Preferably, the control apparatus detects a temperature of air near an air inlet of the condensing apparatus, compares the temperature of the water in the air channel with the temperature of the air, and make the fan run according to the second parameter when a difference between the two reaches a preset temperature value. Because in a drying process, a temperature of air continuously changes, and a temperature of air that enters the condensing apparatus from the drying drum is generally higher than a temperature of air after the heat exchange, a difference between the two may be set as a reference value.

[0015] Preferably, the control apparatus makes the fan run according to the second parameter for a fixed time and then change into running according to the first parameter. Most of water after the heat exchange is discharged when the fan runs according to the second parameter, and this running time may be set as a fixed time. Subsequently, the fan changes into running according to the first parameter.

[0016] Preferably, the parameter is a voltage. A change of a running parameter may be controlled according to a change of the voltage.

[0017] Preferably, a voltage value of the first parameter is larger than a voltage value of the second parameter. A wind speed corresponding to the first parameter is higher than that corresponds to the second parameter; therefore, the voltage value of the first parameter is set to being larger than the voltage value of the second parameter.

[0018] According to another aspect of the present invention, a laundry dryer having a condensing apparatus is provided, including a drying drum in communication with a condensing apparatus, where the condensing apparatus has an air channel, a water supply apparatus

connected to the air channel, and a fan for forcing wet hot air to pass through the air channel; and a control apparatus for controlling running of the fan, where the condensing apparatus is set in a manner that the condensing apparatus can use a method as described above for condensation.

[0019] Preferably, the air channel is provided with a turbulence apparatus for making air passing through the air channel form a turbulence flow. Because the fan drives the airflow to move upwards, air forms a turbulence flow at the turbulence apparatus. Because of the turbulence flow and a lifting effect of the airflow, water gathered in the air channel rolls and surges in the air channel, which facilitates the heat exchange between cooling water and hot air.

[0020] Preferably, the turbulence apparatus is a blocking member that extends from a wall of the air channel towards an interior of the channel to change a circulation path of blocked airflow, or is deformation of a wall of the air channel in an air circulation direction or on a circulation cross section.

[0021] Preferably, a motor of the fan is a brushless direct current motor.

[0022] Preferably, at least two sensors for detecting a temperature value are provided in the condensing apparatus, and are separately disposed at an air inlet and near a turbulence apparatus of the condensing apparatus.

[0023] By means of the present invention, a problem in the prior art that utilization of cooling water is low because the cooling water cannot be fully used during heat exchange is resolved. In addition it is ensured that cooling water is efficiently used; and on the other hand, noise of a machine is also reduced because of reduction of an average air volume of a fan.

[0024] The preferred and facultative embodiments in this application and characteristics in these embodiments may be combined with one another in the absence of any apparent conflict.

[0025] Preferred embodiments of the invention are now explained in detail with reference to the accompanying drawing. In the drawing,

FIG. 1 is a side view of a laundry dryer;
 FIG. 2A is a schematic view of a first implementation manner of a condensing apparatus;
 FIG. 2B is a schematic view of a second implementation manner of the condensing apparatus;
 and
 FIG. 2C is a schematic view of a third implementation manner of the condensing apparatus.

[0026] FIG. 1 is a side view of a laundry dryer. As shown in FIG. 1, the laundry dryer 1 has a case body 2, a drum 5 that is located in the case body 2 and that is rotatable if driven by a main motor 4, and a tub 6 (that is, a drying drum 6) sleeved on the drum 5. The tub 6 is connected to and is spatially in communication with an air channel 9 of a condensing apparatus 7. The air channel 9 of the

condensing apparatus is sequentially connected to a fan 11 and an air heating channel 10. The other end of the air heating channel 10 is spatially in communication with the tub 6.

[0027] In a drying program, a heater 12 in the air heating channel 10 heats dried air 8 passing through the air heating channel 10. The heated high-temperature dried air 8 enters the drum 5 and the tub 6 under the action of the fan 11, and heats wet laundry in the drum 5, to make moisture in the laundry evaporate. The dried air 8 carrying the evaporated moisture enters the air channel 9 of the condensing apparatus 7, and moisture in the dried air 8 is condensed into a liquid in the air channel 9, and is separated from the dried air 8. Therefore, the dried air 8 becomes low temperature and dry air again, is driven by the fan 11 to go back to the air heating channel 10, starts a new cycle, and the process repeats. Finally, the laundry in the drum 5 are dried.

[0028] A water supply apparatus 20, that is, a water inlet pipe 20 of cooling water, is connected to the air channel 9 of the condensing apparatus 7. In the drying program, the cooling water flows into the air channel 9 through the water inlet pipe 20, and exchanges heat with the dried air 8 in the air channel 9, to condense the moisture in the dried air 8.

[0029] In preferable embodiments, FIG. 2A is a schematic diagram of a first implementation manner of the condensing apparatus, FIG. 2B is a schematic diagram of a second implementation manner of the condensing apparatus, and FIG. 2C is a schematic diagram of a third implementation manner of the condensing apparatus. As shown in FIG. 2A, 2B, and 2C, the air channel 9 has a turbulence apparatus 30, 31, or 32 that makes air passing through the air channel 9 form a turbulence flow. A water outlet of the water supply apparatus 20 is located above the turbulence apparatus 30, 31, or 32. Because the fan 11 drives the airflow to move upwards, air forms a turbulence flow at the turbulence apparatus 30, 31, or 32. Because of the turbulence flow and a lifting effect of the airflow, water gathered in the air channel 9 rolls and surges in the air channel 9, which facilitates heat exchange between cooling water and hot air.

[0030] Specifically, the foregoing turbulence apparatus is a blocking member 32 that extends from a wall of the air channel towards an interior of the channel to change a circulation path of blocked airflow, or is deformation 30 or 31 of a wall of the air channel in an air circulation direction or on a circulation cross section. In the first embodiment shown in FIG. 2A, the turbulence apparatus 30 is a bent part that is formed on the wall 19 of the air channel 9. In the second embodiment shown in FIG. 2B, the turbulence apparatus 31 is a bulge that is formed on the wall 19 of the air channel 9. In the third embodiment shown in FIG. 2C, the turbulence apparatus 32 is the blocking member 32 that extends from a wall 19 of the air channel 9 towards the interior to change the circulation path of the blocked airflow.

[0031] The laundry dryer 1 further has a control appa-

ratus 100. The fan 11 includes a direct current brushless motor 18. The direct current brushless motor 18 is connected to and is controlled by the control apparatus 100. The control apparatus 100 may control a rotational speed of the fan 11 by controlling an input voltage or current applied to the direct current brushless motor 18.

[0032] Preferably, at least two sensors for detecting a temperature value are provided in the condensing apparatus 7, and are separately disposed at an air inlet 7a (an upper position) and in the air channel 9, that is, near the foregoing turbulence apparatus, of the condensing apparatus, to detect temperatures of the foregoing two positions. The control apparatus 100 controls a running parameter of the fan 11 by comparing values of detected temperatures of the two positions.

[0033] The foregoing control apparatus 100 controls the condensing apparatus 7, and a control method includes: supplying, by the water supply apparatus 20, water to the air channel 9; and setting, by the control apparatus 100, a first parameter and a second parameter to control running of the fan 11, where the first parameter is set to controlling a lifting force that is generated when the fan 11 drives an airflow to move upward, so that most of the water remains in the air channel 9, and the second parameter is set to controlling the fan 11 to reduce a rotational speed, to reduce the lifting force that is generated when the airflow is driven to move upward, so that most of the water is discharged from the air channel 9.

[0034] When the fan 11 runs according to the first parameter, because the fan 11 drives the airflow to move upward, the generated lifting force makes most of the water remain in the air channel 9, and in this case, a large amount of water fully exchanges heat with air. Therefore, efficiency of condensed water is improved. When a temperature of the foregoing cooling water gradually becomes high after the heat exchange, and accordingly, a cooling effect is reduced, in this case, the fan 11 runs according to the second parameter, and controls the fan to reduce the rotational speed, to reduce the lifting force that is generated when the airflow is driven to move upward, so that most of the water is discharged from the air channel 9, so as to achieve an objective of fully using the cooling water.

[0035] Preferably, when the fan 11 runs according to the first parameter, the water supply apparatus 20 supplies a particular amount of water and then stops, and the fan 11 continues to run according to the first parameter for at least a period of time and then changes into running according to the second parameter. The foregoing water supply apparatus 20 may be set to supplying water stage by stage. When the fan 11 runs according to the first parameter, the water supply apparatus 20 may be stopped from supplying water, which aims to fully use current cooling water for the heat exchange. After a period of time of running, the cooling water fully achieves a heat exchange effect, and then the fan 11 further runs according to the second parameter.

[0036] Preferably, the fan 11 runs according to the sec-

ond parameter for at least a period of time and then changes into running according to the first parameter, and the water supply apparatus 20 restarts to supply a particular amount of water. In the foregoing solution, the fan 11 runs according to the second parameter, to discharge the water after the heat exchange from the air channel 9, and changes into running according to the first parameter again after a period of time of running, that is, returns to a normal heat exchange process. In this case, the water supply apparatus 20 restarts to supply water once again. In this manner, new cooling water is not mixed with the water after the heat exchange, which reduces waste of a water resource.

[0037] In a preferable embodiment, the control apparatus 100 periodically controls, at a fixed frequency, the fan 11 to run between according to the first parameter and according to the second parameter. As can be known from the above, in the foregoing solution, the fan 11 alternatively runs according to the first parameter and the second parameter. A running time may be set, and a time for periodically controlling the fan 11 to run according to the first parameter or the second parameter may be set by changing a frequency such as a voltage or a current, to facilitate accurate control of a condensing process by the control apparatus 11.

[0038] In another preferable embodiment, the control apparatus 100 triggers, by determining a temperature value of water in the air channel 9, the fan 11 to change from running according to the first parameter into running according to the second parameter. For more accurate control of the condensing process, and improvement of utilization of the cooling water, a temperature within the air channel 9, that is, a temperature value of water in a heat exchange area may be detected to determine whether the heat exchange process is sufficient, thereby controlling and triggering the fan 11 to change from running according to the first parameter into running according to the second parameter.

[0039] Preferably, the control apparatus 100 detects a temperature of air near the air inlet 7a of the condensing apparatus, compares the temperature of the water in the air channel 9 with the temperature of the air, and make the fan 11 run according to the second parameter when a difference between the two reaches a preset temperature value. Because in a drying process, a temperature of air continuously changes, and a temperature of air that enters the condensing apparatus 7 from the tub 6 is generally higher than a temperature of air after the heat exchange, a difference between the two may be set as a reference value.

[0040] Preferably, the control apparatus 100 makes the fan 11 run according to the second parameter for a fixed time and then change into running according to the first parameter. Most of water after the heat exchange is discharged when the fan 11 runs according to the second parameter, and this running time may be set as a fixed time. Subsequently, the fan changes into running according to the first parameter.

[0041] Preferably, the parameter is a voltage. A change of the running parameter may be controlled by a change of the voltage.

[0042] Preferably, a voltage value of the first parameter is larger than a voltage value of the second parameter. A wind speed corresponding to the first parameter is higher than that corresponds to the second parameter; therefore, the voltage value of the first parameter is set to being larger than the voltage value of the second parameter.

[0043] Various specific implementation manners described in the foregoing and shown in accompanying drawings are merely used for illustrating the present invention, and are not considered as the entirety of the present invention. Within the scope of the basic technical thought of the present invention, any types of modifications to the present invention made by persons ordinarily skilled in the art fall within the protection scope of the present invention.

REFERENCE NUMERALS

[0044]

1	Laundry dryer
2	Case body
4	Motor
5	Drum
6	Tub
7	Condensing apparatus
7a	Air inlet
8	Dried air
9	Air channel
10	Heating channel
11	Fan
12	Heater
18	Brushless motor
19	Wall of air channel
20	Water supply apparatus, water inlet pipe
30	Turbulence apparatus, deformation
31	Turbulence apparatus, deformation
32	Turbulence apparatus, blocking member
100	Control apparatus

Claims

1. A control method for a condensing apparatus (7) of a laundry dryer (1), wherein the laundry dryer (1) comprises a drying drum (6) and a condensing apparatus (7), wherein the condensing apparatus (7) has an air channel (9), a water supply apparatus (20) connected to the air channel (9), and a fan (11) for forcing wet hot air to pass through the air channel (9), and a control apparatus (100) for controlling running of the fan (11), **characterized in that** the control method comprises:

supplying, by the water supply apparatus (20),

- water to the air channel (9); and setting, by the control apparatus (100), a first parameter and a second parameter to control the running of the fan (11), wherein the first parameter is set to controlling a lifting force that is generated when the fan (11) drives an airflow to move upward, so that most of the water remains in the air channel (9), and the second parameter is set to controlling the fan (11) to reduce a rotational speed, to reduce the lifting force that is generated when the airflow is driven to move upward, so that most of the water is discharged from the air channel (9).
2. The method according to claim 1, wherein when the fan (11) runs according to the first parameter, the water supply apparatus (20) supplies a particular amount of water and then stops, and the fan (11) continues to run according to the first parameter for at least a period of time and then changes into running according to the second parameter.
 3. The method according to claim 2, wherein the fan (11) runs according to the second parameter for at least a period of time and then changes into running according to the first parameter, and the water supply apparatus (20) restarts to supply a particular amount of water.
 4. The method according to claim 3, wherein the control apparatus (100) periodically controls, at a fixed frequency, the fan (11) to run between according to the first parameter and according to the second parameter.
 5. The method according to claim 2, wherein the control apparatus (100) triggers, by determining a value of a temperature of water in the air channel (9), the fan (11) to change from running according to the first parameter into running according to the second parameter.
 6. The method according to claim 5, wherein the control apparatus (100) detects a temperature of air near an air inlet (7a) of the condensing apparatus, compares the temperature of the water in the air channel (9) with the temperature of the air, and make the fan (11) run according to the second parameter when a difference between the two reaches a preset temperature value.
 7. The method according to claim 5, wherein the control apparatus (100) makes the fan (11) run according to the second parameter for a fixed time and then change into running according to the first parameter.
 8. The method according to claim 5, wherein
- the parameter is a voltage.
9. The method according to claim 8, wherein a voltage value of the first parameter is larger than a voltage value of the second parameter.
 10. A laundry dryer having a condensing apparatus, comprising a drying drum in communication with a condensing apparatus (7), wherein the condensing apparatus (7) has an air channel (9), a water supply apparatus (20) connected to the air channel (9), and a fan (11) for forcing wet hot air to pass through the air channel; and a control apparatus (100) for controlling running of the fan, **characterized in that:**

the condensing apparatus (7) is set in a manner that the condensing apparatus (7) can use the method according to any one of the foregoing claims for condensation.
 11. The laundry dryer according to claim 10, wherein the air channel (9) is provided with a turbulence apparatus (30, 31, 32) for making air passing through the air channel (9) form a turbulence flow.
 12. The laundry dryer according to claim 11, wherein the turbulence apparatus (30, 31, 32) is a blocking member (32) that extends from a wall (19) of the air channel towards an interior of the channel to change a circulation path of blocked airflow, or is deformation (30, 31) of a wall (19) of the air channel in an air circulation direction or on a circulation cross section.
 13. The laundry dryer according to claim 10, wherein a motor of the fan (11) is a brushless direct current motor.
 14. The laundry dryer according to claim 10, wherein at least two sensors (21, 22) for detecting a temperature value are provided in the condensing apparatus (7), and are separately disposed at an air inlet (7a) and near a turbulence apparatus (30, 31, 32) of the condensing apparatus (7).

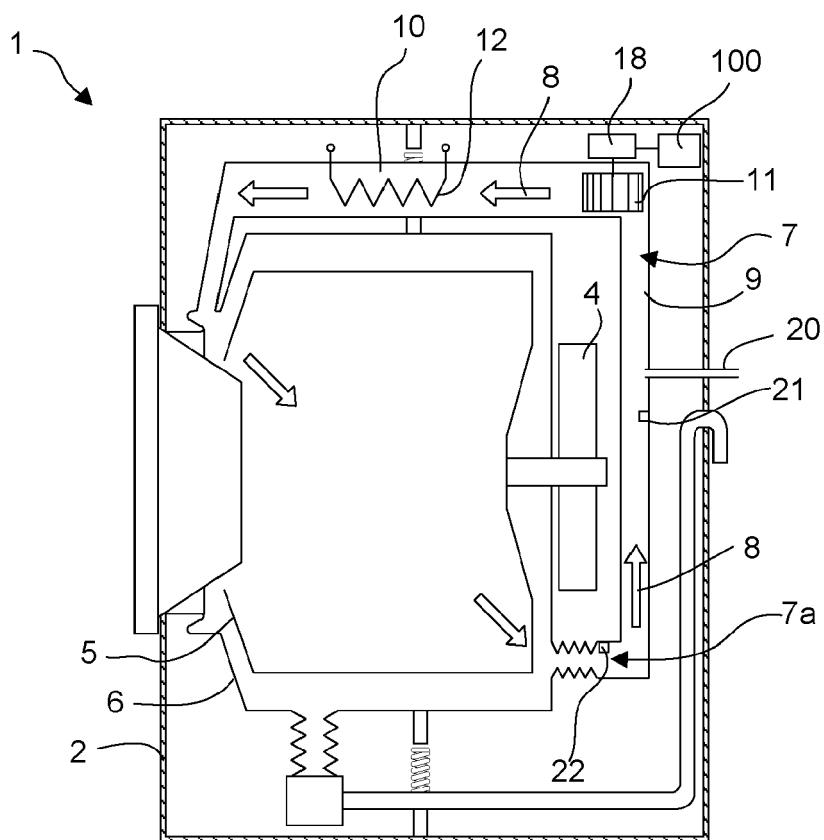


FIG. 1

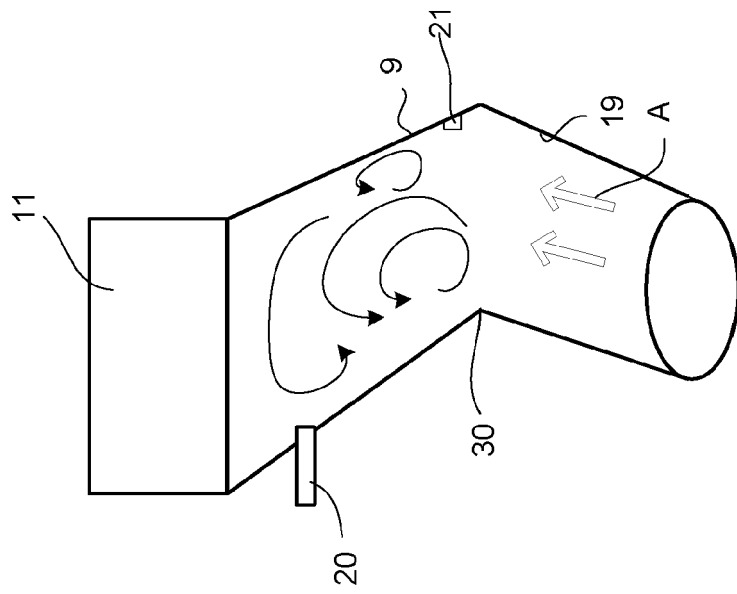


FIG. 2A

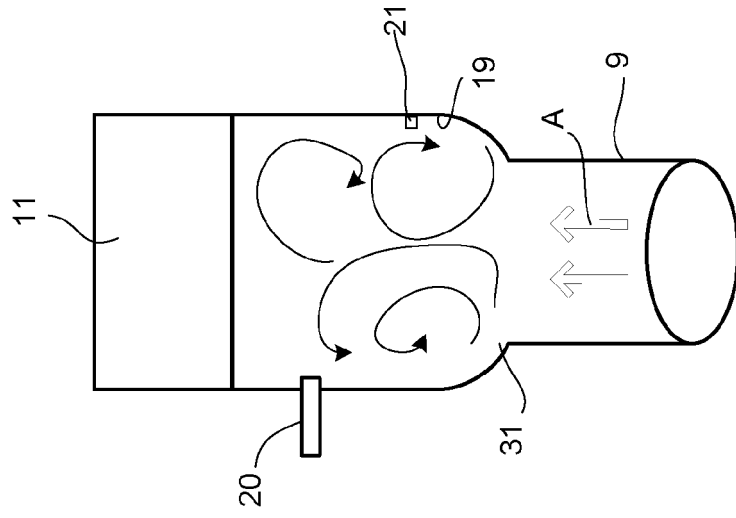


FIG. 2B

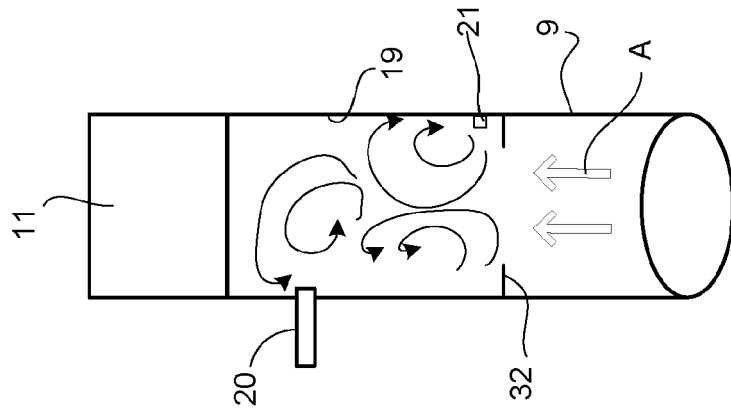


FIG. 2C



EUROPEAN SEARCH REPORT

Application Number
EP 16 18 0614

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 19 September 2016	Examiner Bermejo, Marco
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 16 18 0614

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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