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(71) Applicant: **LG Electronics Inc.**
Yeongdeungpo-gu
Seoul 150-721 (KR)

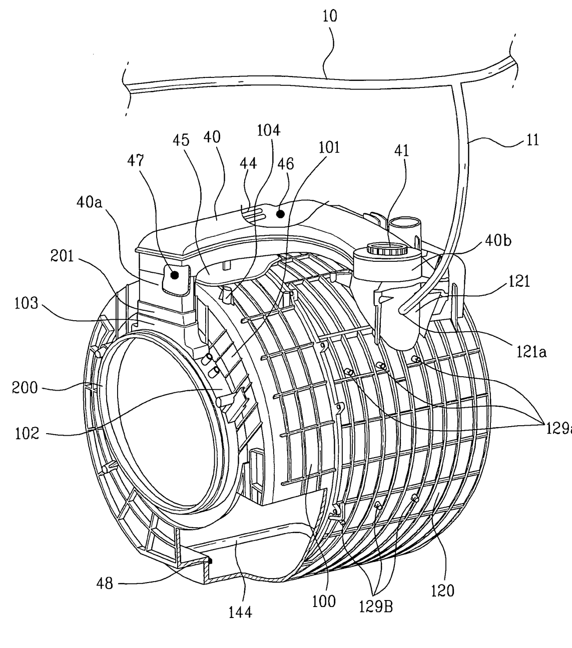
(72) Inventor: **HONG, Sangwook**
Seoul 153-802 (KR)

(74) Representative: **Urner, Peter**
Ter Meer Steinmeister & Partner
Mauerkircherstrasse 45
81679 München (DE)

(54) **LAUNDRY MACHINE HAVING A DRYING FUNCTION, AND METHOD FOR CONTROLLING SAME**

(57) The present invention relates to a laundry machine having a drying function. The laundry machine having a drying function comprises: a rotatably installed drum; a heater that generates hot air, and a fan; a filter that filters the hot air; a sensor that senses a hot-airflow resistance generated by a flow channel through which the hot air flows; and a controller which determines whether or not the filter is clogged on the basis of the hot-airflow resistance sensed by the sensor.

FIG. 2



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Description

[Technical Field]

[0001] The present invention relates to a laundry machine having a drying function and a control method for the same. More particularly, the present invention relates to a laundry machine having a drying function, which is adapted to dry laundry as a drying object, and a control method for the same, although the disclosure is not limited thereto.

[Background Art]

[0002] Examples of laundry machines having a drying function include an exclusive drying machine having only a drying function, and a dual purpose drying machine having a laundry washing function as well as a drying function. Also, laundry machines may be classified, based on the configuration and shape thereof, into a drum type machine in which a rotatable drum tumbles laundry to be dried, and a so-called cabinet type machine in which laundry is dried in a hung state.

[0003] In general, a conventional combined drying and washing machine includes a tub in which wash water is received. A drum in which laundry is located is rotatably installed in the tub. The drum is connected to a rotating shaft, and a motor is used to rotate the rotating shaft. The rotating shaft is rotatably supported via a bearing housing that is mounted to a rear wall of the tub. A suspension is connected to the tub, and serves to absorb vibration of the drum and the tub.

[0004] To achieve a drying function, a drying duct and a condensing duct are included. The drying duct is located at the top of the tub, and a hot air heater and a fan are installed within the drying duct. One end of the condensing duct is connected to the tub, and the other end is connected to the drying duct. Cold water is fed into the condensing duct and is used to condense moisture contained in wet air. The wet air is condensed in contact with the cold water while flowing in the condensing duct, and thereafter is introduced into the drying duct. Once having dried laundry, hot air is returned into the drying duct and is reheated by the hot air heater, prior to being again fed into the tub.

[Disclosure]

[Technical Problem]

[0005] An object of the present invention is to provide a laundry machine having a drying function, which is capable of sensing whether or not a filter is clogged, the filter being used to filter lint, etc. from hot air, and a control method for the same.

[Technical Solution]

[0006] The object of the present invention can be achieved by providing a laundry machine having a drying function, the machine including a rotatably installed drum, a hot air heater and a fan to generate hot air, a filter to filter the hot air, a sensor to sense a hot air flow resistance generated in a flow path, through which the hot air flows, and a controller to judge whether or not the filter is clogged using the hot air flow resistance sensed by the sensor. The hot air flow resistance may include at least one of a temperature, flow rate, and flow speed of the hot air at a predetermined position affected by flow of the hot air, revolutions per minute of the fan, power input to the fan, and an On/Off period of the hot air heater.

[0007] The laundry machine may further include at least one of a first temperature sensor and a second temperature sensor to sense the temperature of the hot air, and the first temperature sensor may be located closer to the hot air heater than the second temperature sensor. The controller may judge that the filter is clogged using at least one of the case in which a temperature sensed by the first temperature sensor exceeds a predetermined reference value, the case in which a temperature sensed by the second temperature sensor is less than a predetermined reference value, and the case in which a difference between the temperature sensed by the first temperature sensor and the temperature sensed by the second temperature sensor exceeds a predetermined reference value. The first temperature sensor may be located in a drying duct in which the hot air heater is installed, and the second temperature sensor may be installed in a tub in which the drum is accommodated.

[0008] The laundry machine may further include a flow sensor located in a drying duct in which the hot air heater is installed, the flow sensor serving to measure at least one of the flow rate and flow speed of the hot air. The flow sensor may include at least one of an orifice flow-meter, a pressure sensor, and an impeller flow-meter.

[0009] The controller may judge that the filter is clogged in the case in which the revolutions per minute of the fan are less than a reference value. The controller may judge that the filter is clogged in the case in which the power input to the fan exceeds a reference value. The controller may judge that the filter is clogged in the case in which the On/Off period of the hot air heater is less than a reference value.

[0010] The controller may judge whether or not the filter is clogged when judging that the laundry machine is normally operated. In this case, for example, the controller may judge that the laundry machine is normally operated using at least one of the case in which revolutions per minute of the fan reach a preset value, the case in which a predetermined time has passed after actuation of the fan, the case in which a preset time has passed after a drying course begins, the case in which a preset time has passed after actuation of the hot air heater, and the case in which the hot air reaches a preset temperature.

[0011] The controller may perform a required action when judging that the filter is clogged. The required action may include at least one of a user alarm, washing of the filter, inactivation of a drying course, and change in a control pattern of the hot air heater. In this case, a drying course that is being performed, or a drying course that will be performed next may be inactivated. The controller may control washing of the filter using air flow generated by rotation of the drum. Alternatively, the laundry machine may further include a filter washing unit to wash the filter.

[0012] Washing of the filter may be performed after a drying course that is being performed is finished. For example, washing of the filter may be performed in the case in which a preset time has passed after the drying course is finished, in the case in which a door is opened and closed after the drying course is finished, and/or in the case in which a next drying course or a washing course is performed. Washing of the filter may be performed in response to a user request.

[0013] The control pattern of the hot air heater may include at least one of the number of turning on and off the hot air heater, On/Off temperatures, On/Off time, and duration time of a temperature rising section/temperature maintenance section. For example, the number of reference values of On/Off temperatures for the temperature rising section in the case in which it is judged that the filter is clogged may be greater than the number of reference values of On/Off temperatures for the temperature rising section in the case in which the filter is not clogged. Also, a reference value of the On temperature for the temperature maintenance section in the case in which it is judged that the filter is clogged may be less than a reference value of the On temperature for the temperature rising section in the case in which the filter is not clogged. The number of turning off the hot air heater for the temperature rising section in the case in which it is judged that the filter is clogged may be greater than the number of turning off the hot air heater for the temperature rising section in the case in which the filter is not clogged.

[0014] The laundry machine may further include a tub in which wash water is accommodated, and the filter may be located in a hot air outlet of the tub.

[0015] The laundry machine may further include a drive unit including a rotating shaft connected to the drum, a bearing housing configured to support the rotating shaft, and a motor to rotate the rotating shaft, and a suspension assembly connected to the bearing housing to reduce vibration of the drum. The laundry machine may further include a tub in which wash water is accommodated, and a rear gasket located between the tub and the drive unit, the rear gasket allowing movement of the drive unit relative to the tub. The laundry machine may further include a hot air inlet and a hot air outlet, which are provided at the tub, and a drying duct connecting the hot air inlet and the hot air outlet to each other.

[0016] The laundry machine may further include a tub in which a suspension assembly to reduce vibration of the drum and wash water are accommodated, and the tub may be more rigidly supported than the drum.

[0017] In accordance with another embodiment of the present invention, there is provided a control method of a laundry machine having a drying function, the method including sensing a hot air flow resistance generated in a flow path of hot air used to dry an object, and judging whether or not the filter is clogged using the sensed hot air flow resistance. The hot air flow resistance may include at least one of a temperature, flow rate, and flow speed of the hot air at a predetermined position affected by flow of the hot air, revolutions per minute of a fan, power input to the fan, and an On/Off period of a hot air heater.

[0018] The control method may further include judging whether or not the laundry machine is normally operated, and judgment of whether or not the filter is clogged may be performed in the case in which it is judged that the laundry machine is normally operated. For example, whether or not the laundry machine is normally operated may be judged using at least one of the case in which revolutions per minute of a fan reach a preset value, the case in which a predetermined time has passed after actuation of the fan, the case in which a preset time has passed after a drying course begins, the case in which a preset time has passed after actuation of a hot air heater, and the case in which the hot air reaches a preset temperature.

[0019] The control method may further include performing a required action in the case in which it is judged that the filter is clogged. The required action may include at least one of a user alarm, washing of the filter, inactivation of a drying course, and change in a control pattern of the hot air heater.

[Advantageous Effects]

[0020] According to the present invention, it is advantageously possible to easily sense whether or not a filter is clogged by lint, etc. According to embodiments, an action to deal with clogging of the filter is performed by a user or in an automated manner, which can advantageously prevent deterioration in drying performance due to clogging of the filter, for example.

[Description of Drawings]

[0021] FIG. 1 is a partial exploded perspective view illustrating a first embodiment of the present invention;

[0022] FIG. 2 is a perspective view illustrating a tub and a drying module of FIG. 1;

[0023] FIG. 3 is a partial sectional view illustrating a hot air inlet of FIG. 1;

[0024] FIG. 4 is a perspective view illustrating the interior of the tub of FIG. 1;

[0025] FIG. 5 is a partial sectional view illustrating a filter assembly of FIG. 1, which is installed in a hot air outlet;

[0026] FIG. 6 is a conceptual view illustrating a filter of FIG. 5, which is radially projected onto an outer circumferential surface of a drum;

[0027] FIG. 7 is a perspective view illustrating the filter assembly of FIG. 5;

[0028] FIG. 8 is a perspective view diagrammatically illustrating a state in which wash water is fed and dispersed to the filter of FIG. 7 through a shower nozzle;

[0029] FIG. 9 is a perspective view diagrammatically illustrating a state in which wash water collides with the filter of FIG. 7 to thereby be deflected by a collision plane;

[0030] FIG. 10 is a plan view illustrating a wire filter and a punched filter, which are applicable to the filter assembly of FIG. 7;

[0031] FIG. 11 is a perspective view illustrating a circulation path of hot air in a laundry machine of FIG. 1;

[0032] FIG. 12 is a perspective view illustrating a second embodiment of the present invention;

[0033] FIG. 13 is a perspective view illustrating a third embodiment of the present invention;

[0034] FIG. 14 is a partial perspective view of FIG. 13;

[0035] FIG. 15 is a graph illustrating a temperature difference based on whether or not the filter is clogged;

[0036] FIG. 16 is a graph illustrating a relationship between the flow rate and the static pressure based on whether or not the filter is clogged;

[0037] FIG. 17 is a graph illustrating operation of a hot air heater based on whether or not the filter is clogged;

[0038] FIG. 18 is a view illustrating a diagrammatic control configuration according to an embodiment of the present invention;

[0039] FIG. 19 is a flowchart diagrammatically illustrating a control method according to an embodiment of the present invention;

[0040] FIG. 20 is a graph illustrating operation of the hot air heater when the filter is not clogged;

[0041] FIG. 21 is a graph illustrating operation of the hot air heater when the filter is clogged; and

[0042] FIG. 22 is a graph illustrating another operation of the hot air heater when the filter is not clogged.

[Best Mode]

[0043] The entire configuration of a laundry machine having a drying function according to an exemplary embodiment of the present invention will hereinafter be described with reference to FIGs. 1 and 2.

[0044] FIG. 1 is a partial exploded perspective view illustrating the laundry machine according to the embodiment of the present invention. In FIG. 1, it is intended to only diagrammatically illustrate an entire configuration of the embodiment, and thus some elements may be omitted. The laundry machine of FIG. 1 is a combined drying and washing machine having both a drying function and a washing function. In the present embodiment, a tub serves as a condenser.

[0045] In the laundry machine according to the embodiment, the tub is fixed to and supported by a cabinet. The tub may consist of a tub front part 100 and a tub rear part 120.

[0046] The tub front part 100 and the tub rear part 120 may be assembled to each other using screws, and internally define a space in which a drum is accommodated. The tub rear part 120 has an opening formed in a rear side thereof. A flexible member, i.e. a rear gasket 250 is attached to the opening of the tub rear part 120. The rear gasket 250 may in turn be connected, at a radial inner periphery thereof, to a tub back part 130. The tub back part 130 has a center hole, through which a rotating shaft 351 penetrates. The rear gasket 250 is flexibly deformable to prevent vibration of the tub back part 130 from being transmitted to the tub rear part 120.

[0047] The rear gasket 250 is connected to the tub back part 130 and the tub rear part 120 respectively, and serves as a seal to prevent leakage of wash water from the tub. The tub back part 130 is adapted to vibrate along with the drum during rotation of the drum. In this case, the rear gasket 250 is spaced apart from the tub rear part 120 by a sufficient distance so as not to interfere with the tub rear part 120. Since the rear gasket 250 is flexibly deformable, the rear gasket 250 may allow the tub back part 130 to perform relative motion without interference with the tub rear part 120. The rear gasket 250 may have a curved portion or a creased portion, which can extend by a sufficient length to allow relative motion of the tub back part 130.

[0048] The tub has a front opening for entrance/exit of laundry. A front gasket 200 may be attached to the front opening of the tub. The front gasket 200 serves not only to prevent leakage of wash water through the entrance/exit opening, but also to prevent laundry or foreign substances from entering between the tub and the drum, although it may also accomplish other functions.

[0049] The drum may consist of a drum front part 300, a drum center part 320, and a drum back part 340. Ball balancers 310 and 330 may be mounted respectively to front and rear positions of the drum. The drum back part 340 is connected to a spider 350, and in turn the spider 350 is connected to a rotating shaft 351. The drum is rotated within the tub by rotational force that is transmitted through the rotating shaft 351.

[0050] The rotating shaft 351 penetrates the tub back part 130 and is connected to a motor. In the present embodiment, the motor and the rotating shaft are concentrically connected to each other. Also, in the present embodiment, the motor is directly connected to the rotating shaft. More specifically, a rotor of the motor is directly connected to the rotating shaft 351. A bearing housing 400 is coupled to a rear surface 128 of the tub back part 130. The bearing housing 400 functions to rotatably support the rotating shaft 351 between the motor and the tub back part 130.

[0051] A stator is secured to the bearing housing 400. The stator is surrounded by the rotor. As described above, the rotor is directly connected to the rotating shaft

351. That is, the motor is an outer rotor type motor and is directly connected to the rotating shaft 351.

[0052] The bearing housing 400 is supported by a cabinet base 600 with a suspension unit interposed therebetween. The suspension unit may include a plurality of brackets, which is connected to the bearing housing. The plurality of brackets may include radial brackets 430 and 431, which extend in a radial direction, and axial brackets 440 and 450 which extend in a front-and-rear direction or in a rotation-axis direction of the drum.

[0053] The suspension unit may include a plurality of suspensions, which is connected to the plurality of brackets. In the present embodiment, the suspensions may include three vertical suspensions 500, 510 and 520, and two oblique suspensions 530 and 540 that are installed obliquely with respect to a front-and-rear direction. The suspension unit is not completely fixed to the cabinet base 600, but is elastically deformable to some extent. With this configuration, the suspension unit allows forward or rearward movement as well as leftward or rightward movement of the drum. That is, the suspension unit is elastically supported, so as to pivotally rotate forward or rearward and leftward or rightward to some extent about a support point thereof connected to the base. To accomplish the elastic support configuration, the suspension unit may be mounted to the base 600 with a rubber bushing interposed therebetween. Of the plurality of suspensions, the vertical suspensions may serve to elastically absorb vibration of the drum, and the oblique suspensions may serve to alleviate the vibration. That is, in consideration of a vibration system including a spring and a damping means, the vertical suspensions may serve as the spring, and the oblique suspensions may serve as the damping means.

[0054] The tub is secured to the cabinet, and vibration of the drum is absorbed by the suspension unit. The tub may be secured, at a front surface and a rear surface thereof, to the cabinet. The tub may be seated on and supported by the base of the cabinet, and may also be secured to the base.

[0055] In the drying machine of the present embodiment, the tub and the drum may substantially have separate support configurations. In the case of the drying machine, moreover, the tub may not vibrate even if the drum vibrates. The magnitude of vibration of the drum transmitted to the tub may be changed according to the rear gasket.

[0056] The drying machine of the present embodiment exhibits remarkably low vibration of the tub, which eliminates a need for a distance between the cabinet and the tub that has conventionally been required as a vibration margin. This allows an outer surface of the tub to be located close to the cabinet to the maximum extent. As a result, it is possible to increase the size of the tub even without increasing the size of the cabinet, and to increase the capacity of the drying machine based on the size of the same external appearance.

[0057] A distance between a cabinet right plate 630 or a cabinet left plate 640 and the tub may be substantially not more than about 5 mm. In a conventional drying machine in which the tub exhibits vibration, a distance between the tub and the cabinet must be about 30 mm, in order to prevent vibration of the tub from having a negative effect on the cabinet. In the present embodiment, the diameter of the tub may be 50 mm greater than the diameter of the conventional tub. This results in an outstanding advantage, i.e. enhanced capacity of the drying machine.

[0058] Although the above described embodiment exemplifies the tub as being fixedly installed to the cabinet, the present invention is not limited thereto. For example, the tub may be supported using a flexible support structure, such as a suspension unit. Moreover, the tub may be supported to exhibit a medium state between a suspended support state and a fixed support state.

[0059] More specifically, the tub may be supported using the same flexible structure as the suspension unit, or may be supported to perform more rigid movement than that obtained when supported by the flexible support structure. In one example, the tub may be supported using a flexible suspension unit. In another example, the tub may be supported using a rubber bushing that is less flexible than the suspension unit, but may ensure somewhat flexible movement. Alternatively, the tub may be completely fixed.

[0060] Examples of the case in which the tub is more rigidly supported as compared to the case of using the suspension unit will hereinafter be described. First, at least a portion of the tub may be integrally formed with the cabinet. For example, the tub and the cabinet may be integrally formed via injection molding. More specifically, a partial front portion of the tub is integrally injection molded with a front surface of the cabinet. Second, the tub may be connected to and supported by the cabinet using screws, rivets, rubber bushings, etc., or may be secured to and supported by the cabinet via welding, adhesive sealing, etc. In these cases, the resulting connection member has greater rigidity than the suspension unit with respect to a main vibration direction of the drum, i.e. with respect to a vertical direction.

[0061] As described above, the tub may have an increased size within the possible limit of an installation space. That is, the tub may be increased in size such that at least one of left and right walls of the tub (extending in a direction perpendicular to the horizontal rotating shaft) is located close to a wall or frame that limits a left-and-right dimension of the installation space (for example, the cabinet left plate or the cabinet right plate). Here, the tub may be integrally formed with the cabinet left plate or the cabinet right plate.

[0062] The tub may be configured so as to be closer to a wall or frame of the cabinet than the drum with respect to a left-and-right direction. For example, the tub may be spaced apart from the wall or frame by a distance of 1.5 times or less of a distance between the tub and the drum. Assuming that the tub has an increased left-and-right dimension, the drum may also have an increased left-and-right dimension. Additionally, the smaller the left-and-right distance between the tub and the drum, the greater the left-and-right length of the drum. To reduce the left-and-right distance between the tub and the drum, left-and-right vibration of the drum may be considered. The smaller the left-and-right vibration of the drum, the greater the diameter of the drum. As a result, the suspension unit, which is used to absorb vibration of the drum, may have greater rigidity with respect to the left-and-right direction than with respect to other directions. For example, the suspension unit may have the maximum rigidity against left-and-right displacement as compared to displacement in other directions.

[0063] Additionally, as described above, the suspension unit may be directly connected to the bearing housing that supports the rotating shaft connected to the drum, instead of penetrating the tub as in the related art. In this case, the suspension unit may include a bracket, which extends in an axial direction of the rotating shaft. The bracket may protrude forward to a door.

[0064] The suspension unit may include at least two suspensions, which are spaced apart from each other in an axial direction of the rotating shaft. In one embodiment, the suspension unit may include a plurality of suspensions arranged below the rotating shaft to support an object (for example, the drum) in a standing posture. In another embodiment, the suspension unit may include a plurality of suspensions arranged above the rotating shaft to support the object in a hanging posture. It will be appreciated that the aforementioned embodiments deal with a configuration in which the suspensions are arranged only above or below the rotating shaft to support the drum.

[0065] The drum, the rotating shaft, the bearing housing, the motor, etc. constitute a vibrating body. The center of gravity of the vibrating body may be positioned toward the motor at least on the basis of the longitudinal center of the drum. At least one of the suspensions may be located at the front or rear side of the center of gravity. Alternatively, two suspensions may respectively be located at the front and rear sides of the center of gravity.

[0066] As described above, the tub may have the rear opening. A drive unit, which is constructed by the rotating shaft, the bearing housing, the motor, etc., may be connected to the tub with a flexible member interposed therebetween. The flexible member may serve not only as a seal to prevent leakage of wash water through the rear opening of the tub, but also to allow movement of the drive unit relative to the tub. The flexible member may be formed of various materials so long as they are sealable and flexible. For example, the flexible member may be formed of the same material as that of the front gasket. In this case, for convenience, the flexible member may be referred to as a rear gasket, in response to the front gasket. The rear gasket may be connected to the drive unit such that rotation of the rear gasket is restricted at least with respect to the rotation direction of the rotating shaft. In one embodiment, the rear gasket may be directly connected to the rotating shaft, and may be connected to an extension of the bearing housing.

[0067] A part of the drive unit, which is arranged in front of a connecting portion between the drive unit and the rear gasket and may be exposed to wash water within the tub, may be formed to be free from corrosion due to wash water. For example, the corresponding part may be subjected to anticorrosion coating, and may be enclosed at a front surface thereof by a separate plastic part (for example, the aforementioned tub back part). In the case of a metallic part of the drive unit, it is desirable to prevent the metallic part from being directly exposed to water, in order to prevent corrosion thereof.

[0068] Differently from the above described embodiment, the cabinet may not be provided. For example, in the case of a built-in drying machine, an installation space for the drying machine may be defined by a wall structure, rather than the cabinet. That is, the drying machine may not include the cabinet, which independently defines an external appearance. Even in this case, a front wall structure may be necessary.

[0069] Now, a configuration related to a drying function will be described with reference to FIGs. 2 and 3. FIG. 2 illustrates a drying duct 40 that is installed to the tub 100; 120. FIG. 3 illustrates the cross section of a front upper region of the tub 100; 120, to which the drying duct 40 is connected.

[0070] The tub 100; 120 includes a front surface portion 101 that is located in front of a laundry entrance/exit opening of the drum 300; 320; 340. The front surface portion 101 is provided with a forwardly protruding rim portion 102. The front gasket 200 is fitted to a front end of the rim portion 102. The rim portion 102 has an upper region protruding forward than a lower region thereof.

[0071] A hot air inlet 103 for introduction of hot air is provided at the top of the rim portion 102. The hot air inlet 103 is configured to protrude upward from the top of the rim portion 102. The protrusion angle of the hot air inlet 103 is within a range of 45 degrees with respect to a virtual plane where the laundry entrance/exit opening of the drum 300; 320; 340 is placed. In the present embodiment, the protrusion angle is within a range of 10 degrees, such that the hot air inlet 130 is approximately parallel to the virtual plane.

[0072] Both ends of the drying duct 40 are in direct communication with the tub 100; 120. The drying machine of the present embodiment does not include a condensing duct, differently from the related art. Accordingly, the drying duct 40 is in direct communication with the tub 100; 120. That is, although a conventional hot air circulation flow path is in the order of "drying duct - tub - drum - tub - condensing duct - drying duct", a circulation flow path of the present embodiment is in the order of "drying duct - drum - tub - drying duct". The conventional circulation flow path including the condensing duct is complicated and long because hot air is introduced into a gap between the tub 100; 120 and the drum 300; 320; 340.

More specifically, conventionally, hot air has been introduced into a gap between an inner surface of a front wall of the tub and an outer surface of a front wall of the drum to thereby be directed to an outer circumferential surface of the drum. This introduction of hot air between wall surfaces of the drum and the tub, however, may inefficiently cause some of the hot air to stay in the tub and then be directed into the condensing duct, rather than being introduced into the drum. Additionally, the complicated long circulation flow path may result in occurrence of heat loss and disadvantageously large flow resistance.

[0073] In the present embodiment, the drying duct 40 includes a connection duct 40a, which is inserted into the hot air inlet 103, and a scroll 40b which is connected to a hot air outlet 121 formed at the tub 100 and 120, the scroll 40b being configured to accommodate a fan 41 located therein. A hot air heater 44 is installed in the drying duct 40 between the connection duct 40a and the scroll 40b.

[0074] Preferably, a temperature sensor to sense the temperature of hot air is installed at a certain position on the circulation flow path (function of the temperature sensor will be described hereinafter). For example, a first temperature sensor 47 to sense the temperature of hot air may be installed to the drying duct 10, and a second temperature sensor 48 may be installed to the tub. Although the first temperature sensor 47 and the second temperature sensor 48 of the present embodiment is installed respectively to sense the interior temperature of the duct 10 and the tub, they may be installed to sense the surface temperature of the duct 10 and the tub. The temperature sensors 47 and 48 are preferably spaced apart from each other and are more preferably spaced apart from each other in a flow direction of hot air. Of course, only one of the first temperature sensor 47 and the second temperature sensor 48 may be installed. Each of the first temperature sensor 47 and the second temperature sensor 48 may be affected by radiant heat from the hot air heater 44 and a tub heater 144. Therefore, there is a need for a shield capable of blocking radiant heat. The shield may serve not only to protect the first temperature sensor 47 and the second temperature sensor 48, but also to reduce the effect of radiant heat on temperature sensing.

[0075] Although the present embodiment has illustrated and described as one of the temperature sensors 47 and 48 being installed to the duct and the other one being installed to the duct, the present invention is not limited thereto. For example, the temperature sensors 47 and 48 may be installed at positions suitable to directly or indirectly measure the interior temperature of a hot air flow path. For example, the temperature sensors may be installed at positions suitable to measure the temperature of the surface of the duct through which the hot air flows, or the temperature of the surroundings. Alternatively, both the first temperature sensors 47 and 48 may be installed within the duct or the tub.

[0076] Additionally, a sensor to sense the flow rate or flow speed of hot air (hereinafter, for convenience, referred to as "flow sensor") is preferably installed at a certain position on the circulation flow path (function of the flow sensor will hereinafter be described). In the present embodiment, a flow sensor 46 to sense the flow rate or flow speed of hot air is installed to the drying duct 10. An installation position of the flow sensor 46 is not limited to the drying duct 10, and may be installed at another hot air path. For example, the sensor 46 may be installed within the tub. In the present embodiment, there is no condensing duct because condensation occurs within the tub. However, if there is a condensing duct, the sensor 46 may be installed to the condensing duct. The hot air discharged from the tub is condensed while flowing through the condensing duct, and the sensor 46 may sense the flow rate or flow speed of the hot air.

[0077] The sensor 46 may be selected from various kinds of sensors so long as it can sense the flow rate or flow speed of hot air. For example, an orifice flow-meter or a pressure sensor may be used. Since change in the flow rate or flow speed of hot air causes change in the pressure of hot air, the flow rate of hot air may be sensed by sensing the pressure of hot air. Alternatively, the sensor may be an impeller flow-meter. The impeller flow-meter may sense the flow rate or flow speed of hot air using change in revolutions per minute of an impeller.

[0078] A connection configuration of the drying duct 10 will hereinafter be described with reference to FIGs. 2 and 3.

[0079] The front gasket 200 is coupled to the front end of the rim portion 102 of the tub 100; 120. The front gasket 200 has a duct connecting portion 201 inserted into the hot air inlet 103, and serves as a seal between the connection duct 40a and the hot air inlet 103. The connection duct 40a is inserted into the duct connecting portion 201 of the front gasket 200. An upper end of the connection duct 40a is assembled to a portion of the drying duct 40 in which the hot air heater 44 is installed, and a lower end of the connection duct 40a is snug-fitted to the hot air inlet 103 with the duct connecting portion 201 of the front gasket 200 interposed therebetween.

[0080] As illustrated in FIG. 3, the hot air inlet 103 is located in front of the laundry entrance/exit opening of the drum 300; 320; 340. A discharge port of the connection duct 40a inserted into the hot air inlet 103 is also located in front of the laundry entrance/exit opening of the drum 300; 320; 340.

[0081] As illustrated in FIG. 3, the laundry entrance/exit opening of the tub 100; 120 is located in front of the hot air inlet 103. A door 90 is provided to open or close the laundry entrance/exit opening and is provided with a door glass 91, at least an upper portion of which is tilted downward toward the drum 300, 320 and 340. The door glass 91 is located below the hot air inlet 103. Hot air discharged from the connection duct 40a is directed downward to thereby collide with the door glass 91, and then is changed in direction toward the interior of the drum 300; 320; 340. That is, the upper portion of the door glass 91 assists the hot air discharged from the connection duct 40a in entering the drum 300; 320; 340.

[0082] The present embodiment may ensure that almost all the hot air is introduced into the drum 300; 320; 340. With a conventional configuration, hot air is introduced into a gap between the front surface portion 101 of the tub 100; 200 and a front surface portion of the drum 300; 320; 340, and moreover introduction of the hot air is guided such that the hot air orthogonally collides with the front surface portion of the drum 300; 320; 340. Accordingly, the conventional configuration allows only about 30% of hot air directed from the drying duct 40 to be introduced into the drum 300; 320; 340. This inefficiently causes the other 70% of hot air to be discharged into the condensing duct after having passed through the gap between the drum 300; 320; 340 and the tub 100; 120, and the discharged hot air cannot be used to dry laundry located within the drum 300; 320; 340.

[0083] In the present embodiment, the tub 100; 120 is tilted such that a front portion is located higher than a rear portion. As such, the front surface portion 101 of the tub 100; 120 is tilted by the same angle on the basis of a vertical axis. The drum 300; 320; 340 is also tilted by a similar angle.

[0084] However, the laundry entrance/exit opening of the tub 100; 120 is oriented parallel to the vertical axis, rather than being tilted. This is accomplished as an upper end of the rim portion 102 of the tub 100; 120 protrudes forward. That is, to achieve the laundry entrance/exit opening parallel to the vertical axis, the upper end of the rim portion 102 is protruded farther forward than the front surface portion 101 of the tub 100; 120 that is tilted by a predetermined angle on the basis of the vertical axis.

[0085] A predetermined space is defined between an upper region of the front surface portion 101 of the tub 100; 120 and the inner surface of the front wall of the cabinet as the tub 100; 120 is tilted. The connection duct 40a is installed in the space. Of course, the tub 100; 120 may not be tilted differently from the above description.

[0086] In the present embodiment, the tub 100; 120 is fixedly connected to the cabinet. That is, the tub 100; 120 is secured to the cabinet. In the present embodiment, the tub 100; 120 has substantially no vibration as compared to the drum 300; 320; 340, and thus can stably support the drying duct 40. Specifically, in the present embodiment, the front surface portion 101 of the tub 100; 120 and a rear surface portion of the tub 100; 120 are respectively fastened to a front wall (not shown) and a rear wall 620 of the cabinet via screws or bolts. In addition, the tub 100; 120 is installed to a bottom plate 600 so as to exhibit a self-standing posture.

[0087] The drying duct 40 is mounted at the top center of the tub 100; 120. One end of the drying duct, i.e. the connection duct 40a is inserted into the hot air inlet 103 and the other end of the drying duct, i.e. the scroll 40b in which the fan 41 is installed is laterally bent and is connected to the hot air outlet 121 of the tub 100; 120 (see FIG. 2).

[0088] The hot air heater 44 to generate hot air is installed in a front region of a portion of the drying duct 40 located at the top of the tub 100; 120. Air blown by rotation of the fan 41 is heated by the hot air heater 44. A region of the drying duct 40 where the hot air heater 44 is located may be kept at a high temperature owing to heat of the hot air heater 44. Accordingly, an insulator 45 is located between the tub 100; 120 and the region of the drying duct 40 where the hot air heater 44 is located. The drying duct 40 is fixedly installed to the top of the tub 100; 120. In the present embodiment, the drying duct 40 is screwed to the tub 100; 120.

[0089] The hot air outlet 121 is formed at a lateral position (in the present embodiment, at a right position) of an upper region of the outer circumferential surface of the tub 100; 120 (see FIG. 2). The scroll 40b of the drying duct 40 is installed above the hot air outlet 121. The fan 41 located within the scroll 40b suctions hot air from the hot air outlet 121 and blows the hot air into the drying duct 40. The fan 41 is configured to suction hot air in an axial direction of the rotating shaft and blow the hot air in a radial direction. That is, in the present embodiment, a centrifugal fan is used.

[0090] The discharge direction of hot air from the hot air outlet 121 coincides with the suction direction of hot air into the fan 41. This configuration facilitates more efficient circulation of hot air. The hot air discharged from the tub 100; 120 through the hot air outlet 121 is directly introduced into the fan 41 and is blown to the drying duct 40 without change in the discharge direction thereof.

[0091] Both the hot air inlet 103 and the hot air outlet 121 are located at an upper region of the tub 100; 120. Also, the hot air inlet 103 is located at a front position and the hot air outlet 121 is located at a rear position. A longitudinal axis of the hot air flow direction of each of the hot air inlet 103 and the hot air outlet 121 is within a range of 10 degrees on the basis of the vertical axis. Also, an angle between the longitudinal axes of the hot air inlet 103 and the hot air outlet 121 is within a range of 10 degrees. In the present embodiment, the longitudinal axis of the hot air flow direction of the hot air inlet 103 and the longitudinal axis of the hot air flow direction of the hot air outlet 121 are parallel to each other, and the hot air inlet 103 and the hot air outlet 121 have opposite hot air flow directions.

[0092] The hot air inlet 103 and the hot air outlet 121 are in communication with each other through the drying duct 40 that is located at the top of the tub 100 and 120. As such, the hot air flows in a simplified circulation path in the order of "Drying duct - Tub- Drying duct". The tub 100; 120 internally defines a relatively wide space, and thus may cause relatively low flow resistance. In the present embodiment, the flow resistance may mainly occur in the drying duct 40. Considering the conventional drying machine from the above described viewpoint, leaving the complexity of a flow path due to the condensing duct aside, addition of the condensing duct proportionally causes an increase in the length of the duct flow path, resulting in greater flow resistance.

[0093] Referring to FIG. 4, the interior configuration of the tub in relation to a drying function will hereinafter be described as follows. A condenser plate 42 is affixed to an inner circumferential surface of the tub 100; 120. The condenser plate 42 may be formed of a metal material. Although the tub 100; 120 may be formed of a metal material, the tub 100; 120 may be formed by injection molding of a plastic material. In the case in which the tub 100; 120 is formed of a plastic material, installing the metallic condenser plate 42 having cold nature within the tub 100; 120 may be advantageous for condensation.

[0094] To install the condenser plate 42, the tub 100; 120 is provided with three fastening bosses 129a and 129b that are respectively provided at an upper region and a lower region of the tub 100; 120 (see FIG. 2). The fastening bosses are provided to enable screwing from the inner circumferential surface of the tub 100; 120. When attempting to affix the condenser plate 42 placed on the inner circumferential surface of the tub 100; 120 by fastening screws from the outer circumferential surface of the tub 100; 120, it may be necessary to seal fastening holes perforated for screwing. However, the sealing may be unnecessary when the fastening bosses are formed to enable screwing from the inner circumferential surface of the tub 100; 120 as described in the present embodiment. That is, the fastening bosses 129a and 129b protrude from the outer circumferential surface of the tub 100; 120, but do not communicate with the inner circumferential surface of the tub 100; 120.

[0095] The condenser plate 42 is installed at the center of a lateral region of the inner circumferential surface of the tub 100; 200. Installation of the condenser plate 42 is accomplished as screws 42a and 42b are fastened into the above described fastening bosses 129a and 129b. Assuming that the inner circumferential surface of the tub 100; 120 is divided into upper, lower, left and right regions, the condenser plate 42 is affixed to the center of a right region of the inner circumferential surface where the hot air outlet 121 is located. On the basis of the hot air outlet 121, the condenser plate 42 is located on the inner circumferential surface of the tub 100; 120 below the hot air outlet 121. The hot air, which has attained moisture while passing through the drum 300; 320; 340, is condensed in contact with the condenser plate 42 affixed to the inner circumferential surface of the tub 100; 120, prior to being discharged from the tub 100; 120 through the hot air outlet 121. Here, although condensation may occur even at another region of the inner circumferential surface of the tub 100; 120, more effective condensation is possible at the condenser plate 42 because the condenser plate 42 is formed of a metal material. The condenser plate 42 may be formed of stainless steel.

[0096] Meanwhile, the hot air, which is directed to pass through wet laundry within the drum 300; 320; 340 for drying, may contain foreign substances, such as lint, etc. A filter to remove the foreign substances may be installed. This will hereinafter be described in more detail with reference to FIGs. 4 to 10.

[0097] An installation configuration of a filter 52 will hereinafter be described with reference to FIGs. 4 and 5. The filter 52 is installed to an inner region of the tub 100; 120 that is exposed. In particular, the filter 52 is located on the inner circumferential surface of the tub 100; 120. The hot air outlet 121 is formed in the circumferential wall of the tub 100; 120, and in turn the filter 52 is installed to the hot air outlet 121.

[0098] If the drum 300; 320; 340 is rotated, an air eddy is created around the rotating drum 300, 320 and 340. As the air eddy collides with the filter 52, removal of foreign substances, such as lint, etc., from the filter 52 is accomplished. In this case, if wet laundry is present within the drum 300; 320; 340, water extracted from the laundry may be diffused to the inner wall surface of the tub 100; 120 through holes 321 of the drum 300; 320; 340. Collision of the water with the filter 52 may increase washing effects of the filter 52. This is because wetting the filter 52 using the water may ensure easier washing of the filter 52 in consideration of the case in which dried foreign substances, such as lint, etc., are adhered to a surface of the filter 52.

[0099] The filter 52 is installed inside the hot air outlet 121. In the case in which the hot air outlet 121 protrudes outward from the tub 100; 120 as illustrated, the filter 52 may be installed inside the hot air outlet 121, more particularly, at a position close to the inner surface of the tub 100; 120. This ensures easy access of the eddy caused by the drum 300; 320; 340 or the water extracted from the laundry as described above to the filter (here, the water extracted from the laundry may be discharged through the holes of the drum according to revolutions per minute of the drum even during a washing course except for a dehydration stroke, and is referred to as 'dehydration water' for convenience). In the present embodiment, the hot air outlet 121 protrudes upward from a rear upper region of the tub 100; 120, and the filter 52 is installed inside the hot air outlet 121 at a position close to a lower end of the hot air outlet 121.

[0100] Differently from the present embodiment, the filter 52 may protrude from the hot air outlet 121 inward of the tub 100; 120. It will be appreciated that the filter 52 may protrude inward of the tub 100; 120 beyond the hot air outlet 121 so long as the filter 52 does not interfere with the drum 300; 320; 340.

[0101] The filter 52 may be curved by a radius of curvature similar to that of the inner surface of the tub 100; 120. A difference between the radius of curvature of the inner surface of the tub 100; 120 and the radius of curvature of the filter 52 may be within a range of 10%. although it may be slightly changed according to an installation position of the filter 52 with respect to the hot air outlet 121. Since the eddy created around the rotating drum 300; 320; 340 partially flows along the inner circumferential surface of the tub 100; 120 to thereby be accessible to the filter 52, less difference in the radius of curvature may be effective for washing of the filter.

[0102] Referring to FIG. 6, the filter 52 may be positioned around the circumferential surface of the drum 300; 320; 340. Of course, the filter 52 is spaced apart from the drum so as not to interfere with rotation of the drum, the filter 52 may be positioned such that at least a half or more of the filter 52 overlaps the circumferential surface of the drum 300; 320; 340 in the viewpoint of an arrangement relationship with respect to a front-and-rear direction. In other words, when projecting the filter 52 in a radial direction onto the circumferential surface of the drum 300; 320; 340, a half or more of a projected portion PA of the filter 52 may overlap the circumferential surface of the drum 300; 320; 340. This serves to facilitate access of the eddy caused by the drum 300; 320; 340 or the dehydration water to the filter 52, thereby allowing the eddy or the dehydration water to relatively strongly hit the filter 52.

[0103] In the present embodiment, the filter 52 is preferably provided by a filter assembly. A filter assembly 50 will now be described with reference to FIGs. 5 and 7. The filter assembly 50 includes a filter housing 51 in which the filter 52 is mounted. The filter housing 51 includes a hollow body 51c having a predetermined length. The filter 52 is mounted at one end of the filter housing 51. The filter housing 51, as illustrated in FIG. 5, may be inserted into the hot air outlet 121 so as to be affixed to an inner surface thereof. An outer surface of the filter housing 51 may be fixedly fastened to the inner surface of the hot air outlet 121. To this end, in the present embodiment, the filter housing 51 has a fastening hole 51a for screwing. Alternatively, the outer surface of the filter housing 51 may be snug-fitted to the inner surface of the hot air outlet 121. The filter housing 51 may have the same length as a protruding length of the hot air outlet 121.

[0104] Although not illustrated, differently from the above described filter assembly, the filter housing may have a hollow disc shape. The filter may be mounted to one surface of the disc-shaped filter housing. The filter assembly having the above described shape may be fixedly hooked to the hot air outlet 121. The disc-shaped filter assembly may be obtained by removing an upwardly protruding hollow portion from the filter housing 51 of the filter assembly 50 of FIG. 7 except for the lower end of the filter housing 51 at which the filter 52 is mounted.

[0105] Meanwhile, to further enhance washing effects of the filter 52, a filter washing unit may be added to feed air or water to the filter 52. In the case of air ejection, air may be ejected in an opposite direction of the flow direction of hot air passing through the filter 52 during drying.

[0106] In the present embodiment, the filter washing unit feeds cleaning water w. To this end, as illustrated in FIG. 2, a water feed hose 10 may be provided to feed water into the tub 100; 120, and a branch hose 11 may be diverged from the water feed hose 10 and be connected to a water feed hole 121a of the hot air outlet 121.

[0107] The water fed from the branch hose 11 is fed to an outer surface of the filter 52 opposite to an inner surface of the filter 52 facing the interior of the tub 100; 120. The fed water flows into the tub 100; 120 while being used to wash the filter 52.

[0108] The cleaning water w used to wash the filter 52 may be fed simultaneously with feed of wash water into the tub 100; 120. A valve may be installed at a junction between the water feed hose 10 and the branch hose 11 or within the branch hose 11. As such, a time period when the cleaning water w is fed to the filter 52 may be adjusted. If the above described valve is not present, the cleaning water w may be fed to the filter 52 whenever wash water is fed into the tub 100; 120.

[0109] During washing of the filter 52, e.g., lint adhered to the filter 52 is primarily wet by the cleaning water w fed as described above. If the drum 300; 320; 340 is rotated in such a state, the filter 52 is washed with collision of the eddy or the dehydration water with the filter 52.

[0110] Meanwhile, the cleaning water w may be dispersed so as to be uniformly fed to the outer surface of the filter 52. To this end, as illustrated in FIG. 8, an ejector 121b, such as a shower nozzle, may be installed to the water feed hole. In the present embodiment, as illustrated in FIG. 9, a collision plane 51b is provided. As the falling cleaning water w collides with the collision plane 51b to thereby be dispersed, the cleaning water 2 is widely spread onto the filter 52. The collision plane 51b may be integrally formed at one end of the above described filter housing 51.

[0111] The filter 52 may be a metal filter. For example, a metal wire filter formed by weaving a metal wire may be used as illustrated in FIG. 10(a) (see the upper drawing of FIG. 10). Alternatively, a punched filter formed by punching a plurality of holes in a metal plate may be used as illustrated in FIG. 10(b) (see the lower drawing of FIG. 10). The punched filter is advantageous to easily remove, e.g., lint because it can provide the filter 52 with a smooth surface. In the case of the metal wire filter, the best is preferably a #30 mesh or less. The wire filter having the mesh size of more than 30 mesh may have difficulty in removing, e.g., lint because of an excessively small hole size and a great number of meshes. Here, the mesh size is determined by the number of meshes per the vertical length of 1 inch. That is, the mesh 30 means the mesh size of a wire filter having about 30 meshes per inch.

[0112] The kind of the filter 52 may be determined in consideration of washing effects of the filter 52 based on revolutions per minute of the drum 300; 320; 340. For example, the kind of the filter 52 may be determined to enable washing of the filter 52 when revolutions per minute of the drum 300; 320; 340 are 400 rpms or more.

[0113] However, regardless of the kind of the filter 52, satisfactory washing effects of the filter 52 may be confirmed if revolutions per minute of the drum 300; 320; 340 exceed 1000 rpms. In particular, excellent washing effects of the filter 52 has experimentally confirmed when dehydration of wet laundry received in the drum 300; 320; 340 is performed at 1000 rpms or more in a state in which e.g., lint is accumulated on the filter 52. In the above experiment, the above described cleaning water w to wash the filter 52 is not fed.

[0114] In one embodiment of the laundry machine according to the present invention, the filter 52 is exposed to the interior of the tub 100; 120, so as to be automatically washed by the eddy caused by the drum 300; 320; 340 or the dehydration water. In this case, as described above, the cleaning water w may be additionally fed via the filter washing unit.

[0115] Alternatively, differently from the above described embodiment, the filter 52 may be installed at a position where the filter 52 can be washed by wash water stored in the tub 100 and 120. For example, differently from the above described embodiment, the hot air outlet 121 may be formed at a lower position of the tub 100; 120 and the filter 52 may be installed in the hot air outlet 121. As such, the filter 52 can be washed by wash water or rinse water during a washing stroke or a rinsing stroke of a certain washing course. Through rotation of the drum 300; 320; 340, the water stored in the tub 100; 120 forms a rising water stream to reach the filter 52, thereby enabling washing of the filter 52. Alternatively, the filter 52 may be located at a position where the filter 52 can be immersed in the water stored in the tub 100; 120 during the washing stroke or the rinsing stroke to enable washing of the filter 52.

[0116] The above described embodiments exemplify the combined washing and drying machine. Accordingly, the above described water feed hose 10 may be connected to the tub 100; 120 by way of a detergent box (not shown). As such, water may be fed into the tub 100; 120 through the water feed hose 10 during washing or rinsing.

[0117] According to a used washing course, a dehydration stroke may be performed after completion of a washing stroke and a rinsing stroke, and a drying stroke may be performed after completion of the dehydration stroke. Foreign substances, such as lint, etc., accumulated on the filter 52 during the drying stroke may be automatically removed through implementation of the washing stroke, the rinsing stroke, or the dehydration stroke during a next use time of the laundry machine. During the dehydration stroke, water droplets are ejected from wet laundry through the holes of the drum, and act to wet lint by coming into contact with the filter. The drum maintains high revolutions per minute during the dehydration stroke and the above described water droplets are accessible to the filter, resulting in more excellent washing effects.

[0118] Referring to FIG. 11, the flow path of hot air will be described as follows. FIG. 11 illustrates the flow path of hot air during drying in the above described combined washing and drying machine. Hot air may be generated by the hot air heater 44 installed in the drying duct 40 and the fan 41 located in the scroll 40b. Air blown by the fan 41 is heated to a high temperature by the hot air heater 44. Then, the air flows to the front of the drum 300; 320; 340 through the connection duct 40a that is inserted into the hot air inlet 103 of the tub front part, thereby being introduced into the drum through the laundry entrance/exit opening of the drum.

[0119] The hot air introduced into the drum 300; 320; 340 comes into contact with wet laundry, whereby the high humidity air is discharged from the drum 300; 320; 340 through the holes 321 perforated in the wall of the drum 300; 320; 340. The high humidity air, introduced into a space between the drum 300; 320; 340 and the tub 100; 120 through the holes 321, is discharged from the tub 100; 120 through the hot air outlet 121 located at the rear surface of the tub rear part 120 after passing through the space between the drum 300; 320; 340 and the tub 100; 120. Then, the air discharged from the hot air outlet 121 is suctioned by the fan 41 to thereby be again blown into the drying duct 40 for circulation.

[0120] Here, prior to being discharged from the hot air outlet 121, moisture contained in the high humidity air is condensed as the air flows the space between the tub 100; 120 and the drum 300; 320; 340. To achieve efficient condensation, absorbing heat from the high humidity air is necessary. To this end, the high humidity air is directed into contact with air around the outer surface of the tub 100; 120 to enable heat emission therefrom to the outside of the tub 100; 120 via natural convection. Through the natural convection via the outer surface of the tub 100; 120, the high humidity air between the tub 100; 120 and the drum 300; 320; 340 is deprived of heat, which causes condensation of moisture contained in the air.

[0121] In this case, water droplets are generated via condensation at the surface of the condenser plate 42 and the inner surface of the tub 100; 120. The condenser plate 42 may not be essential for the above described natural cooling. Although the condenser plate 42 may contribute to enhancement in condensation efficiency, required condensation efficiency may be accomplished at the inner surface of the tub 100; 120 even without the condenser plate 42. The case of not using the condenser plate 42 will hereinafter be described in another embodiment.

[0122] The drying machine of the present embodiment constitutes a circulation type drying system using circulation of hot air. There is no separate condensing duct, and the space between the drum 300; 320; 340 and the tub 100; 120 serves as a condensing space.

[0123] Condensation may occur at the condenser plate 42 or the wall surface of the tub 100; 120 because the space between the drum 300; 320; 340 and the tub 100; 120 may have a lower temperature than the interior of the drum 300; 320; 340, and the outer surface of the tub 100; 120 comes into contact with cold outside air.

[0124] FIG. 12 illustrates the case in which the condenser plate 42 is not installed within the tub 100; 120. The outer surface of the tub 100; 120 undergoes heat exchange with the outside via natural convection. The high humidity air discharged from the drum 300; 320; 340 comes into contact with the low temperature inner surface of the tub 100; 120, causing condensation of moisture contained therein. The embodiment of FIG. 12 is identical to the above described embodiment except for not using the condenser plate 42, and thus an additional description thereof will be omitted.

[0125] In the above described embodiments, the interior space of the tub serves as a condensing space. That is, the above described embodiments exemplify the case in which the tub serves as a condenser. However, a separate condenser may be present. For example, a condensing duct may be used as in the related art. In this case, as an outer surface of the condenser undergoes heat exchange with the outside via natural convection, moisture contained in high humidity air flowing in the condenser is condensed. That is, the condenser may be added separately from the tub, and condensation may occur in the condenser via natural cooling using natural convection.

[0126] Additionally, although the above described embodiments exemplify condensation via natural cooling, for example, cooling water or cold air may be used for forcible cooling. For example, as illustrated in FIGs. 13 and 14, the tub 100; 120 may be provided with a cooling water injection port 122 to inject cooling water into the tub 100; 120. FIGS. 13 and 14 illustrate the embodiment of using the condenser plate 42 among the above described embodiments. As illustrated, the tub is provided with the cooling water injection port 122 and a condenser plate 42a has a flow path for cooling water. In the drying machine, the cooling water injection port 122 is formed at the tub rear part 120. The cooling water injection port 122 is located below the hot air outlet.

[0127] The cooling water injection port 122 may be configured to inject cooling water into a space between the tub and the drum. Alternatively, the cooling water injection port may be configured to feed cooling water such that the cooling water flows along the inner wall surface of the tub. In the present embodiment, cooling water is fed into a gap between the condenser plate 42 and the wall surface of the tub, thereby flowing along the condenser plate 42. The cooling water may be discharged through a drain hole formed in the bottom of the tub.

[0128] The condenser plate 42 may have a cooling water flow path to allow cooling water to flow in a zigzag path. The cooling water flow path may be defined by forming a groove 42a in the condenser plate.

[0129] FIG. 14 illustrates the cross section of the condenser plate 42 affixed to the inner surface of the tub. To form the cooling water flow path, the condenser plate 42 has the groove 42a facing the wall surface of the tub. That is, the zigzag groove 42a is formed in a surface of the condenser plate 42 facing the wall surface of the tub, so as to define a flow path between the wall surface of the tub and the condenser plate 42. Corners of upper and lower ends of the condenser plate 42 are bent toward the wall surface of the tub to block the top and bottom of a cooling water flow space. This serves to substantially prevent hot air from entering the cooling water flow space. When cooling water is directly exposed to hot air, this may cause cooling water particles to be introduced into the drying duct 40 by the hot air.

[0130] Differently from the embodiment as illustrated in FIGs. 13 and 14, the condenser plate may not be used. That is, in the embodiment of FIGs. 13 and 14, cooling water may be injected into the tub through the cooling water injection port 122. Here, the cooling water injection port 122 may be configured to guide cooling water to flow along the wall surface of the tub.

[0131] Meanwhile, the filter 52 may be clogged by lint, etc. contained in the hot air. Clogging of the filter 52 may prevent smooth circulation of hot air, causing deterioration in drying performance. Accordingly, it is desirable to sense whether or not the filter 52 is clogged and to take an appropriate action, for example, washing of the filter.

[0132] A method of sensing whether or not the filter 52 is clogged will now be described with reference to FIG. 2. Although directly sensing whether or not the filter 52 is clogged may be possible, whether or not the filter 52 is clogged may be sensed based on the state of the flow path or circulation path of hot air in which the filter 52 is located. If the filter 52 is clogged, the filter 52 acts as a flow resistor. Accordingly, if the filter 52 is clogged, the hot air exhibits inefficient flow as compared to the case in which the filter 52 is not clogged. That is, the flow state of hot air when the filter 52 is clogged differs from the flow state of hot air when the filter 52 is not clogged. As such, whether or not the filter is clogged may be indirectly sensed based on the flow state of hot air. The flow state of hot air may include the temperature, flow rate, and flow speed of hot air, for example.

[0133] Examples of judging whether or not the filter 52 is clogged based on the flow state of hot air will hereinafter be described in detail.

[0134] A method of judging whether or not the filter is clogged based on the temperature of hot air will first be described. Whether or not the filter is clogged may be judged using a temperature sensor installed close to the hot air heater 44, for example, the first temperature sensor 47. Hot air is generated by the hot air heater 44 and the fan 41. The air heated around the hot air heater 44 is blown by the fan 41. If the filter 52 is clogged, the flow rate or flow speed of the blown air is reduced, which causes a gradual increase in the temperature of the surrounding air. That is, if the filter 52 is clogged, the first temperature sensor 47 will sense an increase in temperature. As such, whether or not the filter 52 is clogged may be judged based on the temperature sensed by the first temperature sensor 47. That is, if the temperature sensed by the first temperature sensor 47 is greater than a predetermined reference value, it may be judged that the filter is clogged.

[0135] The sensed temperature may be changed according to a clogged degree of the filter 52, and thus a temperature corresponding to a selected clogged degree of the filter 52 to be sensed may be set to a reference value. The sensed temperature based on the clogged degree of the filter, i.e. the reference value may be experimentally determined. For example, when the surface temperature of the drying duct 10 is used, the temperature reference value required to sense a clogged degree of the filter of 50% or more may be 180°C or more.

[0136] The reference value may be changed based on design by determining a reference value of a clogged degree of the filter 52. For example, a clogged degree of 50% may be set to a reference value representing that the filter is clogged, or a clogged degree of 75% may be set to the reference value. It could be experimentally confirmed that a clogged degree of 75% causes an increase in drying time only within a range of 10% as compared to the case in which the filter is almost not clogged. A plurality of reference values may be set, in addition to the aforementioned clogged degrees. In this case, a required action, such as washing of the filter, etc., may be performed in consideration of the clogged degree of the filter as well as whether or not the filter is clogged.

[0137] Alternatively, whether or not the filter is clogged may be judged using a temperature sensor that is relatively distant from the hot air heater 44, for example, the second temperature sensor 47. If the filter 52 is clogged, the flow rate or flow speed of the blown air is reduced, which causes a gradual increase in the temperature of the air around the hot air heater 44. However, since a region distant from the hot air heater 44, for example, the interior of the tub, in particular, the bottom of the tub is a region to which heat is transferred by hot air, inefficient flow of hot air may cause temperature drop. Thus, if the filter 52 is clogged, the second temperature sensor 48 may sense a lower temperature than that when the filter is not clogged. As such, whether or not the filter 52 is clogged may be judged based on the temperature sensed by the second temperature sensor 48. That is, if the sensed temperature based on the clogged degree of the filter, i.e. the reference value may be determined via experiments, etc.

[0138] Alternatively, whether or not the filter is clogged may be judged using both the first temperature sensor 47 and the first temperature sensor 47. This will now be described with reference to FIG. 15. FIG. 15(a) (the left graph) illustrates the case in which the filter is almost not clogged, and FIG. 15(b)(the right graph) illustrates the case in which the filter is clogged. In the above graphs, the sensed temperature of the first temperature sensor 47 is T1, the sensed temperature of the second temperature sensor 48 is T2, and a temperature difference is ΔT.

[0139] As described above, if the filter 52 is clogged, the temperature difference ΔT between the first temperature sensor 47 and the second temperature sensor 48 is changed due to inefficient flow of hot air. Although the temperature sensed by the first temperature sensor 47 is raised because the first temperature sensor 47 is located closer to the hot air heater than the second temperature sensor 48, the temperature sensed by the second temperature sensor 48 may drop because a reduced amount of hot air required to transfer heat of the hot air heater reaches the second temperature sensor 48.

[0140] The temperature difference ΔT between the first temperature sensor 47 and the second temperature sensor 48 may be changed based on the clogged degree of the filter. If the temperature difference ΔT exceeds a preset value, it may be judged that the filter is clogged. In consideration of the fact that the hot air heater is turned off at a first preset temperature and is turned on at a second preset temperature under control, that the filter is clogged may be determined when the temperature difference beyond the preset value is sensed for a preset time. Also, that the filter is clogged may be determined when sensing of the temperature difference beyond the preset value for the preset time occurs beyond a preset number. This condition for determining that the filter is clogged is determined to eliminate the case in which the filter is temporarily clogged due to other reasons, such as a water film.

[0141] The first temperature sensor 47 and the second temperature sensor 48 may be installed at different positions from those of the present embodiment. The temperature sensors 47 and 48 may be positioned differently from the present embodiment so long as they can sense temperatures that are changed based on the clogged degree of the filter.

[0142] Next, a method of judging whether or not the filter is clogged based on the flow rate or flow speed of hot air will be described. If the filter 52 is clogged, the flow rate or flow speed of hot air may be reduced. Thus, whether or not the filter 52 is clogged may be judged by sensing the flow rate or flow speed of hot air. The flow rate or flow speed of hot air may be sensed using the above described flow sensor 46. That is, it can be judged that the filter 52 is clogged if a value sensed by the flow sensor 46 is equal to or less than a predetermined reference value. Here, based on the kind of the flow sensor 46 or data processing, the case in which the sensing signal value is equal to or greater than the reference value may be judged as that the filter 52 is clogged. That is, whether or not the filter 52 is clogged is judged by comparing the sensing signal value with a reference value. The comparison method may differ as occasion demands. The reference value may be determined by performing appropriate experiments on various kinds of sensors.

[0143] Differently from the above described embodiment, whether or not the filter is clogged may be judged using the operational state of a device to generate hot air, for example, the fan 41 and/or the hot air heater 44. First, a method of judging whether or not the filter is clogged using the operation state of the fan 41 will be described with reference to FIG. 16.

[0144] In the case in which the fan 41 is controlled in a Pulse Width Modulation (PWM) control manner, it may be advantageous to use revolutions per minute of the fan 41 as information on the operational state of the fan 41. In the case in which the fan 41 is controlled based on preset revolutions per minute, it may be advantageous to use power applied to a motor to rotate the fan 41.

[0145] FIG. 16 illustrates a relationship between the flow rate and the static pressure with respect to a circulation flow path. Here, the flow rate refers to the volume of air per unit time. FIG. 16 illustrates that the greater the static pressure of the circulation flow path, the greater the flow resistance.

[0146] In FIG. 16, the curve C represents a relationship of flow rate - static pressure of the fan 41 and the scroll 40b. This may be acquired via a wind tunnel experiment. Here, the data is acquired by locating the scroll 40b and the fan 41 in a wind tunnel and changing the static pressure of the wind tunnel in a state in which constant input power is applied to the fan 41.

[0147] The curves A and B represent the static pressure depending on the flow rate that is experimentally acquired with respect to a circulation flow path except for regions of the fan 41 and the scroll 40b. The curve B corresponds to the case in which a clogged degree of the filter is almost 0%, and the curve A corresponds to the case in which the filter is partially clogged. To acquire the curves A and B, after removing the regions of the fan 41 and the scroll 40b from the circulation flow path of the above described laundry machine, one exposed end of the circulation flow path is kept at atmospheric pressure, and the other end of the circulation flow path is subjected to pressure drop below the atmospheric pressure. As such, data on the flow rate depending on a pressure difference between the atmospheric pressure and a lower pressure below the atmospheric pressure is acquired as illustrated.

[0148] It can be said that points where the curve C intersects the curve A or the curve B represent the maximum flow rate for each case. Of course, it is assumed that power applied to the fan 41 at this time is the limit of power applied when the curve C is acquired. In the case in which PWM control is used for rotation of the fan 41, the flow resistance of the circulation flow path is increased when the filter is clogged, and thus the curve B moves on the curve C. The flow rate is reduced from FR2 to FR1, and this means a reduction in the revolutions per minute of the fan 41. Accordingly, a clogged degree of the filter may be sensed by sensing the revolutions per minute of the fan 41.

[0149] If the revolutions per minute of the fan 41 are controlled at a constant value regardless of whether or not the filter is clogged, energy required to overcome flow resistance, which is gradually increased as the clogged degree of the filter is increased, will be increased, which may result in an increase in input power required to rotate the fan 41. Thus, in this case, whether or not the filter is clogged may be sensed using the above described input power.

[0150] Next, a method of judging whether or not the filter is clogged using the operational state of the hot air heater 44 will be described with reference to FIG. 17. To maintain a desired drying temperature, the hot air heater 44 may be turned off at a preset upper limit temperature Tu and be turned on at a preset lower limit temperature TL under control. To realize the control of the hot air heater 44, the temperature sensed by the first temperature sensor 44 located in the drying duct 40 may be used.

[0151] The temperature around the hot air heater 44 may be raised due to inefficient flow of hot air when the filter 52 is clogged. This temperature increase around the hot air heater 44 due to inefficient flow of hot air when the filter 52 is clogged may shorten a time period required to reach the upper limit temperature Tu. Thus, when the filter 52 is clogged, the On/Off period of the hot air heater 44 may be reduced, or the number of repeatedly turning on and off the hot air heater for a predetermined time Δt may be increased. As such, whether or not the filter is clogged may be judged using the On/Off period of the hot air heater 44 and the number of turning on and off the hot air heater as a reference value.

[0152] Accordingly, whether or not the filter 52 is clogged may be judged in consideration of the above described operational states of the hot air heater 44. A clogged degree of the filter 52 may also be judged because the On/Off period or the number of On/Off times may be changed based on the clogged degree of the filter 52. For example, the On/Off period or the number of On/Off times may be changed based on the clogged degree, such as a clogged degree of 50%, a clogged degree of 75%, and a clogged degree of 90%.

[0153] FIG. 17(a) (the upper graph) illustrates operation of the hot air heater when the filter is clogged by 90%, and FIG. 17(b) (the lower graph) illustrates operation of the hot air heater when the filter is almost not clogged. As illustrated in the graphs, temperature drop caused when the hot air heater 44 is turned off at the upper limit temperature Tu and temperature rising caused when the hot air heater 44 is turned on at the lower limit temperature TL are repeated. It can be confirmed that the number of turning on and off the hot air heater 44 for the preset time Δt is greater when the filter is clogged by 90% than that when the filter is not clogged.

[0154] Referring to FIGs. 18 and 19, one example of a control method of the laundry machine according to an embodiment of the present invention will be described as follows. First, a control configuration of the laundry machine according to an embodiment of the present invention will diagrammatically be described. A controller 900 is electrically connected to the first temperature sensor 47, the second temperature sensor 48, and the flow sensor 46. The controller 900 is also electrically connected to a motor 930 that drives the drum, the hot air heater 44, the fan 41, and a filter washing unit 940. Additionally, the controller 900 is connected to an input unit 910 by which the user can operate the laundry machine, and an output unit 920 that informs the user of, e.g., the operational state of the laundry machine.

[0155] One example of the control method of the laundry machine according to an embodiment of the present invention will now be described with reference to FIG. 19.

[0156] It is judged whether or not the filter is clogged (S5). If it is judged that the filter is clogged, a required action, such as washing of the filter, is performed (S7). To judge whether or not the filter is clogged (S5), preferably, a value, which is changed by the flow resistance of hot air caused when the filter is clogged, such as the temperature and flow rate of hot air, is sensed (S3). Judgment of whether or not the filter is clogged is preferably performed when it is judged that the laundry machine is normally operated (S1). This is because if that the filter is clogged is judged in an abnormal operation state of the laundry machine, clogging of the filter may be misjudged even if the filter is not clogged.

[0157] The aforementioned respective operations will be described as follows. First, judgment of whether or not the laundry machine is normally operated (S1) will be described. To accurately judge whether or not the filter 52 is clogged, it is preferable to judge whether or not the filter is clogged when the laundry machine is under normal operation except for clogging of the filter 52. This is because clogging of the filter may be misjudged even if the filter is not clogged while the laundry machine is not normally operated.

[0158] Although there are various methods of judging whether or not the laundry machine is normally operated, for example, that the laundry machine is normally operated may be judged in the following cases. The first case is that revolutions per minute of the fan 41 reach a preset value, the second case is that a preset time has passed after actuation of the fan 41, the third case is that a preset time has passed after a drying course begins, the fourth case is that a preset time has passed after actuation of the hot air heater 44, and the fifth case is that hot air reaches a preset temperature. Of course, conditions to determine the sensing time or the time for judging clogging of the filter may be used alone or in combination with one another.

[0159] The fan 41 is one of elements that have a great effect on the flow rate or flow speed of hot air. Therefore, it may be judged whether or not the fan 41 breaks down, and the flow resistance of hot air may be sensed when it is judged that the fan does not break down. For example, if revolutions per minute of the fan 41 exceed a preset value or if a preset time has passed after actuation of the fan 41, it can be appreciated that the fan 41 is normally operated. Accordingly, in this case, the flow resistance of hot air may be sensed to judge whether or not the filter is clogged.

[0160] If a preset time has passed after a drying course begins, it can be appreciated that the drying course is normally performed. This is because the laundry machine may include a self-diagnosis device and/or program to diagnose breakdown of each element, and thus the drying course may be stopped without filling a preset time when any one element breaks down. Accordingly, in this case, whether or not the filter is clogged may be judged by sensing the flow resistance of hot air.

[0161] Additionally, the laundry machine may be programmed such that normal operation of the hot air heater 44 is not performed if any one element of the laundry machine malfunctions. Therefore, the sensing time may be determined using actuation time of the hot air heater 44. For example, the above described sensing operation may be performed when a preset time has passed after a control temperature of the hot air heater reaches a preset temperature. The hot air heater may be controlled so as to be turned off at a first preset temperature (for example, 106°C) and be turned on at a lower second preset temperature (for example, 100°C). The above described sensing operation may be performed when a preset time has passed after the hot air heater is initially actuated to reach the first preset temperature.

[0162] Next, sensing of the flow resistance of hot air (S3) will be described. If the filter is clogged, the flow resistance of hot air is increased. The flow resistance of hot air may be indirectly sensed using the state of the hot air flow path, such as the temperature, flow rate, and flow speed of hot air in the flow path. In addition, the flow resistance of hot air may be indirectly sensed using the state of a hot air generator including the hot air heater and the fan, for example, revolutions per minute of the fan, input power, or the On/Off period of the hot air heater. The aforementioned various values required to sense the flow resistance of hot air may be used alone or in combination with one another. Meanwhile, the sensed flow resistance of hot air is transmitted to the controller 900, and the controller 900 judges whether or not the filter is clogged using the sensed flow resistance of hot air. The method of judging whether or not the filter is clogged has been described above, and thus a detailed description thereof will be omitted.

[0163] According to the illustration and description of the above described embodiment, judgment of whether or not the laundry machine is normally operated is first performed, and then sensing of the flow resistance of hot air is performed if it is judged that the laundry machine is normally operated. However, the present invention is not limited thereto. Sensing of the flow resistance of hot air may always be performed, and whether or not the filter is clogged may be judged using the flow resistance of hot air by the controller only when it is judged that the laundry machine is normally operated.

[0164] Next, performing a required action if it is judged that the filter 52 is clogged (S7) will be described in detail. There are various actions to deal with clogging of the filter, and for example, user notice and filter washing functions are preferable.

[0165] If it is necessary to inform the user of that the filter 52 is clogged, a user notice signal is output. The notice signal may be visual or auditory output. The visual output may include outputting a message informing that the filter 52 is clogged on an output unit 920, such as a Liquid Crystal Display (LCD). Alternatively, the visual output may be emission of light. For example, that the filter is clogged may be informed to the user via emission of a Light Emitting Diode (LED) that is mounted to the output unit 920 of the laundry machine. The auditory output may provide the user with notice by generating a sound, such as buzzer sound. The above described user notice signal may be changed based on a clogged degree of the filter 52. The clogged degree of the filter may be judged based on the magnitude of the sensed signal, and correspondingly the output magnitude of the user notice signal may be changed.

[0166] Meanwhile, a command for implementation of an action related to clogging of the filter may be input via the output unit 920 by the user. For example, the output unit 920 may include a means to input a command 'washing of the filter. Once the command has been input, the controller 900 may perform washing of the filter according to a predefined program. Of course, no user command input means for washing of the filter may be present, and in this case filter washing may be automatically performed.

[0167] There are various filter washing methods as follows. First, the filter 52 may be washed by an eddy created around the drum when the drum is rotated by driving of the motor 920. In this case, since water fed into the tub is present on the surface of the drum, the water may be fed to the filter 52 as the water is centrifugally scattered during rotation of the drum. Second, the filter 52 may be washed via actuation of the above described filter washing unit 940. The above described two methods may be used alone or in combination with each other.

[0168] As a required action to be performed when it is judged that the filter is clogged, washing of the filter is preferably performed at an appropriate time. For example, although washing of the filter may be performed during implementation of a drying course, it may be performed at an appropriate time after the drying course is finished. This is because washing of the filter using water is preferably performed after the drying course is finished.

[0169] For example, the case in which washing of the filter is performed at an appropriate time after the current drying course is finished is as follows. Washing of the filter may be performed when a preset time has passed after the current drying course is finished. This is because the user requires time to take out laundry after the drying course is finished, and therefore washing of the filter is performed when a preset time has passed after the drying course is finished. Alternatively, if the door is opened and then closed after completion of the drying course, this can be contemplated as laundry is taken out. Thus, washing of the filter may be performed when sensing the opening and closing of the door. Also, washing of the filter may be performed before a next drying course is performed.

[0170] If the drying course is performed in a clogged state of the filter 52, overheating of the hot air heater 44 may occur. Thus, it may be programmed to stop the drying course that is being performed if it is judged that the filter 52 is clogged. Alternatively, the current drying course is continuously performed, but a next drying course is not performed. In the inactivation case in which the drying course is not performed, actuation of the user input means of the input unit 910 related to the drying course may be inactivated. That is, even if the user selects the user input means, the controller 900 may ignore the user selection.

[0171] Alternatively, washing of the filter may be performed during implementation of a washing course. This may minimize the risk of laundry contamination because wash water is fed into the tub during washing and even if water used to wash the filter is present, the used water will be discharged from the tub along with the wash water.

[0172] Hereinafter, a control method of the hot air heater 44 will be described with reference to FIGs. 20 and 21. In the case in which it is judged that the filter is clogged, it is preferable to change a control method of the hot air heater 44. FIG. 20 illustrates a heater control pattern when the filter is not clogged, and FIG. 21 illustrates a heater control pattern when it is judged that the filter is clogged.

[0173] If a drying stroke begins, the controller 900 turns on the hot air heater 44. Once the hot air heater 44 has been turned on, the interior temperature of the laundry machine is rapidly raised at the initial stage. Initially, thermal energy of the hot air heater 44 is not largely used to dry wet laundry, and therefore a temperature rising rate is high. When drying of wet laundry begins in earnest, thermal energy of the hot air heater 44 is consumed for drying, and the temperature rising rate is reduced.

[0174] In this case, it is preferable to control the hot air heater 44 in consideration of the amount of energy consumed for drying per hour. This is because supply of excessive thermal energy may problematically cause overheating. For this reason, the hot air heater 44 may be repeatedly turned on and off. For example, repeatedly turning on and off the hot air heater may be controlled as illustrated in FIGs. 20 and 21. Although FIGs. 20 and 21 illustrate that the heater is repeatedly turned on and off even for an initial temperature rising section DT1, the present invention is not limited thereto. However, it may be necessary to control the hot air heater 44 so as to reduce an initial overshooting degree for a transition from the section DT1 to a section DT2. Since the interior temperature is raised in an On-state of the hot air heater 44, temperature drop does not begin immediately even if the hot air heater 44 is turned off. Temperature drop will begin after the interior temperature is further slightly raised even if the hot air heater is turned off.

[0175] For the section DT2 in which drying begins in earnest, the heater is turned off at a preset upper limit temperature (Off-temperature), and is again turned on at a preset lower limit temperature (On-temperature). That is, the heater is controlled so as to be repeatedly turned off upon reaching the Off-temperature (Off-time) and then turned on upon reaching the On-temperature (On-time).

[0176] For the section DT1 as an initial temperature rising section, the hot air heater 44 may remain in an On-state so long as an overshooting problem does not occur when entering the section DT2. To reduce overshooting of the temperature caused when entering the section DT2 as described above, the heater may be turned off at least one time even for the section DT1. For example, the hot air heater 44 may be turned off at a predetermined time prior to enter the section DT2. The heater may be turned off three times for the section DT1. Although increasing the number of turning off the heater is advantageous to reduce overshooting, time taken to enter the section DT2 may be increased as the number of turning off the heater is increased. Accordingly, the number of turning off the heater may be determined in consideration of the time taken to enter the section DT2.

[0177] Controlling the hot air heater 44 to achieve a stepwise temperature rising for the section DT1 may be advantageous to reduce overshooting. As illustrated in FIGs. 20 and 21, this control of the hot air heater 44 may be accomplished by setting a plurality of Off-temperatures that is raised stepwise for the section DT1. The above described first temperature sensor 47 may be used to sense the temperature for controlling the hot air heater 44 based on the Off-temperature and the On-temperature.

[0178] Meanwhile, the above described control of the hot air heater 44 may be changed based on whether or not the filter is clogged. That is, if it is determined that the filter is clogged, the controller may change a control pattern of the heater by changing a control factor of the hot air heater 44. The control pattern of the heater may be the On/Off temperature of the heater, the number of On/Off times, the On/Off time period, the time of temperature rising section/temperature maintenance section, etc. Control patterns that will be described hereinafter may be used alone or in combination with one another.

[0179] As illustrated in FIG. 20, if the filter is not clogged, three-stage temperature rising is performed for the section DT1 under control. As illustrated in FIG. 21, if it is judged that the filter is clogged, eight-stage temperature rising is performed under control. The number of temperature rising stages for the temperature rising section is increased from three to eight because overheating may occur due to inefficient flow of hot air when the filter is clogged. The number of stages may be differently designed based on an actual clogged degree of the filter that determines that the filter is clogged. For example, the case in which it is programmed to determine that the filter is clogged when the clogged degree of the filter is 50% exhibits a greater clogged degree than the case in which it is programmed to determine that the filter is clogged when the clogged degree of the filter is 75%, and therefore the temperature rising stages may further be increased.

[0180] It may also be programmed to change the On/Off control pattern of the hot air heater 44 based on whether or not the filter is clogged even for the section after the temperature rising section, i.e. for the section DT2. In a simplified example, in FIGs. 20 and 21, it may be programmed to change T_{UL} or T_{LL} of each case. For example, it is programmed such that T_{UL} of FIG. 21 is less than T_{UL} of FIG. 20.

[0181] Although FIGs. 20 and 21 illustrate that T_{UL} and T_{LL} are constant for the section DT2, it is not essential. Similar to the section DT1, a plurality of Off-temperatures may be set to represent plural temperature rising stages even for the section DT2.

[0182] Alternatively, it may be programmed such that the section DT1 is continued until the temperature reaches a preset value. That is, in FIGs. 20 and 21, the section DT1 is continued until the temperature reaches T_{UL}.

[0183] FIG. 22 illustrates yet another embodiment with respect to the case in which the filter is clogged. In FIG. 22, the same number of temperature rising stages for the section DT1 as that in the case of FIG. 20 in which the filter is not clogged is applied. However, the number of Off times of the heater per each stage may be changed. The heater is turned off two times in each temperature stage of the section DT1 in the case of FIG. 20, but is turned off three times in the case of FIG. 22.

[0184] In the above case of FIGs. 21 and 22, a duration time of the section DT1 is greater than that in the case of FIG. 20 in which the filter is not clogged.

[0185] Although the above described embodiments have described the combined drying and washing machine, the present invention may be applied to all machines having a drying function. Herein, the drying machine refers to all machines having a drying function.

[0186]

Claims

1. A laundry machine having a drying function, the machine comprising:

    a rotatably installed drum;
    a hot air heater and a fan to generate hot air;
    a filter to filter the hot air;
    a sensor to sense a hot air flow resistance generated in a flow path, through which the hot air flows; and
    a controller to judge whether or not the filter is clogged using the hot air flow resistance sensed by the sensor.

2. The laundry machine according to claim 1, wherein the hot air flow resistance includes at least one of a temperature, flow rate, and flow speed of the hot air at a predetermined position affected by flow of the hot air, revolutions per minute of the fan, power input to the fan, and an On/Off period of the hot air heater.

3. The laundry machine according to claim 2, further comprising at least one of a first temperature sensor and a second temperature sensor to sense the temperature of the hot air,
    wherein the first temperature sensor is located closer to the hot air heater than the second temperature sensor.

4. The laundry machine according to claim 3, wherein the controller judges that the filter is clogged using at least one of the case in which a temperature sensed by the first temperature sensor exceeds a predetermined reference value, the case in which a temperature sensed by the second temperature sensor is less than a predetermined reference value, and the case in which a difference between the temperature sensed by the first temperature sensor and the temperature sensed by the second temperature sensor exceeds a predetermined reference value.

5. The laundry machine according to claim 3, wherein the first temperature sensor is located in a drying duct in which the hot air heater is installed, and the second temperature sensor is installed in a tub in which the drum is accommodated.

6. The laundry machine according to claim 2, further comprising a flow sensor located in a drying duct in which the hot air heater is installed, the flow sensor serving to measure at least one of the flow rate and flow speed of the hot air.

7. The laundry machine according to claim 6, wherein the flow sensor includes at least one of an orifice flow-meter, a pressure sensor, and an impeller flowmeter.

8. The laundry machine according to claim 2, wherein the controller judges that the filter is clogged in the case in which the revolutions per minute of the fan are less than a reference value.

9. The laundry machine according to claim 2, wherein the controller judges that the filter is clogged in the case in which the power input to the fan exceeds a reference value.

10. The laundry machine according to claim 2, wherein the controller judges that the filter is clogged in the case in which the On/Off period of the hot air heater is less than a reference value.

11. The laundry machine according to claim 1, wherein the controller judges whether or not the filter is clogged when judging that the laundry machine is normally operated.

12. The laundry machine according to claim 11, wherein the controller judges that the laundry machine is normally operated using at least one of the case in which revolutions per minute of the fan reach a preset value, the case in which a predetermined time has passed after actuation of the fan, the case in which a preset time has passed after a drying course begins, the case in which a preset time has passed after actuation of the hot air heater, and the case in which the hot air reaches a preset temperature.

13. The laundry machine according to claim 1, wherein the controller performs a required action when judging that the filter is clogged.

14. The laundry machine according to claim 13, wherein the required action includes at least one of a user alarm, washing of the filter, inactivation of a drying course, and change in a control pattern of the hot air heater.

15. The laundry machine according to claim 14, wherein a drying course that is being performed, or a drying course that will be performed next is inactivated.

16. The laundry machine according to claim 14, wherein the controller controls washing of the filter using air flow generated by rotation of the drum.

17. The laundry machine according to claim 14, further comprising a filter washing unit to wash the filter.

18. The laundry machine according to claim 14, wherein washing of the filter is performed after a drying course that is being performed is finished.

19. The laundry machine according to claim 18, wherein washing of the filter is performed in the case in which a preset time has passed after the drying course is finished, in the case in which a door is opened and closed after the drying course is finished, and/or in the case in which a next drying course or a washing course is performed.

20. The laundry machine according to claim 14, wherein washing of the filter is performed in response to a user request.

21. The laundry machine according to claim 14, wherein the control pattern of the hot air heater includes at least one of the number of turning on and off the hot air heater, On/Off temperatures, On/Off time, and duration time of a temperature rising section/temperature maintenance section.

22. The laundry machine according to claim 21, wherein the number of reference values of On/Off temperatures for the temperature rising section in the case in which it is judged that the filter is clogged is greater than the number of reference values of On/Off temperatures for the temperature rising section in the case in which the filter is not clogged.

23. The laundry machine according to claim 21, wherein a reference value of the On temperature for the temperature maintenance section in the case in which it is judged that the filter is clogged is less than a reference value of the On temperature for the temperature rising section in the case in which the filter is not clogged.

24. The laundry machine according to claim 21, wherein the number of turning off the hot air heater for the temperature rising section in the case in which it is judged that the filter is clogged is greater than the number of turning off the hot air heater for the temperature rising section in the case in which the filter is not clogged.

25. The laundry machine according to claim 1, further comprising a tub in which wash water is accommodated,
wherein the filter is located in a hot air outlet of the tub.

26. The laundry machine according to claim 1, further comprising:

a drive unit including a rotating shaft connected to the drum, a bearing housing configured to support the rotating shaft, and a motor to rotate the rotating shaft; and
a suspension assembly connected to the bearing housing to reduce vibration of the drum.

27. The laundry machine according to claim 26, further comprising:

a tub in which wash water is accommodated; and
a rear gasket located between the tub and the drive unit, the rear gasket allowing movement of the drive unit relative to the tub.

28. The laundry machine according to claim 27, further comprising:

a hot air inlet and a hot air outlet, which are provided at the tub; and
a drying duct connecting the hot air inlet and the hot air outlet to each other.

29. The laundry machine according to claim 1, further comprising a tub in which a suspension assembly to reduce vibration of the drum and wash water are accommodated,
wherein the tub is more rigidly supported than the drum.

30. A control method of a laundry machine having a drying function, the method comprising:

sensing a hot air flow resistance generated in a flow path of hot air used to dry an object; and
judging whether or not the filter is clogged using the sensed hot air flow resistance.

31. The control method according to claim 30, wherein the hot air flow resistance includes at least one of a temperature, flow rate, and flow speed of the hot air at a predetermined position affected by flow of the hot air, revolutions per minute of a fan, power input to the fan, and an On/Off period of a hot air heater.

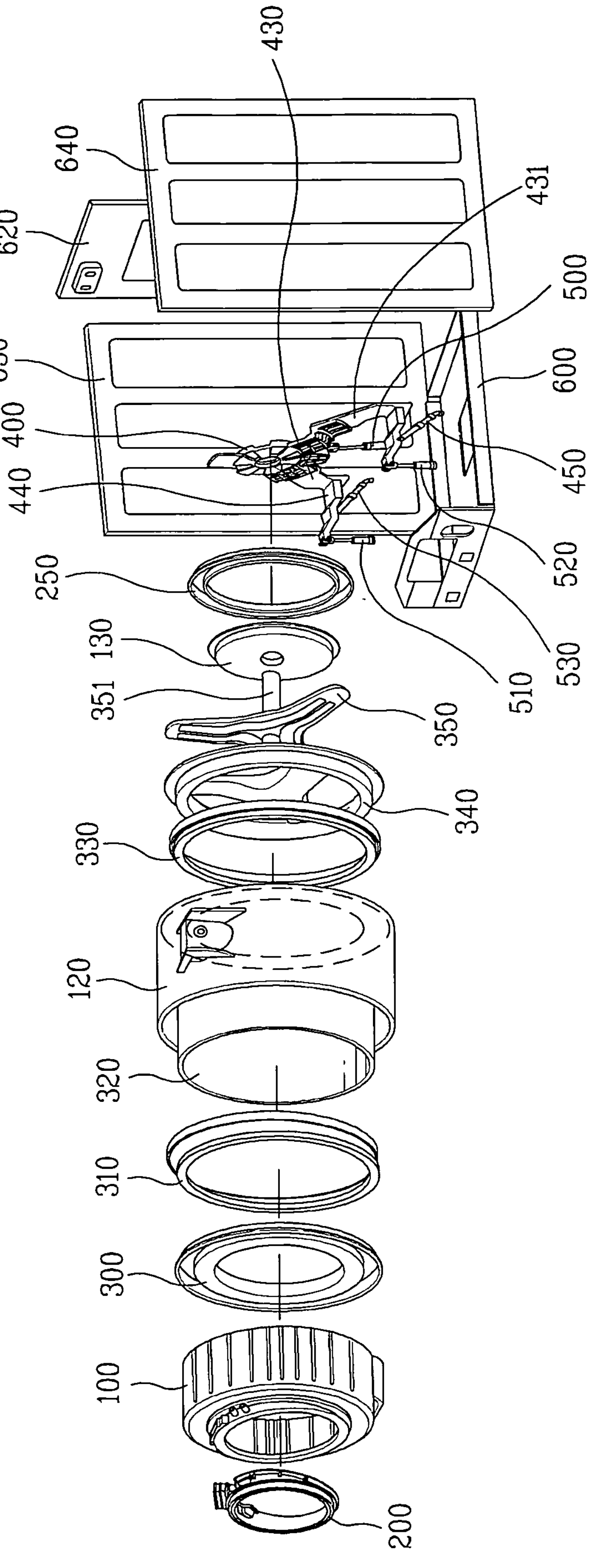
32. The control method according to claim 30, further comprising judging whether or not the laundry machine is normally operated,
wherein judgment of whether or not the filter is clogged is performed in the case in which it is judged that the laundry machine is normally operated.

33. The control method according to claim 32, wherein whether or not the laundry machine is normally operated is judged using at least one of the case in which revolutions per minute of a fan reach a preset value, the case in which a predetermined time has passed after actuation of the fan, the case in which a preset time has passed after a drying course begins, the case in which a preset time has passed after actuation of a hot air heater, and the case in which the hot air reaches a preset temperature.

34. The control method according to claim 30, further comprising performing a required action in the case in which it is judged that the filter is clogged.

35. The control method according to claim 34, wherein the required action includes at least one of a user alarm, washing of the filter, inactivation of a drying course, and change in a control pattern of the hot air heater.

FIG. 1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200

FIG. 2

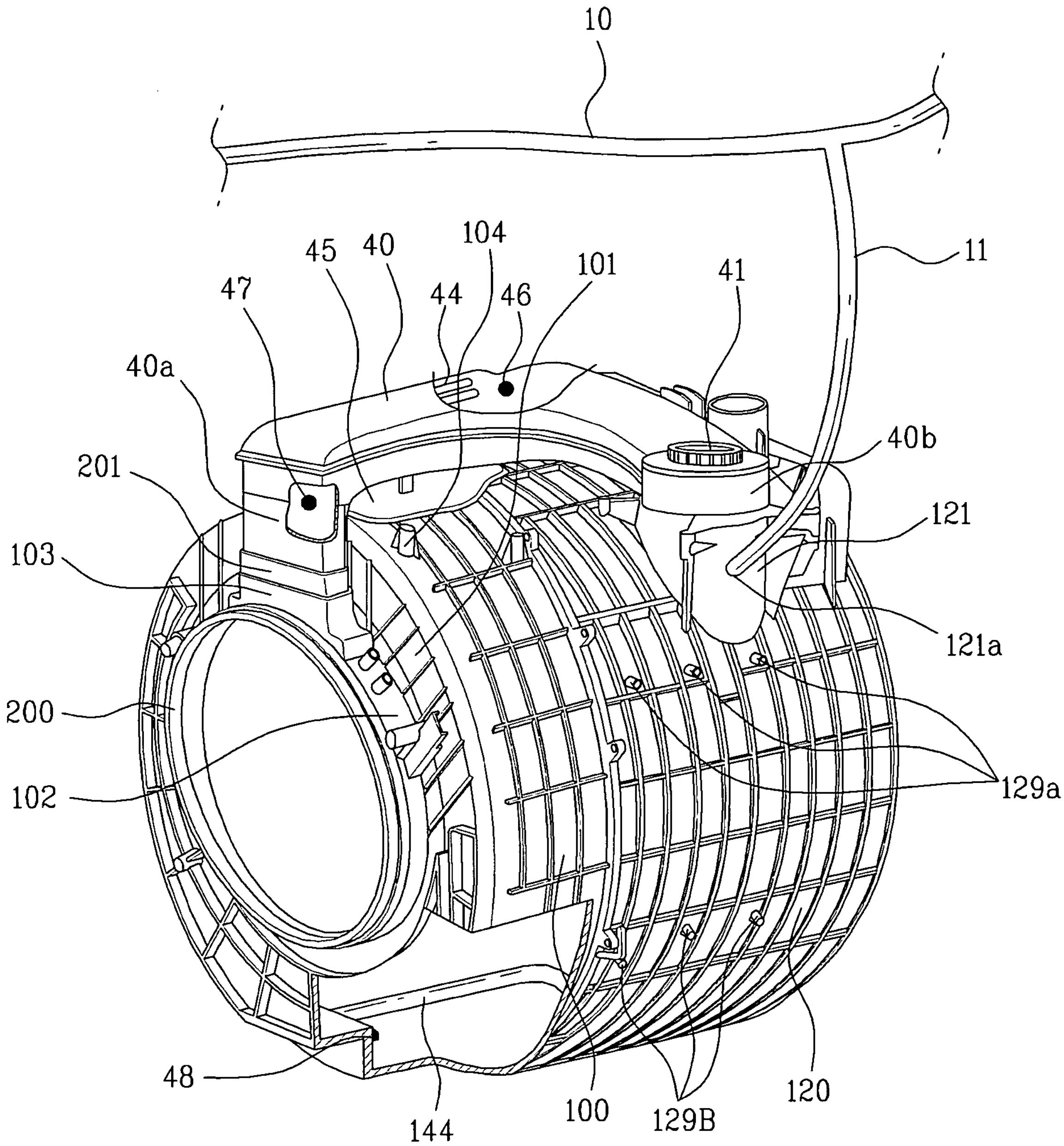

10
11
104
45
40
44
46
101
41
47
40a
40b
201
121
103
121a
200
129a
102
48
144
100
129B
120

FIG. 3

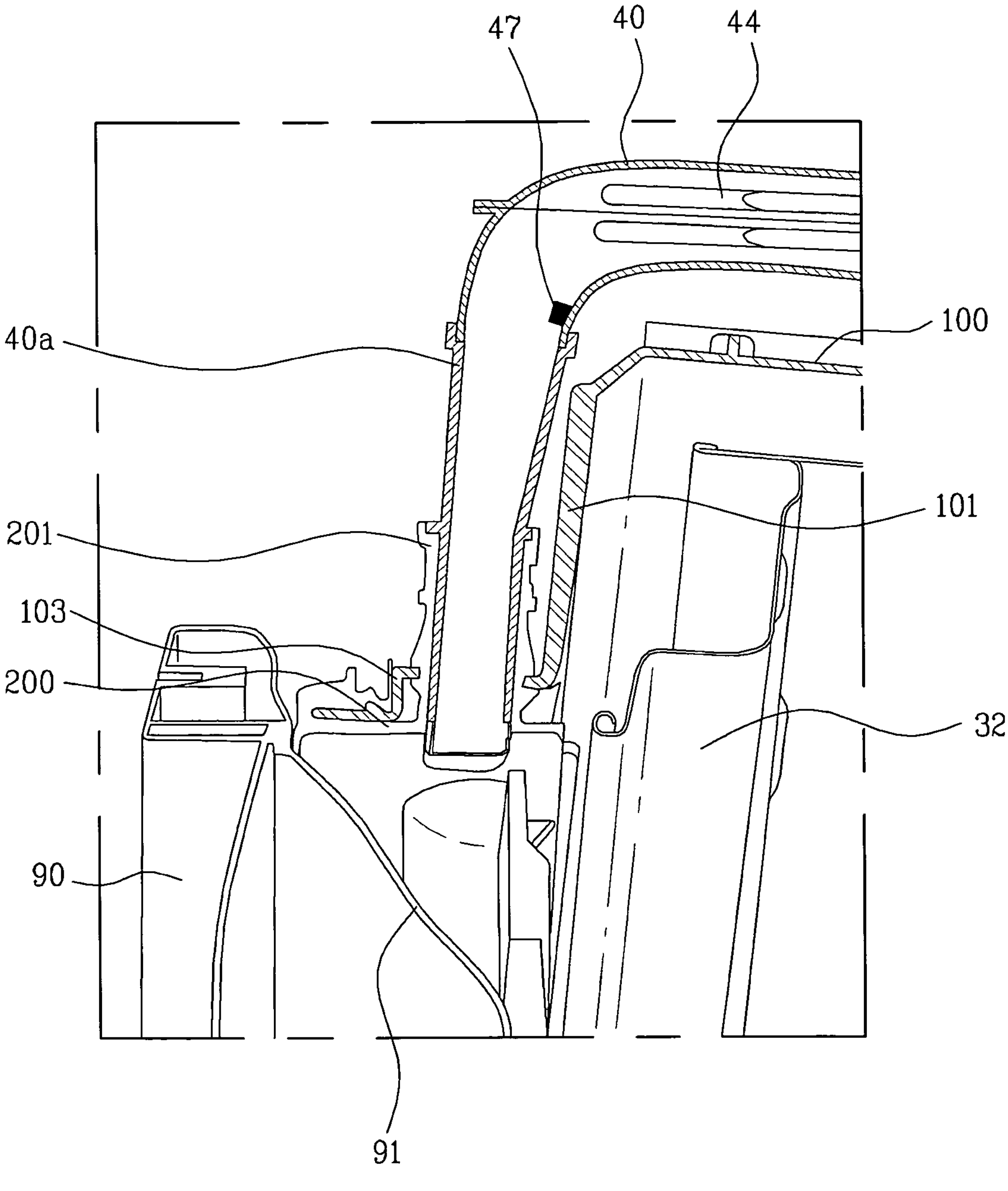


FIG. 4

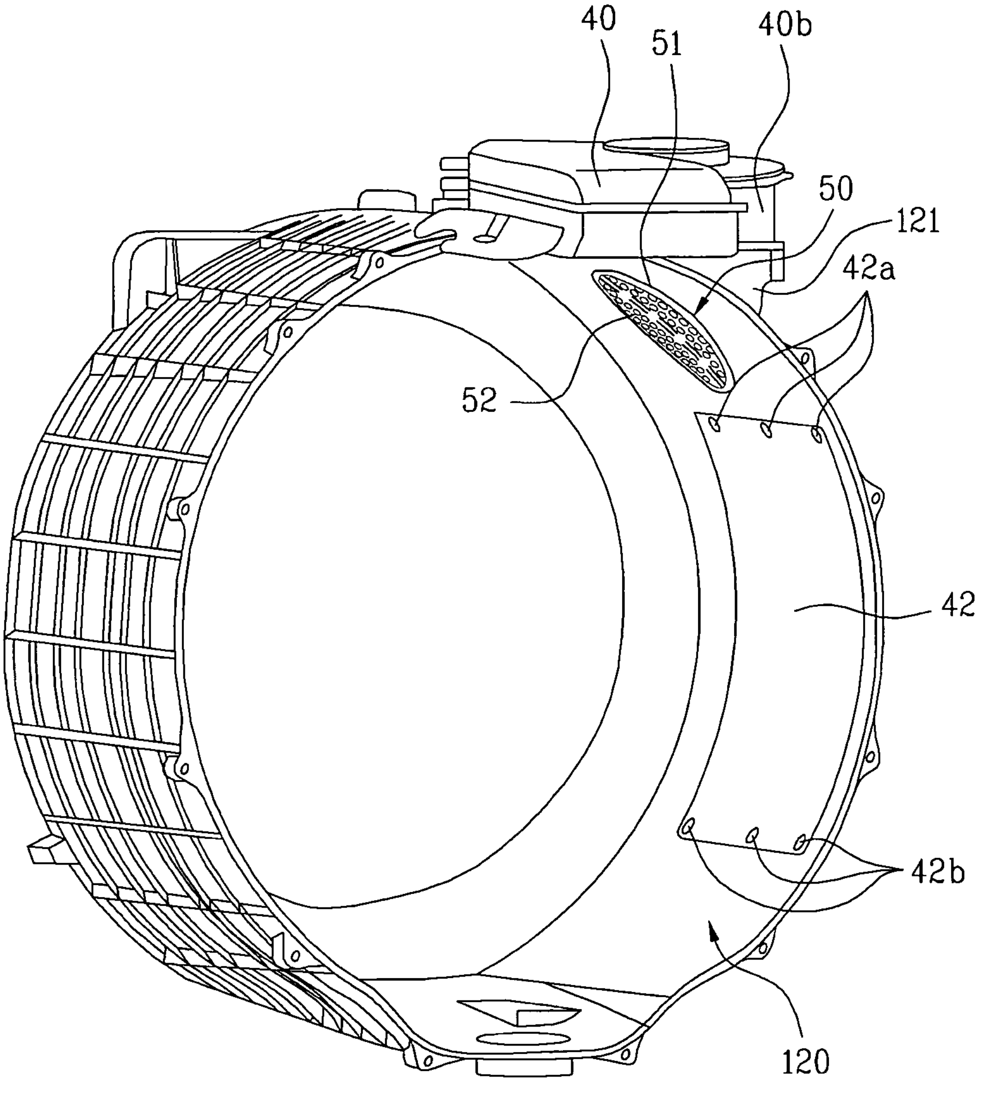


FIG. 5

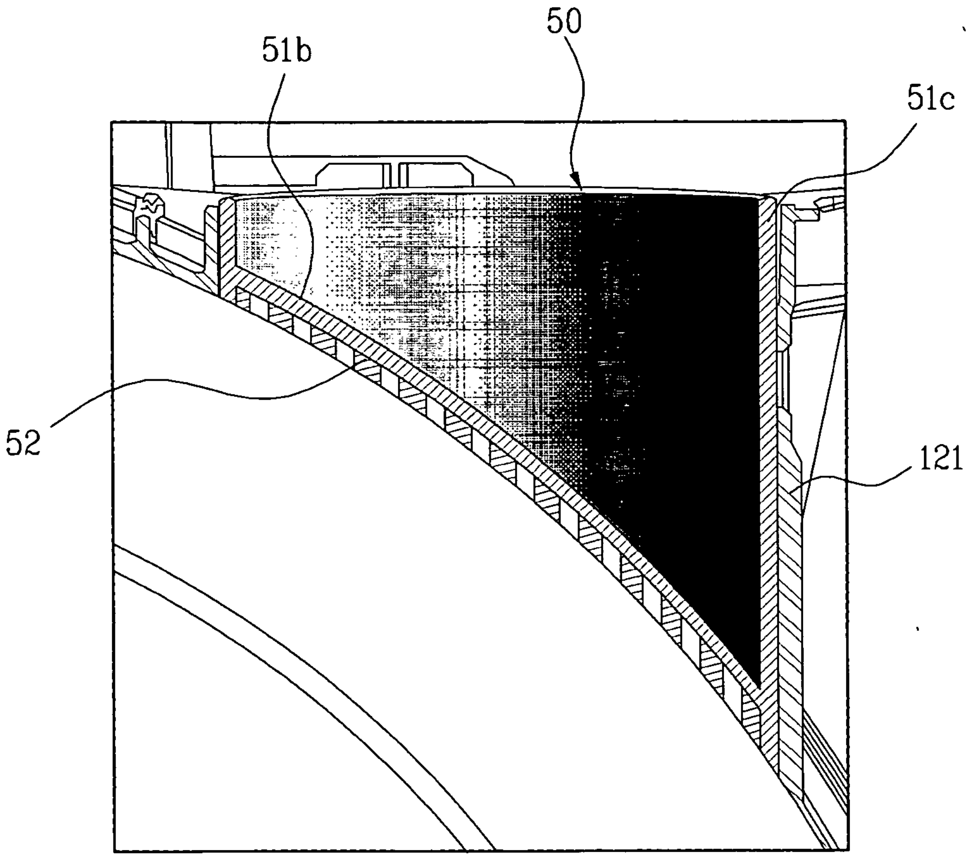


FIG. 6

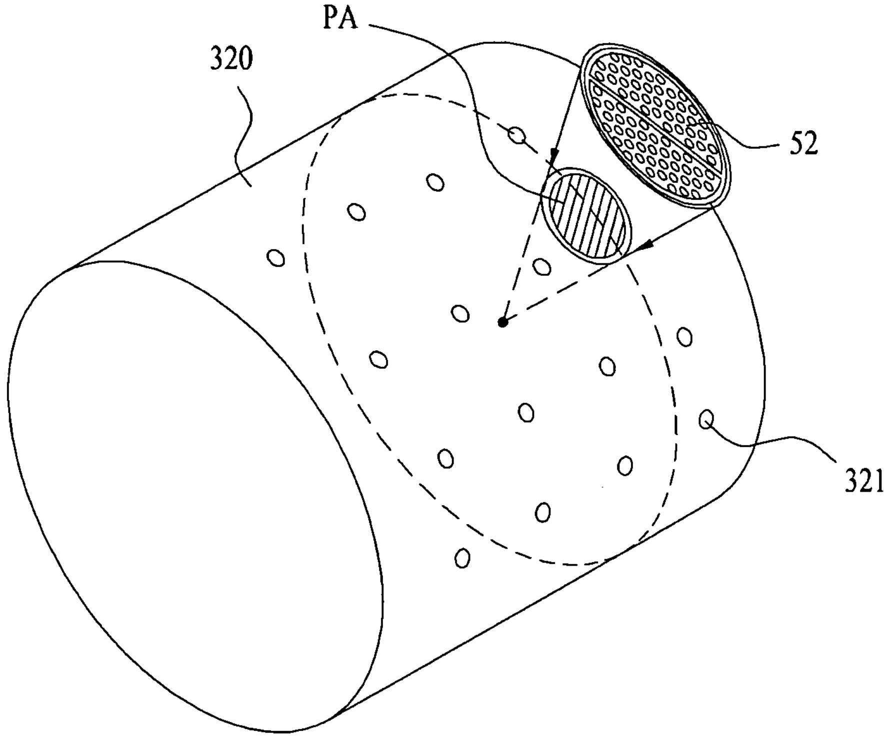


FIG. 7

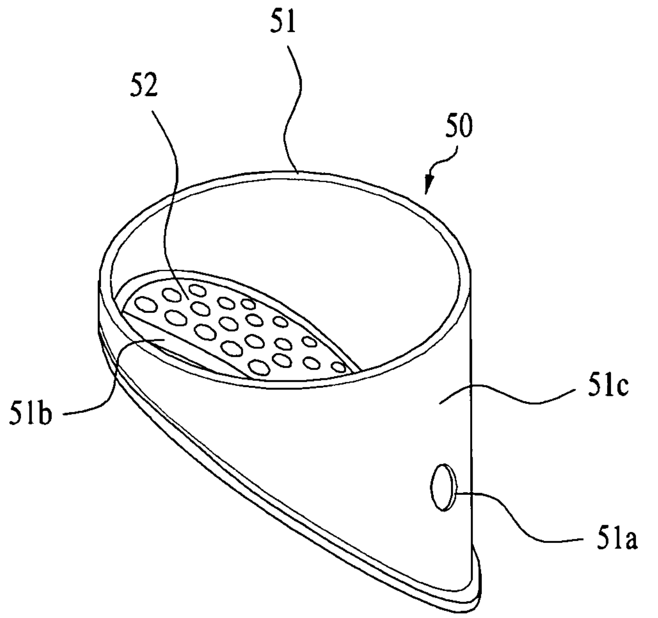


FIG. 8

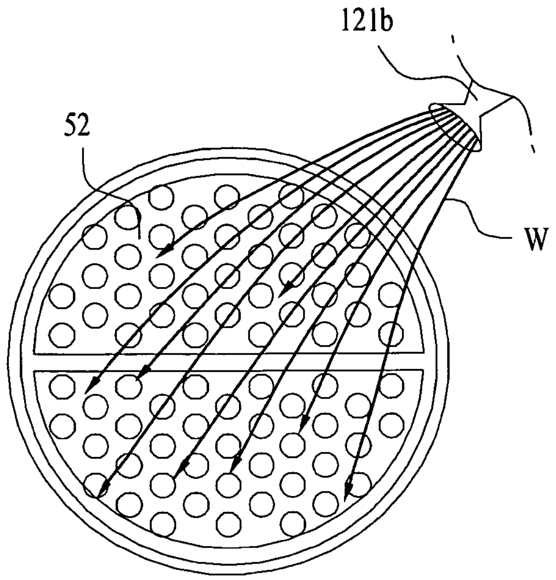


FIG. 9

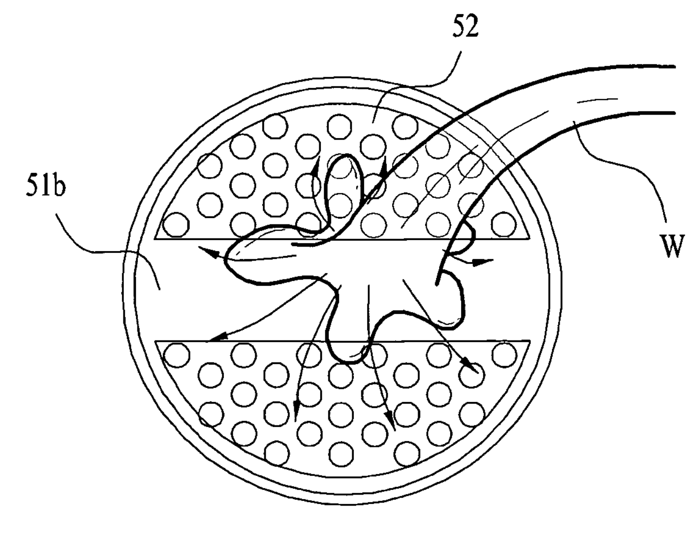
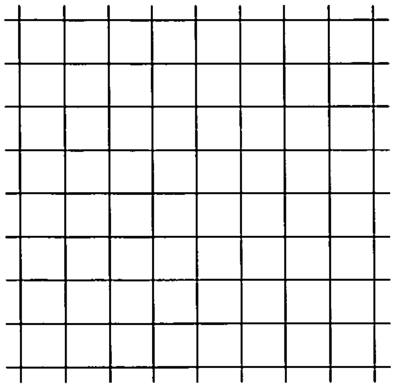
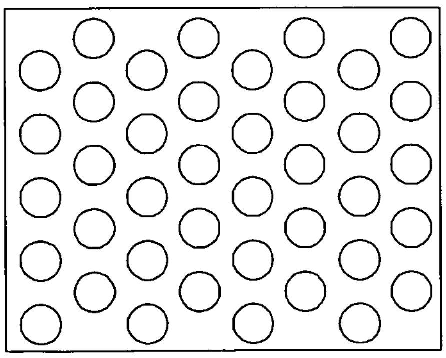


FIG. 10



(a)



(b)

FIG. 11

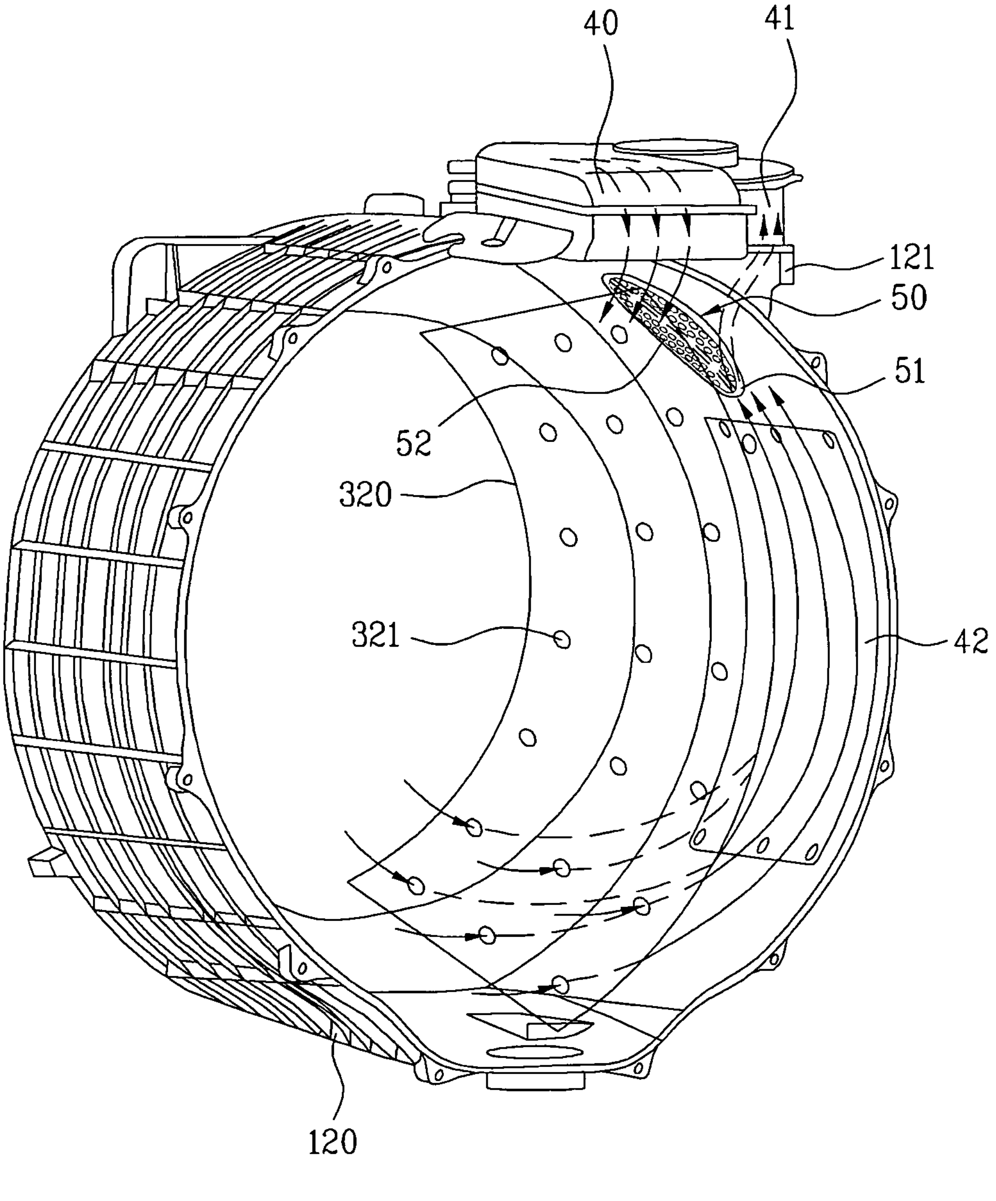


FIG. 12

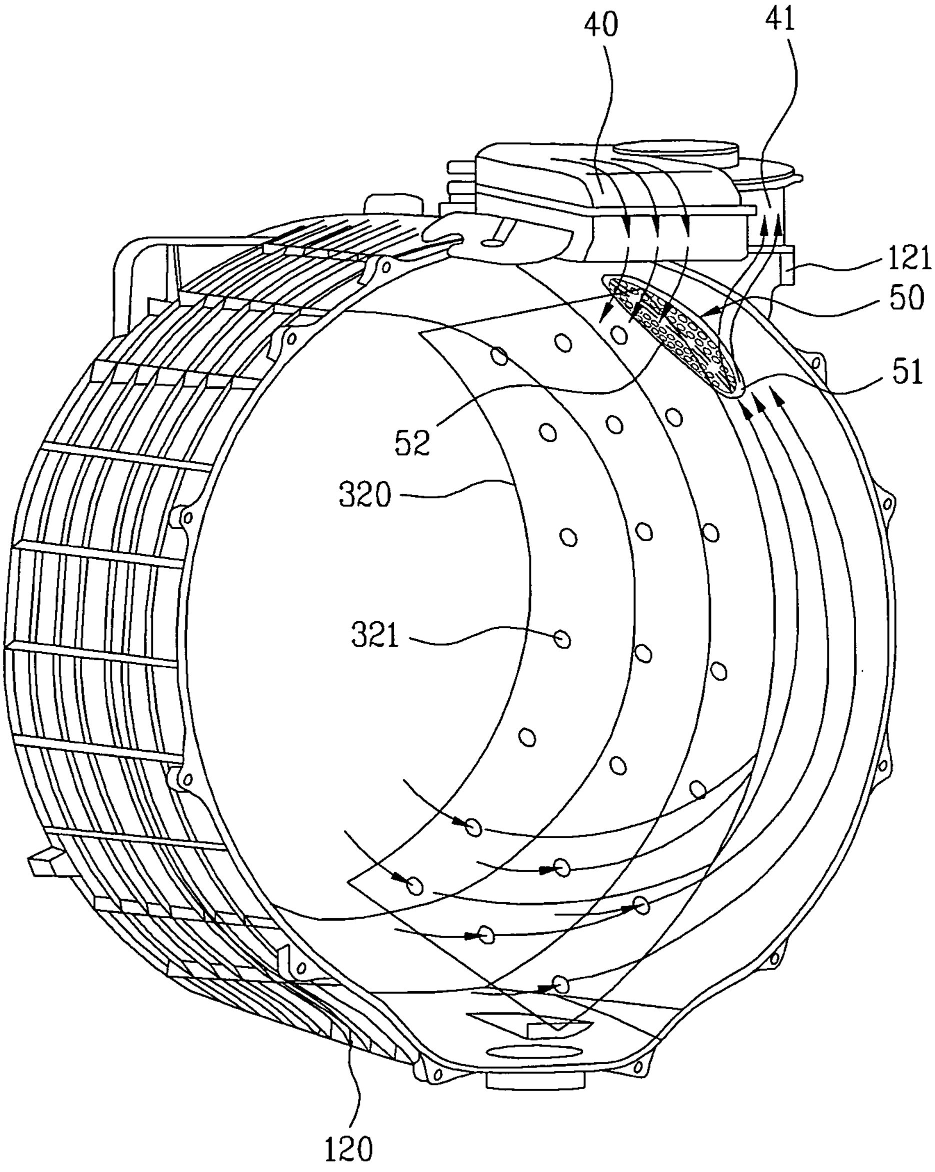


FIG. 13

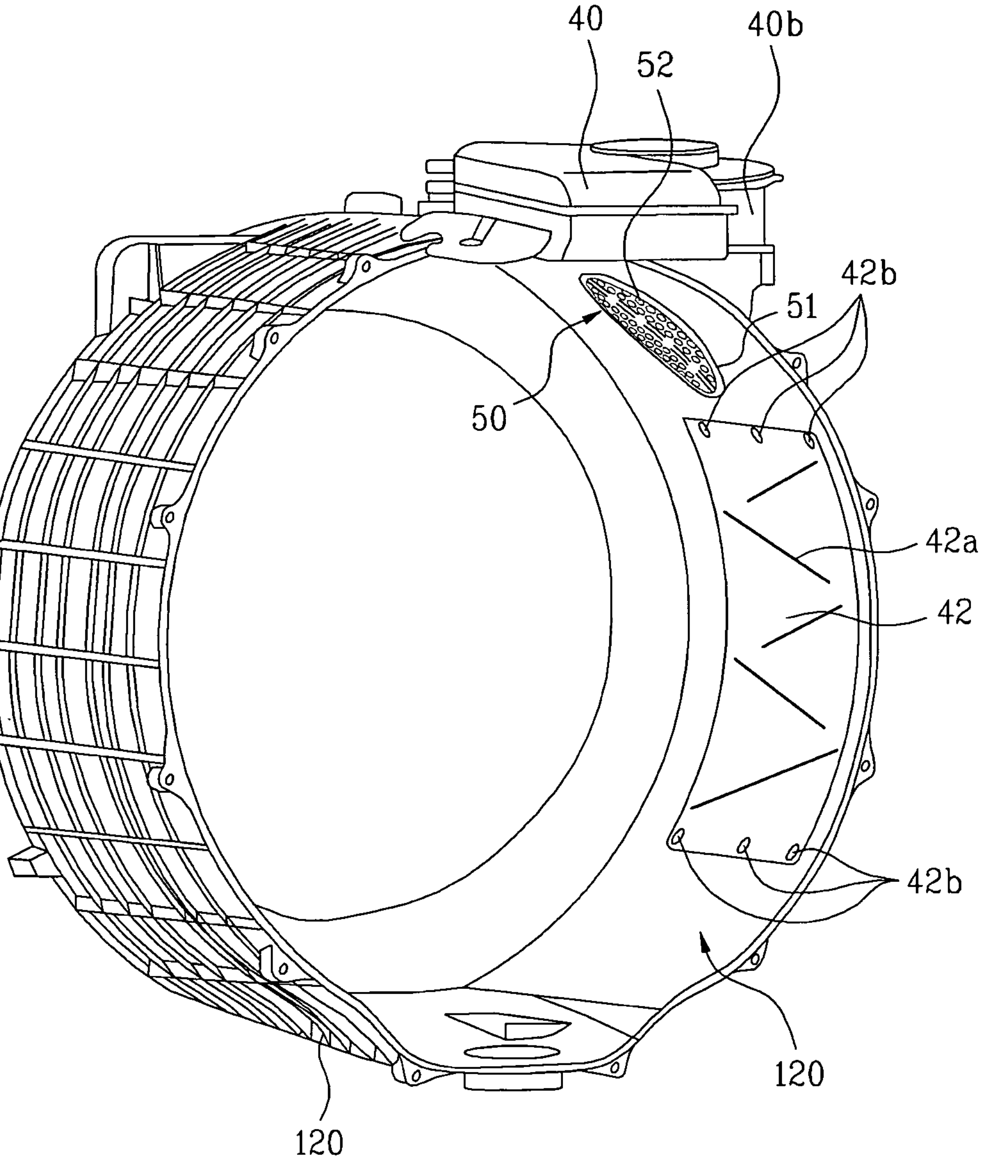


FIG. 14

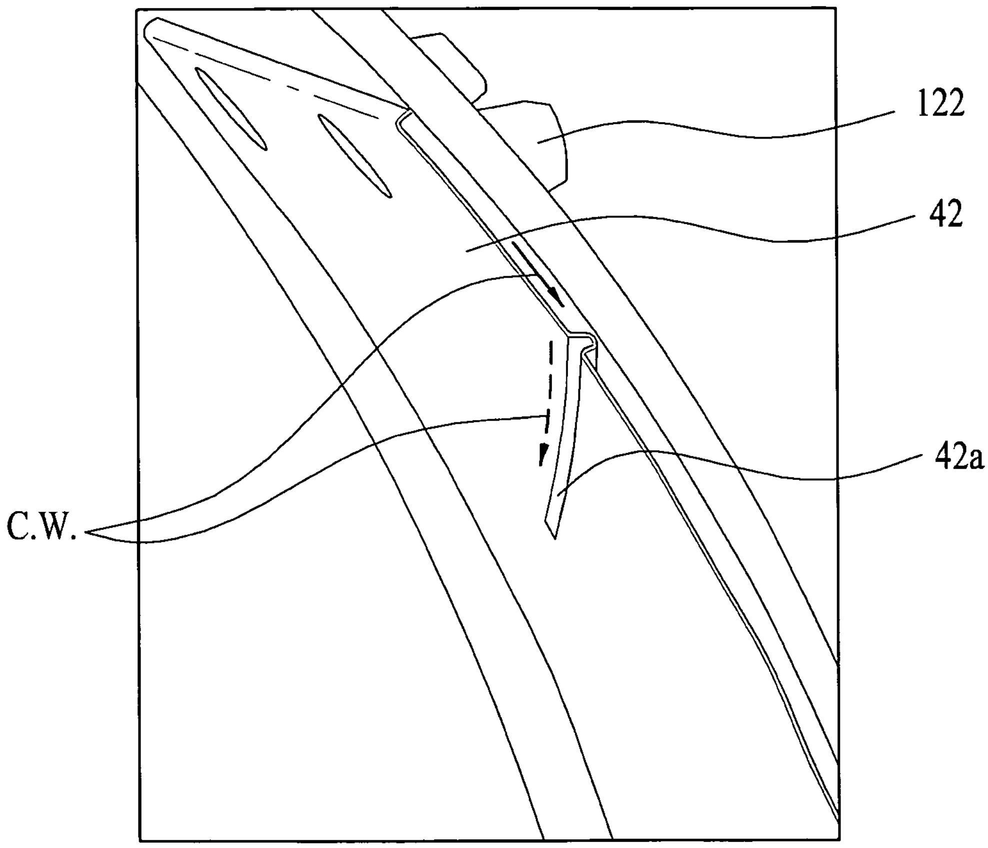


FIG. 15

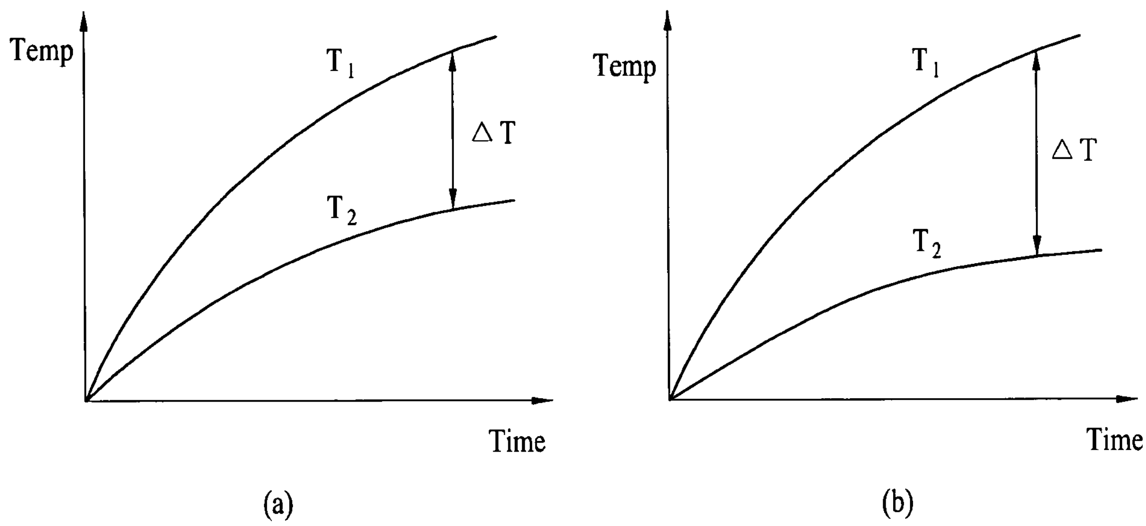


FIG. 16

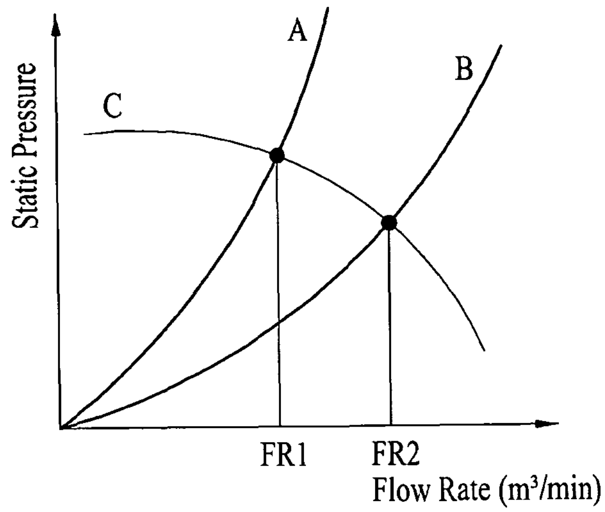
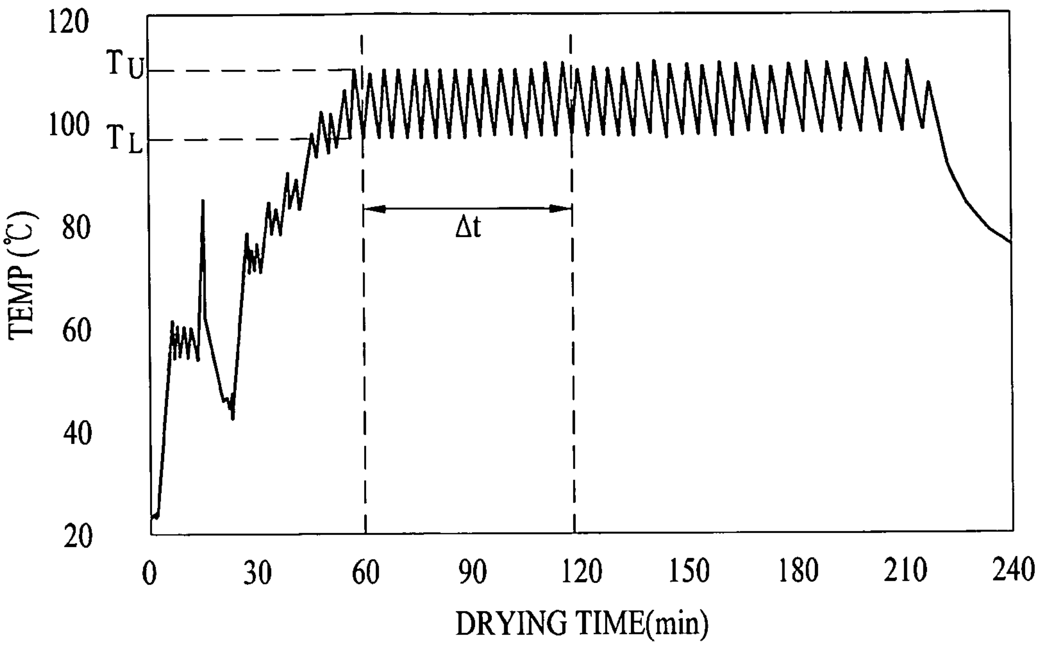
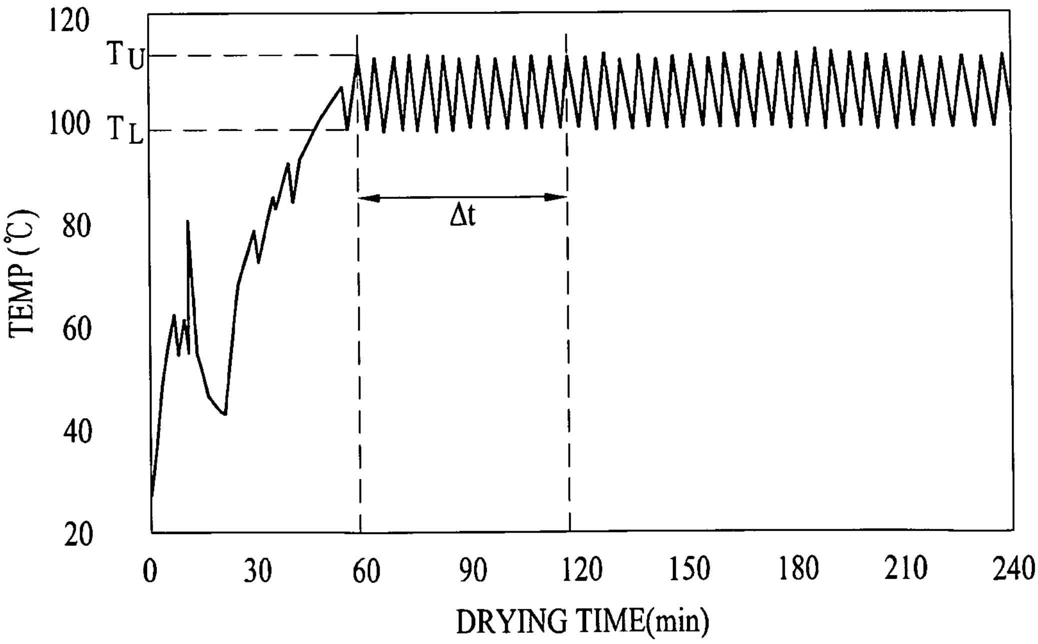


FIG. 17



FILTER IS CLOGGED BY 90%

(a)



FILTER IS NOT CLOGGED

(b)

FIG. 18

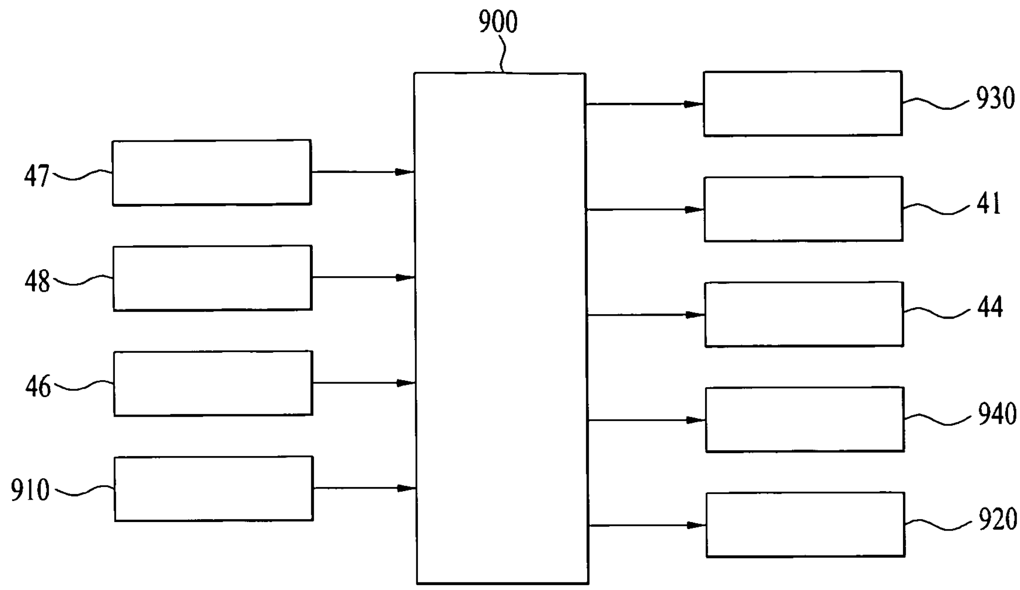

900
930
47
41
48
44
46
940
910
920

FIG. 19

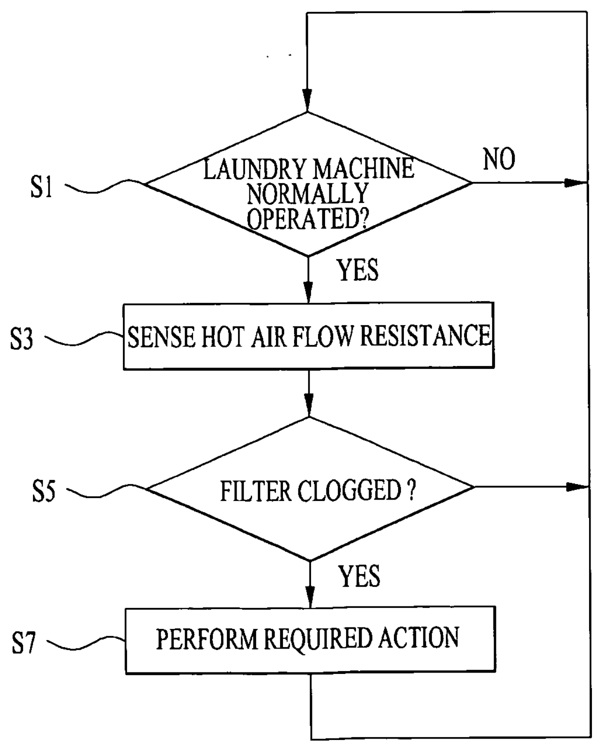

S1
LAUNDRY MACHINE NORMALLY OPERATED?
NO
YES
S3
SENSE HOT AIR FLOW RESISTANCE
S5
FILTER CLOGGED ?
YES
S7
PERFORM REQUIRED ACTION

FIG. 20

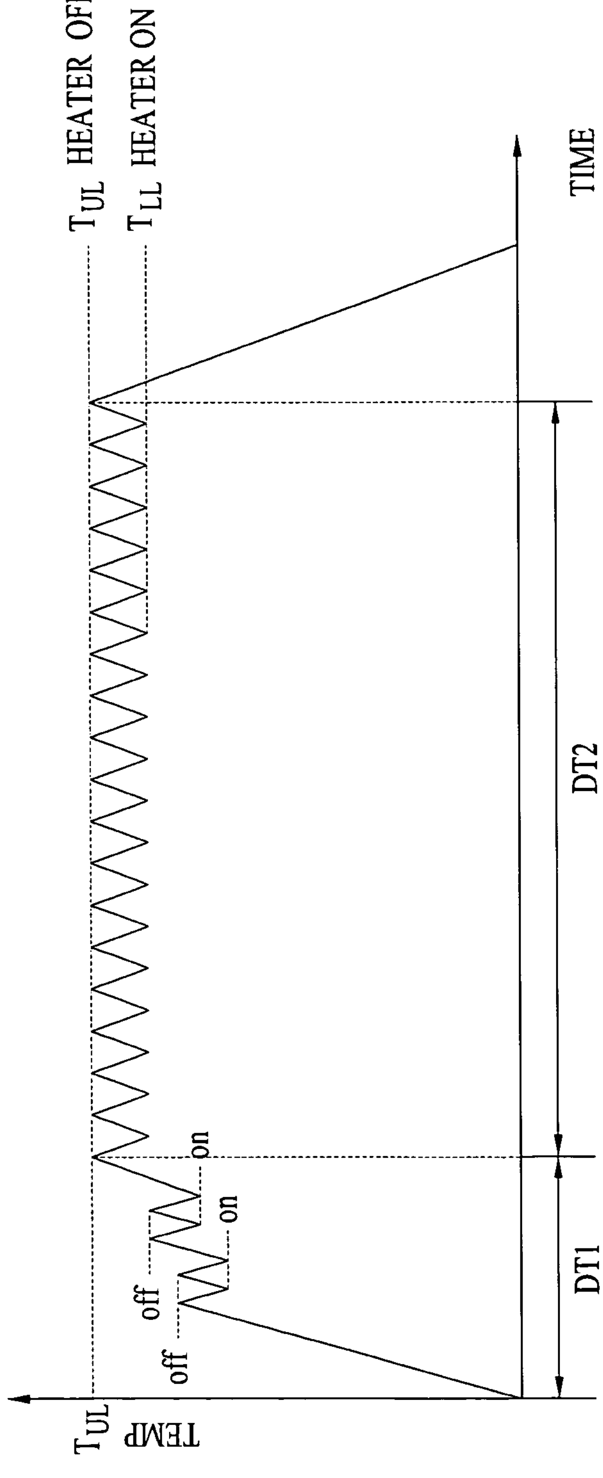

T_{UL} HEATER OFF
T_{LL} HEATER ON
TIME
DT2
DT1
on
on
off
off
T_{UL}
TEMP

FIG. 21

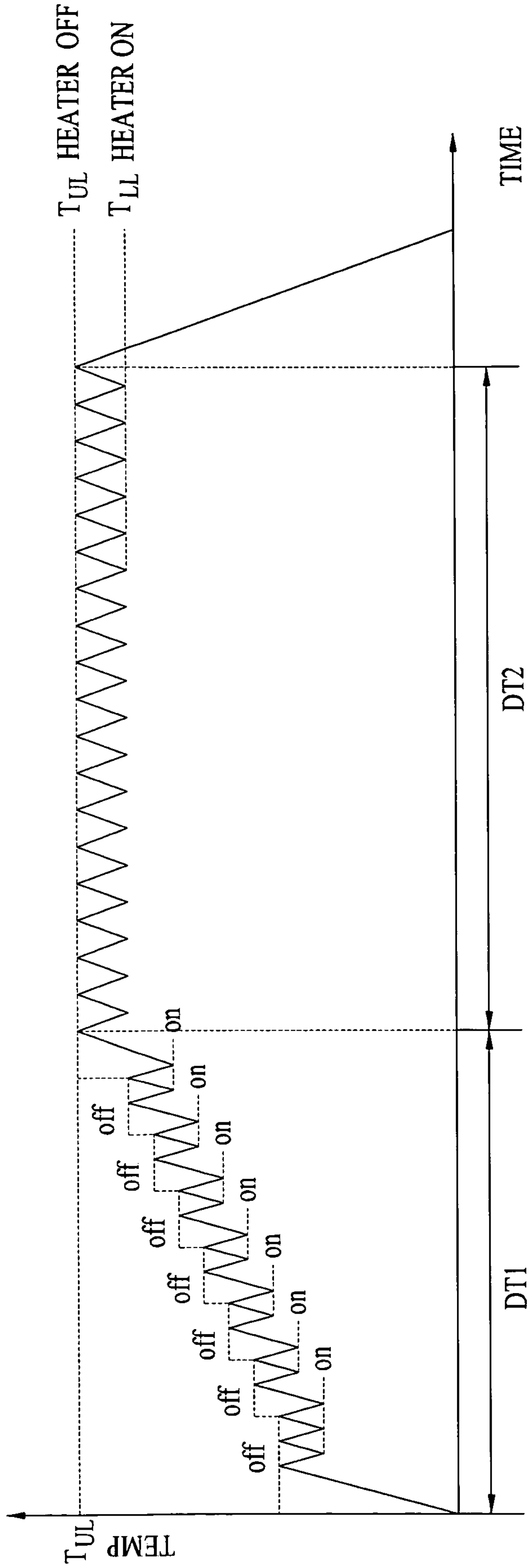
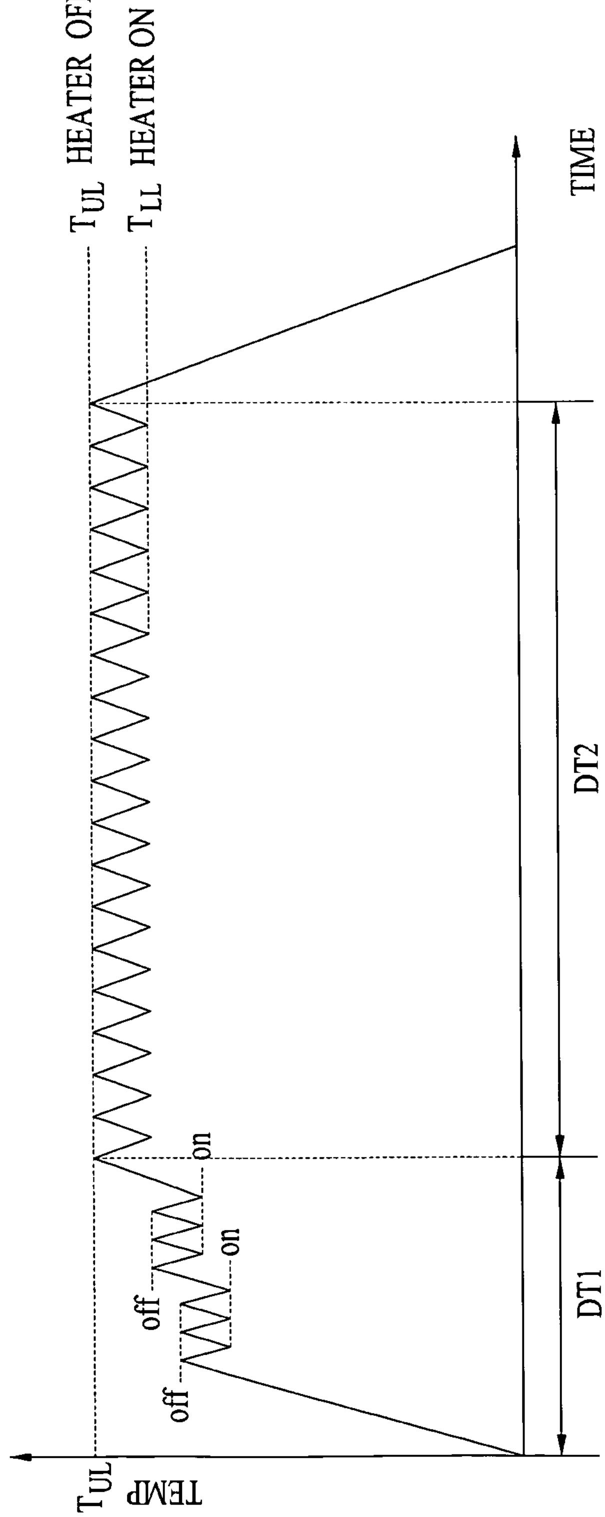


FIG. 22


T_{UL} HEATER OFF
T_{LL} HEATER ON
TIME
DT2
DT1
off
off
on
on
TEMP
T_{UL}