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(54) **LAUNDRY DRYER HAVING CONDENSING APPARATUS AND METHOD OF CLEANING
CONDENSING APPARATUS THEREOF**

(57) The present invention provides a method of cleaning a condensing apparatus 7 of a laundry dryer 1 where the condensing apparatus 7 includes an air passage 9, a water supply apparatus 21 connected to the air passage 9, and a fan 11 that enables air 8 from a drying drum 5, 6 to pass through the air passage 9, where the air passage 9 has a turbulence apparatus 30, 31, 32 that enables the air 8 passing through the air passage 9 to generate a turbulent flow, the cleaning method which includes running a cleaning process, and the cleaning process includes: continuously supplying, by the water supply apparatus 21, water into the air passage 9; and enabling, by the control apparatus 100, the fan 11 to run, controlling a running parameter of the fan 11 to gradually increase a rotation speed of the fan 11, and at least increasing the rotation speed until partially water is lifted by air 8 and gradually converges at the turbulence apparatus 30, 31, 32. The water that converges inside the air passage 9 tumbles and surges in the air passage 9, so as to flush an inner wall 19 of the air passage 9. The invention further discloses a laundry dryer 1 capable of implementing the foregoing cleaning method.

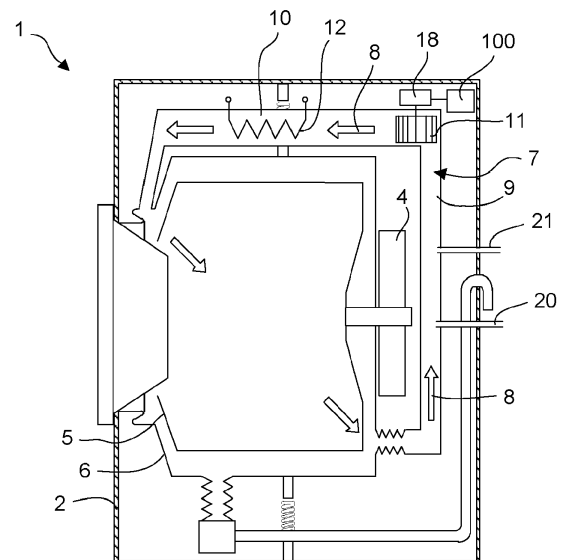


FIG. 1

Description

[0001] The present invention relates to a machine capable of drying laundry, and in particular, to a condensing apparatus of the machine and a cleaning method therefor.

[0002] Laundry dryers usually include machines purely having a function of a laundry dryer and machines integrated with laundry washing and laundry drying functions, with the latter machines usually designated as "washer-dryers". A drying principle of a laundry dryer may be generally summarized as follows: under an effect of a heating apparatus, after being heated by the heating apparatus, dry air forms dry hot air, which then enters a drying drum to exchange heat with wet laundry and removes moisture from the laundry, and forms relatively damp hot air; upon condensation by a condensing apparatus, moisture of the damp hot air is condensed into water, which is then discharged through a drain pipe; after being condensed, the air becomes relatively dry cold air, and under an effect of a fan, is led into the heating apparatus again, and forms dry hot air after being heated to enter a next cycle; and such a process is repeated until a drying program ends. In a washer-dryer the drying drum usually includes a tub for holding washing liquid or for guiding drying process air, and a drum rotatably disposed within the tub for holding laundry to be processed.

[0003] Because in a washing or drying process, laundry would inevitably generate a lot of deposits or other impurities of broken fibres and the like residuals torn from the laundry material (herein after collectively referred to as lint or deposits), the lint would be brought by damp hot air into the condensing apparatus and be attached to an inner wall of the condensing apparatus, thereby affecting a condensing effect or blocking flowing of air. In addition, under the effect of the fan, the lint might be brought into the fan and even into a heating passage and be attached onto the fan or a surface of the heating apparatus in the heating passage, thereby reducing an air blowing effect of the fan, and even a danger that the deposits are ignited by the heating apparatus may probably occur.

[0004] In the prior art, a condensing apparatus is provided with a spraying apparatus, which removes deposits by spraying water onto an inner wall of a condensing passage. However, because a condensing passage is usually irregularly, existence of a place that cannot be flushed is inevitable. Moreover, it is obvious that an area above the spraying apparatus cannot be flushed, and this area is generally an area where deposit accumulation is severer. A fan and a heating passage also cannot be flushed by using the spraying apparatus disposed inside the condensing passage. The spraying apparatus usually also has disadvantages such as a spraying scope is small, water flow pressure is not concentrated, and a flushing force is small.

[0005] An objective of the present invention is to improve an effect of flushing deposits inside a condensing

apparatus.

[0006] With regard to the foregoing objective, the present invention provides a method of cleaning a condensing apparatus of a laundry dryer, and a laundry dryer implementing such method, in accordance with the respective independent claim attached. Preferred and facultative embodiments of the invention are defined in dependent claims, described in the subsequent description, and shown in the drawing attached. Absent any apparent conflict facultative embodiments of the inventive method correspond to facultative embodiments of the inventive laundry dryer and vice versa, even if not indicated expressly herein.

[0007] With regard to the foregoing objective, the present invention accordingly provides a method of cleaning a condensing apparatus of a laundry dryer, where the condensing apparatus includes an air passage, a water supply apparatus connected to the air passage, and a fan that enables air from a drying drum to pass through the air passage, where the air passage has a turbulence apparatus that enables the air passing through the air passage to generate a turbulent flow, a water outlet of the water supply apparatus is located above the turbulence apparatus, and the fan is controlled by a control apparatus, the method includes running a cleaning process, and the cleaning process includes:

continuously supplying, by the water supply apparatus, water into the air passage; and enabling, by the control apparatus, the fan to run, controlling a running parameter of the fan to gradually increase a rotation speed of the fan, and at least increasing the rotation speed until partial water is lifted by air and gradually converges at the turbulence apparatus.

[0008] The laundry dryer may refer to a machine having a laundry drying function, for example, a machine that purely dries laundry, and may also be a laundry washing and drying machine like a washer-dryer.

[0009] As compared with the prior art, the present invention may achieve an improved cleaning effect by adjusting the rotation speed of the fan without changing a structural feature. Because the fan actuates an air flow to move upward, the air generates a turbulent flow at the turbulence apparatus to blow away water at this place. When the rotation speed of the fan increases to enable a lifting force generated the air flow to lift the water that is at least partially blown away upward, and meanwhile, because water is continuously supplied to the air passage, the water that is lifted upward gradually increases and converges at the turbulence apparatus and an area above. Because of the turbulent flow and lifting effect of the air flow, the water that converges inside the air passage tumbles and surges in the air passage, so as to flush the inner wall of the air passage. In addition, as the water that converges inside the air passage increases, air flow resistance inside the air passage increases, and a flowing section area of the air decreases, so an air flow

rate decreases, thereby decreasing a lifting force of the air flow for the water. Gradually, the air flow is insufficient to support more and more water, so the water that flows to a bottom of the air passage increases and the water that converges inside the air passage decreases. Then the air flow resistance inside the air passage decreases, and the flowing section area of the air increases, so the air flow rate increases. Moreover, in this way, the lifting force of the air flow for the water increases, so that the water that converges inside the air passage gradually increases again. A cycle of repeated changes of the water inside the air passage from less to more and further from more to less is restarted. Each change cycle is completed within a short time, so while the water inside the air passage continuously tumbles and surges, a volume thereof continuously changes, thereby producing a continuous and intensive flushing effect on the inner wall of the air passage. The deposits that are flushed down are also brought away by the water flow from the bottom of the air passage.

[0010] To achieve an even better flushing effect, the control apparatus gradually increases a running parameter of the fan and enables the running parameter to reach a target parameter and then remain at the target parameter for at least a period of time. In this period of time, the water that converges inside the air passage continuously flushes the inner wall of the air passage.

[0011] The target parameter is set as that when the running parameter of the fan reaches the target parameter, a lifting force generated by actuating, by the fan, an air flow to move upward at least enables partial water to be lifted by air and gradually converge at the turbulence apparatus.

[0012] Preferably, the target parameter is set as that when the running parameter of the fan reaches the target parameter, a lifting force generated by actuating, by the fan, an air flow to move upward at least enables partial water to be lifted to a top of the air passage. In this way, at least an area from the turbulence apparatus to the top of the passage inside the air passage can be effectively cleaned. As compared with the prior art, the top of the air passage may also be cleaned favorably.

[0013] If it is expected that the fan may also be cleaned, the target parameter is set as that when the running parameter of the fan reaches the target parameter, a lifting force generated by actuating, by the fan, an air flow to move upward enables water to be lifted and partially enter the fan. The water that enters the fan flushes components, particularly blades, of the fan. In addition, partial water, being actuated by the fan, enters an air heating passage, so as to flush both the fan and the air heating passage to some extent.

[0014] The running parameter may be an input voltage. The control apparatus controls the input voltage of the fan. The rotation speed of the fan is increased by gradually increasing the input voltage.

[0015] The control apparatus runs a washing program or a drying program, and the cleaning process of the con-

densing apparatus is integrated into the washing program or the drying program. The laundry dryer may complete cleaning the condensing apparatus in the process of washing or drying the laundry. Moreover, after the flushing water flows into the drying drum, if a washing program is run at the same time, the flushing water may serve as washing or rinsing water to reduce water consumption.

[0016] When the cleaning process is integrated into the drying program, the cleaning process is, preferably, in an earlier stage of the drying program. In this way, even if the water that may be brought by the fan into the air heating apparatus and subsequently enter the drying drum in the cleaning process splashes onto the laundry, the laundry may also be dried by means of the subsequent drying program. If the cleaning process is in a later stage of the drying program, the laundry that are almost dried may be damped by water from the air heating passage.

[0017] The cleaning process may be run according to a use status of the drying program. Each time after the drying program has run for a specific number of times, the control apparatus runs the cleaning process in the washing program or the drying program. Hence, only after the deposit are accumulated to a certain extent, centralized cleaning is performed, thereby reducing consumption of water.

[0018] To be more user friendly and facilitate cleaning and maintenance, the cleaning process is operable to be selected by a user to run separately. The user or post-sale service personnel may run separately the cleaning process according to requirements to clean the condensing apparatus. For example, when the condensing apparatus is provided with a deposit detection apparatus, and a prompt apparatus, such as a display, that prompts a user to clean the condensing apparatus according to a detection result of the detection apparatus, the user or post-sale service personnel may run separately the cleaning process.

[0019] The cleaning process is operable to be selected by a user to run during running of a washing program or a drying program. A specific manner is that, for example, after selecting a washing program or a drying program, a user additionally selects a cleaning process and then starts running, where the cleaning process may be run during running of the selected washing program or drying program.

[0020] The present invention also provides a laundry dryer that improves an effect of flushing deposits inside a condensing apparatus. The laundry dryer includes a drying drum for accommodating laundry and a condensing apparatus fluidly in communication with the drying drum, where the condensing apparatus includes an air passage, a water supply apparatus connected to the air passage, and a fan that enables air from the drying drum to pass through the air passage, where the air passage has a turbulence apparatus that enables the air passing through the air passage to generate a turbulent flow, a

water outlet of the water supply apparatus is located above the turbulence apparatus, and the fan is controlled by a control apparatus, the control apparatus is set to be capable of cleaning the condensing apparatus by using the foregoing method.

[0021] The condensing apparatus may be water-cooled, air-cooled, or of a heat pump type.

[0022] To produce a speed-variable effect of the fan, preferably, the fan has direct-current brushless motor.

[0023] The turbulence apparatus is a blocking member that extends from an air passage wall into an interior of the passage to change a flowing path of a blocked air flow, or a deformation of the air passage wall in an air flowing direction or of a flowing sectional area.

[0024] The present invention is further described below by referring to the accompanying drawing. The disclosure will become more fully understood from the detailed description given hereinbelow for illustration only, and thus not limitative of the disclosure. In the drawing:

FIG. 1 is a side view of a laundry dryer;

FIG. 2A is a schematic diagram of a first implementation manner of a condensing apparatus;

FIG. 2B is a schematic diagram of a second implementation manner of a condensing apparatus; and

FIG. 2C is a schematic diagram of a third implementation manner of a condensing apparatus.

[0025] As shown in FIG. 1, a laundry dryer 1 has a case 2, a drum 5 that can be driven by a primary motor 4 inside the case 2 to rotate, and a tub 6 sleeved on the drum 5. The tub 6 is connected to and in spatial communication with an air passage 9 of a condensing apparatus 7. The air passage 9 of the condensing apparatus is further connected to a fan 11 and an air heating passage 10 in sequence. Another end of the air heating passage 10 is further in spatial communication with the tub 6.

[0026] In a drying program, a heater 12 in the air heating passage 10 heats dried air 8 that flows through the air heating passage 10; the high-temperature dried air 8 after being heated enters, under the effect of the fan 11, the drum 5 and tub 6 to heat wet laundry in the drum 5 and evaporate moisture from the laundry. The dried air 8 carries the evaporated moisture and further enters the air passage 9 of the condensing apparatus, where the moisture in the dried air 8 is condensed, becomes liquid again, and is separated from the dried air 8. Hence, the dried air 8 becomes cold and dried again, enters, under the actuation of the fan 11, the heating passage 10 again, and starts a new cycle. This process is repeated until the laundry in the inner drum 5 are finally dried. The air passage 9 of the condensing apparatus is connected to cooling water inlet pipe 20. In the drying program, the cooling water flows into the air passage 9 through the inlet pipe 20, so as to exchange heat with the dried air 8 in the air passage 9 to condense the moisture in the dried air 8.

[0027] To clean the air passage 9, a water supply ap-

paratus 21 is connected to the air passage 9 to supply water to the air passage 9. In this embodiment, although both the cooling water inlet pipe 20 and the water supply apparatus 21 for cleaning water supply water to the air passage 9, because their used water flow rates are different, they are separately disposed.

[0028] As shown in FIGs. 2A, 2B, and 2C, the air passage 9 has a turbulence apparatus 30, 31, 32 that enables the air passing through the air passage 9 to generate a turbulent flow. A water outlet of the water supply apparatus 21 is located above the turbulence apparatus 30, 31, 32. In a first embodiment as shown in FIG. 2A, the turbulence apparatus 30 is a bend formed on a wall 19 of the air passage 9. In a second embodiment as shown in FIG. 2B, the turbulence apparatus 31 is an expansion formed on the wall 19 of the air passage 9. In a third embodiment as shown in FIG. 2C, the turbulence apparatus 32 is a blocking member 40 that extends from the wall 19 of the air passage 9 into an interior to change a flowing path of a blocked air flow. The laundry dryer 1 further has a control apparatus 100. The fan 11 includes a direct-current brushless motor 18. The direct-current brushless motor 18 is connected to and controlled by the control apparatus 100. The control apparatus 100 may control the rotation speed of the fan 11 by controlling the input voltage loaded onto the direct-current brushless motor 18.

[0029] The control apparatus 100 may run a cleaning process to clean deposits attached inside the condensing apparatus 7.

[0030] The cleaning process includes: Continuously supplying, by the water supply apparatus 21, water into the air passage 9, and in this period, enabling, by the control apparatus 100, the fan 11 to run, and gradually increasing an input voltage of the fan 11 to gradually increase a rotation speed of the fan 11, and after the input voltage reaches a target voltage, maintaining the input voltage at the target voltage for at least a period of time. Under the target voltage, the rotation speed reached by the fan 11 may enable partial water to be lifted by the air and gradually converge at the turbulence apparatus 30, 31, 32.

[0031] The target voltage may be obtained in advance by means of experiments and set in the control apparatus 100.

[0032] As shown in FIGs. 2A, 2B, and 2C, because the fan 11 actuates air A to move upward, the air A generates a turbulent flow at the turbulence apparatus 30, 31, 32 to blow away water W1 at this place. When the rotation speed of the fan 11 increases to enable a lifting force generated the air flow to lift the water W2 that is at least partially blown away upward, and meanwhile, because water W1 is continuously supplied to the air passage 9, the water W2 that is lifted upward gradually increases and converges at the turbulence apparatus 30, 31, 32 and an area above. Because of the turbulent flow and lifting effect of the air flow A, the water W2 that converges inside the air passage 9 tumbles and surges in the air

passage 9, so as to flush the inner wall 19 of the air passage. In addition, as the water W2 that converges inside the air passage 9 increases, air flow resistance inside the air passage 9 increases, and a flowing section area of the air decreases, so an air flow rate decreases, thereby decreasing a lifting force of the air flow A for the water. Gradually, the air flow A is insufficient to support more and more water W2, so the water W3 that flows to a bottom of the air passage 9 increases and the water W2 that converges inside the air passage 9 decreases. Then the air flow resistance inside the air passage 9 decreases, and the flowing section area of the air increases, so the air flow rate increases. Moreover, in this way, the lifting force of the air flow for the water increases, so that the water W2 that converges inside the air passage 9 gradually increases again. A cycle of repeated changes of the water W2 inside the air passage 9 from less to more and further from more to less is restarted. Each change cycle is completed within a short time, so while the water W2 inside the air passage 9 continuously tumbles and surges, a volume thereof continuously changes, thereby producing a continuous and intensive flushing effect on the inner wall 19 of the air passage. The deposits that are flushed down are also brought away by the water W3 flow from the bottom of the air passage 9.

[0033] To achieve the foregoing effect, it needs to be ensured that when the input voltage of the fan 11 reaches the target voltage, a lifting force generated by actuating, by the fan 11, an air flow A to move upward at least enables partial water to be lifted by air A and gradually converge at the turbulence apparatus 30, 31, 32.

[0034] Preferably, the target voltage is set as that when the input voltage of the fan 11 reaches the target voltage, a lifting force generated by actuating, by the fan 11, an air flow A to move upward at least enables partial water to be lifted to a top of the air passage 9.

[0035] More preferably, the target voltage is set as that when the input voltage of the fan 11 reaches the target voltage, a lifting force generated by actuating, by the fan 11, an air flow A to move upward enables water to be lifted and partially enter the fan 11 above the air passage 9.

[0036] The foregoing cleaning process of the condensing apparatus is operable to be selected by a user to run separately and is also operable to be selected by a user to run during running of a washing program or a drying program.

[0037] In addition, when to run the cleaning process may also be determined by the control apparatus 100. For example, each time after the drying program has run for a specific number of times, the control apparatus runs the cleaning process in the washing program or the drying program.

[0038] When the cleaning process is integrated into the drying program, the cleaning process is, preferably, in an earlier stage of the drying program.

[0039] The foregoing descriptions and various specific implementation manners shown in the accompanying

drawings are merely used for describing the present invention rather than all of the present invention. Within the scope of the basic technical ideas of the present invention, a change made by a person of ordinary skill in related art to the present invention in any form shall fall within the protection scope of the present invention.

REFERENCE NUMERALS

10 [0040]

1	Laundry dryer
2	Case
4	Motor
5	Drum
6	Tub
7	Condensing apparatus
8	Dried air
9	Air passage
10	Air heating passage
11	Fan
12	Heater
18	Motor of fan
19	Wall of air passage
20	Cooling water inlet pipe
21	Water supply apparatus
30	Turbulence apparatus
31	Turbulence apparatus
32	Turbulence apparatus
40	Blocking member
100	Control apparatus
A	Air
W1	Water
W2	Water
W3	Water

Claims

1. A method of cleaning a condensing apparatus (7) of a laundry dryer (1), wherein the condensing apparatus (7) comprises an air passage (9), a water supply apparatus (21) connected to the air passage (9), and a fan (11) that enables air (8) from a drying drum (5, 6) to pass through the air passage (9), wherein the air passage (9) has a turbulence apparatus (30, 31, 32) that enables the air (8) passing through the air passage (9) to generate a turbulent flow, a water outlet of the water supply apparatus (21) is located above the turbulence apparatus (30, 31, 32), and the fan (11) is controlled by a control apparatus (100), **characterized in that** the method comprises running a cleaning process, and the cleaning process comprises:

continuously supplying, by the water supply apparatus (21), water into the air passage (9); and enabling, by the control apparatus (100), the fan

- (11) to run, controlling a running parameter of the fan (11) to gradually increase a rotation speed of the fan (11), and
at least increasing the rotation speed until partially water is lifted by air (8) and gradually converges at the turbulence apparatus (30, 31, 32).
2. The method according to claim 1, **characterized in that** the control apparatus (100) gradually increases a running parameter of the fan (11) and enables the running parameter to reach a target parameter and then remain at the target parameter for at least a period of time.
 3. The method according to claim 2, **characterized in that** the target parameter is set as that when the running parameter of the fan (11) reaches the target parameter, a lifting force generated by actuating, by the fan (11), an air flow to move upward at least enables partially water to be lifted by air (8) and gradually converge at the turbulence apparatus (30, 31, 32).
 4. The method according to one of claims 2 and 3, **characterized in that** the target parameter is set as that when the running parameter of the fan (11) reaches the target parameter, a lifting force generated by actuating, by the fan (11), an air flow to move upward at least enables partially water to be lifted to a top of the air passage (9).
 5. The method according to one of claims 2 to 4, **characterized in that** the target parameter is set as that when the running parameter of the fan (11) reaches the target parameter, a lifting force generated by actuating, by the fan (11), an air flow to move upward enables water to be lifted and partially enter the fan (11).
 6. The method according to any preceding claim, **characterized in that** the running parameter is an input voltage.
 7. The method according to any preceding claim, **characterized in that** the control apparatus (100) runs a washing program or a drying program, and the cleaning process is integrated into the washing program or the drying program.
 8. The method according to claim 7, **characterized in that** the cleaning process is in an earlier stage of the drying program.
 9. The method according to one of claims 7 and 8, **characterized in that** each time after the drying program has run for a specific number of times, the control apparatus (100) runs the cleaning process in the washing program or the drying program.
 10. The method according to any preceding claim, **characterized in that** the cleaning process is operable to be selected by a user to run separately.
 11. The method according to any preceding claim, **characterized in that** the cleaning process is operable to be selected by a user to run during running of a washing program or a drying program.
 12. A laundry dryer (1) having a condensing apparatus (7), comprising a drying drum (5, 6) for accommodating laundry and a condensing apparatus (7) fluidly in communication with the drying drum (5, 6), wherein the condensing apparatus (7) comprises an air passage (9), a water supply apparatus (21) connected to the air passage (9), and a fan (11) that enables air from the drying drum (5, 6) to pass through the air passage (9), wherein the air passage (9) has a turbulence apparatus (30, 31, 32) that enables the air (8) passing through the air passage (9) to generate a turbulent flow, a water outlet of the water supply apparatus (21) is located above the turbulence apparatus (30, 31, 32), and the fan (11) is controlled by a control apparatus (100), **characterized in that** the control apparatus (100) is set to be capable of cleaning the condensing apparatus (7) by using the method according to any one of the foregoing claims.
 13. The laundry dryer (1) according to claim 12, **characterized in that** the fan (11) has a direct-current brushless motor (18).
 14. The laundry dryer (1) according to claim 12, **characterized in that** the turbulence apparatus (30, 31, 32) is a blocking member (32) that extends from an air passage wall (19) into an interior of the passage to change a flowing path of a blocked air flow, or a deformation (30, 31) of the air passage wall (19) in an air flowing direction or of a flowing sectional area.

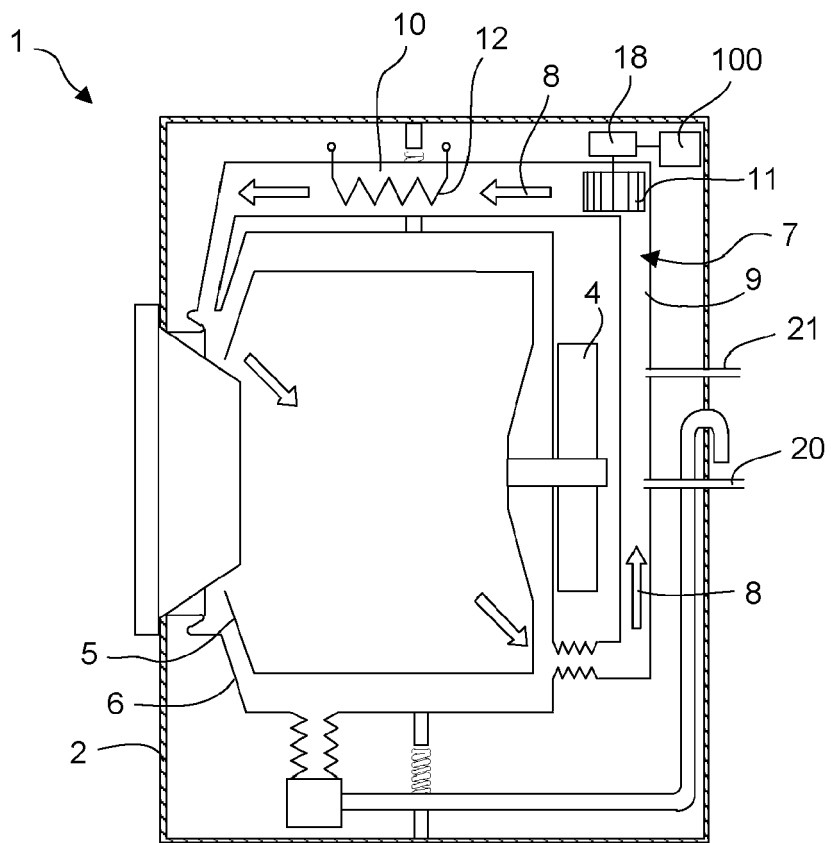


FIG. 1

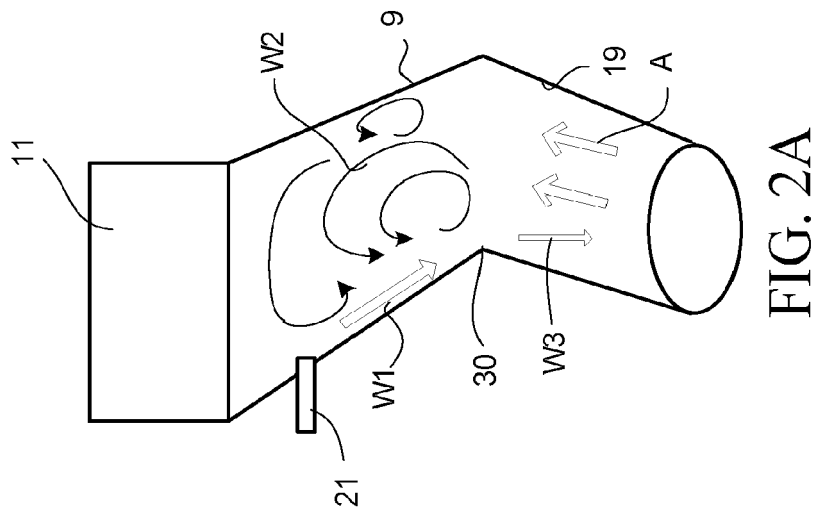


FIG. 2A

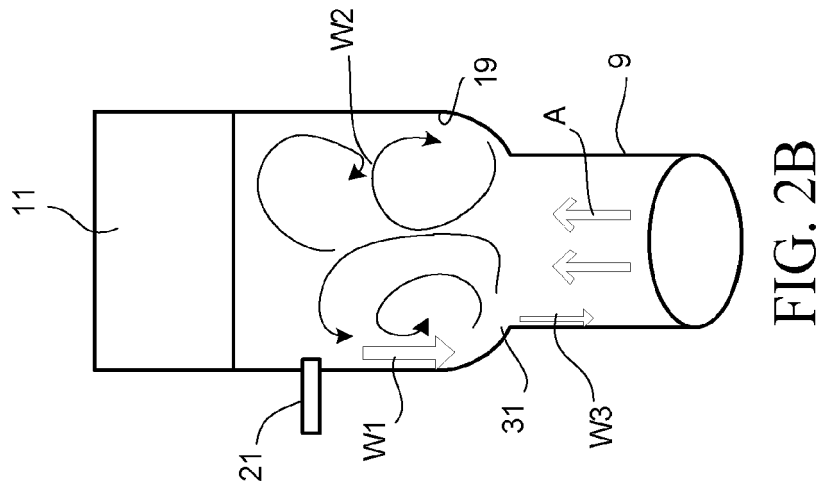


FIG. 2B

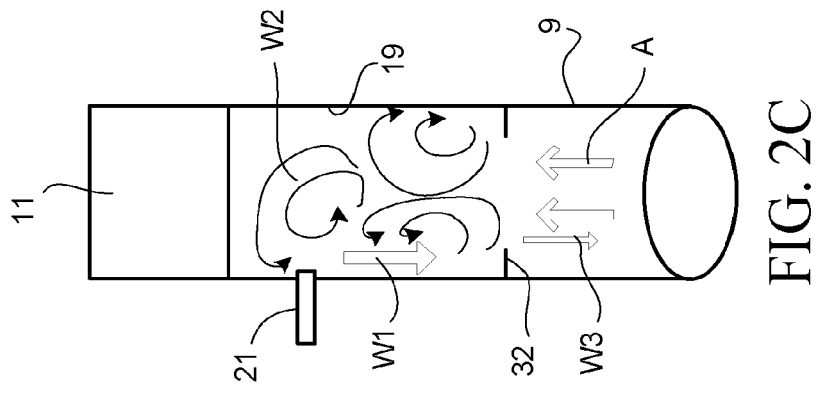


FIG. 2C



EUROPEAN SEARCH REPORT

Application Number
EP 16 18 0619

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
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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 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 16 18 0619

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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