(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 868 792 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.05.2015 Bulletin 2015/19

(51) Int Cl.:
D06F 25/00 *(2006.01)*

(21) Application number: **14178420.7**

(22) Date of filing: **24.07.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **01.11.2013 KR 20130132033**

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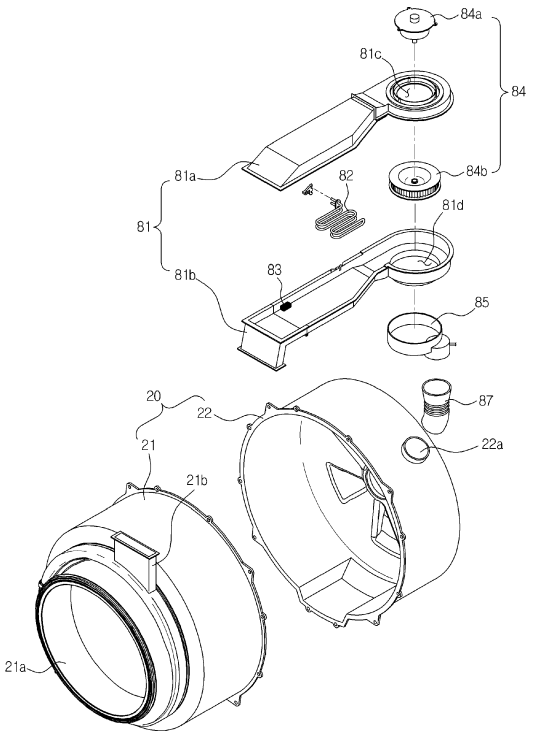
Remarks:
A request for correction of the drawing figures 8,10 and 11 has been filed pursuant to Rule 139 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(54) Washing machine and control method thereof

(57) A washing machine includes a tub (20), a drum (30) rotatably installed at an inside of the tub (20), a drying unit (80) including a blowing fan (84b) suctioning air inside of the tub 820) and the drum (30), and a drying heater (82) heating the air inside of the tub and the drum, a lint filter (85b) filtering foreign substances contained in the suctioned air, and a control unit turning on/off the drying heater (82) and the blowing fan (84b) according to a temperature of a drying duct. If the drying heater (82) is turned off, the control unit determines whether the lint filter (85b) is blocked based on the temperature of the drying duct, the temperature of the tub (20) and the turning-on time of the drying heater (82), and washes the lint filter by determining whether the lint filter (85b) is blocked. The washing of the lint filter (85b) during the drying cycle allows the lint filter to be washed without performing a washing cycle, a rinsing cycle, or a spin cycle, and the air to be circulated between a drying duct and a tub.

FIG. 3



EP 2 868 792 A1

Description

[0001] The present invention relates to a washing machine capable of drying laundry and a controlling method thereof.

[0002] In general, a washing machine is an apparatus configured to wash laundry inside of a tub retaining water by rotating a drum rotatably installed in the tub to accommodate the laundry. The washing machine may perform a washing cycle using water to separate pollutants from the laundry, a rinsing cycle rinsing the laundry, a spin-dry cycle removing water from the wet laundry, and a drying cycle drying the laundry. In particular, the drying cycle may use a heat-drying method which dries the laundry by heating the air inside of the tub and the drum. To perform the drying cycle as mentioned above, the washing machine needs a drying duct configured to heat the air inside of the tub and the drum.

[0003] At this time, the drying duct may be provided with a lint filter configured to prevent the flow of lint, that is, an accumulation of textile fibers separated from the laundry, from being introduced into the drying duct. However, if the lint fiter is blocked by the lint, the drying efficiency may be decreased since the air is not being smoothly circulated between the tub and the drying duct.

[0004] Therefore, it is an aspect of the present disclosure to provide a washing machine capable of determining whether a lint filer is blocked and washing the lint filter according to blockage of the lint filter during a drying cycle, and a control method thereof.

[0005] Additional aspects of the present disclosure will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

[0006] In accordance with one aspect of the present disclosure, a washing machine includes a tub, a drum rotatably installed inside of the tub, a drying unit including a blowing fan suctioning air into the inside of the tub and the drum, and a drying heater heating the air inside of the tub and the drum, a lint filter filtering foreign substance contained in the suctioned air, and a control unit turning on/off the drying heater and the blowing fan according to a temperature of a drying duct. If the drying heater is turned off, the control unit may determine whether the lint filter is blocked based on the temperature of the drying duct, a temperature of the tub and a turning-on time of the drying heater, and may wash the lint filter depending on whether the lint filter is blocked.

[0007] The control unit may calculate a filter blockage index based on a difference between the temperature of the drying duct and the temperature of the tub, and the initial turning-on time of the drying heater, and may wash the lint filter according to the filter blockage index.

[0008] The control unit may calculate the filter blockage index by dividing the difference between the temperature of the drying duct and the temperature of the tub with the initial turning-on time of the drying heater.

[0009] The control unit may wash the lint filter for a filter washing time according to the filter blockage index if the filter blockage index is equal to or larger than a predetermined reference value.

[0010] The control unit may reduce the rotation speed of the blowing fan during washing of the lint filter.

[0011] The control unit may reduce the rotation speed of the drum during washing of the lint filter.

[0012] The washing machine may further include a washing water injection nozzle injecting the washing water to the lint filter, a washing water supply pipe supplying the washing water to the washing water injection nozzle, and a washing water supply valve opening/closing the washing water supply pipe.

[0013] The control unit may open the washing water supply valve depending on whether the lint filter is blocked, after the start of a drying cycle when the drying heater is initially turned off.

[0014] In accordance with one aspect of the present disclosure, a control method of a washing machine includes driving a blowing fan introducing air in a tub into a drying duct, driving a drying heater heating the air in the drying duct, turning off the drying heater when a temperature of the drying duct is equal to or higher than a high temperature limit, and washing a lint filter according to the temperature of the drying duct, the temperature of the tub, and the turning-on time of the drying heater when the drying heater is turned off, wherein the turning-on time of the drying heater is a period of time until that ends when the drying heater is turned off from when the drying heater was turned on.

[0015] The washing of the lint filter may include calculating the filter blockage index based on the temperature of the drying duct, the temperature of the tub, and the initial turning-on time of the drying heater, and washing the lint filter according to the filter blockage index calculated.

[0016] The calculation of the filter blockage index may include dividing the difference between the temperature of the drying duct and the temperature of the tub with the turning-on time of the drying heater.

[0017] The washing of the lint filter according to the filter blockage index calculation may include washing the lint filter for a filter washing time according to the filter blockage index if the filter blockage index is equal to or larger than the predetermined reference value.

[0018] The washing of the lint filter may include supplying washing water to a washing water injection nozzle injecting the washing water to the lint filter.

[0019] The washing of the lint filter may include reducing the rotation speed of the blowing fan.

[0020] In accordance with another aspect of the present disclosure, a washing machine includes a tub, a drum rotatably installed inside of the tub, a drying unit including a blowing fan suctioning air inside of the tub and the drum and a drying heater heating the air inside of the tub and the drum, a lint filter filtering foreign substance contained in the suctioned air, and a control unit turning on/off the drying heater and the blowing fan ac-

cording to a temperature of a drying duct during a drying cycle. During a drying cycle, the control unit may wash the lint filter according to a period of time during which a temperature of the drying duct reaches a predetermined reference temperature of the drying duct, and a temperature of the tub in a process of the drying cycle.

[0021] The control unit may wash the lint filter if the period of time during which the temperature of the drying duct reaches the reference temperature of the drying duct is less than a predetermined reference time, and the temperature of the tub is less than a predetermined reference temperature of the tub after the predetermined drying time expires.

[0022] The control unit may reduce the rotation speed of the blowing fan during washing of the lint filter.

[0023] In accordance with another aspect of the present disclosure, a control method of a washing machine includes driving a blowing fan introducing air in a tub into a drying duct, driving a drying heater heating the air in the drying duct, and turning off the drying heater when a temperature of the drying duct is equal to or higher than a high temperature limit. If a period of time during which the temperature of the drying duct reaches a predetermined reference temperature of the drying duct is less than a predetermined reference time, and a temperature of the tub is less than a predetermined reference temperature of the tub after the predetermined drying time expires, washing of the lint filter may be performed.

[0024] The washing of the lint filter may include reducing the rotation speed of the blowing fan.

[0025] These and/or other aspects of the disclosure will become apparent and more readily appreciated from the following description of embodiments, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a washing machine in accordance with an embodiment of the present disclosure.

FIG. 2 is a cross-sectional view of a configuration of the washing machine in accordance with an embodiment of the present disclosure.

FIG. 3 is an exploded perspective view of a drying unit of the washing machine in accordance with an embodiment of the present disclosure.

FIG. 4 is a perspective view of a lint filter of the drying unit of the washing machine in accordance with an embodiment of the present disclosure.

FIG. 5 is a sectional view of the lint filter of the drying unit of the washing machine in accordance with an embodiment of the present disclosure.

FIG. 6 is a view of a washing water supplying pipe and a washing water supplying valve of the drying unit of the washing machine in accordance with an embodiment of the present disclosure.

FIG. 7 is a control flow diagram illustrating the washing machine in accordance with an embodiment of the present disclosure.

FIG. 8 is a flow chart illustrating a drying cycle of the washing machine in accordance with an embodiment of the present disclosure.

FIG. 9 is a view illustrating an air flow during the drying cycle of the washing machine in accordance with an embodiment of the present disclosure.

FIG. 10 is a graph illustrating a temperature of inside of the drying duct during the drying cycle of the washing machine in accordance with an embodiment of the present disclosure.

FIG. 11 is a flow chart illustrating determining whether the lint filter is blocked by the washing machine in accordance with an embodiment of the present disclosure.

FIG. 12 is a flow chart illustrating a washing of the lint filter by the washing machine in accordance with an embodiment of the present disclosure.

FIG. 13 is a view illustrating a rotation of a drum during the washing of the lint filter by the washing machine in accordance with an embodiment of the present disclosure.

FIG 14a and 14b are flow charts illustrating determining whether a lint filter is blocked by a washing machine in accordance with another embodiment of the present disclosure.

FIG. 15 is a flow chart illustrating a washing of a lint filter by a washing machine in accordance with another embodiment of the present disclosure.

[0026] Reference will now be made in detail to embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like components throughout.

[0027] FIG. 1 is a perspective view of a washing machine in accordance with an embodiment of the present disclosure, and FIG. 2 is a cross-sectional view of a configuration of the washing machine in accordance with an embodiment of the present disclosure.

[0028] Referring to FIGS 1 and 2, a washing machine 1 includes a cabinet forming an external appearance of the washing machine 1, a tub 20 accommodating water used for washing, a drum 30 being rotated to wash laundry, a driving motor 40 rotating the drum 30, a water supply unit 50 supplying water, a water discharge unit 60 discharging water accommodated in the tub 20, a detergent supply unit 70 supplying detergent, and a drying unit 80 drying the laundry accommodated in the drum 30.

[0029] At the center of the front surface of the cabinet 10, an inlet 11 is formed to which the laundry is put into or taken out of. The inlet 27 may be opened and closed by the door 13. The door 13 is rotatably coupled to the cabinet 10 by a hinge and is not easily opened by a hook when the inlet 11 is closed.

[0030] At an upper portion of the front surface of the cabinet 10, a control panel 90 is provided to receive an operation command of the washing machine 1 by a user and to display operation information of the washing machine 1. The control panel 90 includes a plurality of buttons 91 and 93, a dial 92 configured to receive an oper-

ation command of the washing machine 1 by a user, and a display panel 94 displaying operation information of the washing machine 1 by a user. The washing machine 1 receives a course selected among predetermined plurality of washing courses via the dial 92 by a user. The washing machine 1 receives detailed information, e.g. a water temperature, the number of rinses, and strength of spinning, according to the selected course, via the plurality of buttons 91 and 93. The plurality of buttons 91 and 93 may employ a micro switch, a membrane switch or a touch pad. In addition, the display panel 94 displays a wash course selected by a user, a water temperature, the number of rinses, strength of spinning and a washing time. The display panel 95 may employ a Liquid Crystal Display: LCD panel, a Light Emitting Diode: LED panel, or an Organic Light Emitting Diode: OLED panel.

[0031] The tub 20 is provided inside the cabinet 10, and includes the rear tub member 22 in the shape of a cylinder having the rear thereof closed, and the front tub member 21 disposed at the front of the rear tub member 22. A bearing 25 to which a driving motor 40, which will be illustrated later, is rotatably fixed, and a bearing housing 24 are provided at the rear of the rear tub member 22. An air discharge port 22a through which the drying unit 80 draws in the air of the tub 20 and the drum 30 is provided at an upper portion of the rear tub member 22. An opening 21a is configured to let the laundry be put into the drum 30 or withdraw the laundry from the drum 30 and is disposed at the front of the front tub member 21. At an upper portion of the opening 21a, an air intake port 21b configured to direct the air heated by the drying unit 80 toward the tub 20 and the drum 30 is disposed.

[0032] At the inside of the tub 20, a tub temperature sensor 26 detecting a temperature of the inside of the tub 20 is provided. The tub temperature sensor 26 may employ a thermistor whose electrical resistance varies according to the temperature.

[0033] The tub 20 is connected to a water supply unit 50 and a detergent supply unit 70 through a connection pipe 74 provided at an upper portion of the tub 20, and to a water discharge unit 60 through a water discharge pipe 61 provided at a lower portion of the tub 20.

[0034] The drum 30 is rotatably installed inside of the tub 20, and includes a drum body 31 formed in the shape of a cylinder, a drum front plate 32 disposed at the front of the drum body 31, and a drum rear plate 33 dispose at the rear of the drum body 31.

[0035] At an inner surface of the drum body 31, a plurality of holes 31b configured to introduce the water stored in the tub 20 into the inside of the drum 30, and a lifter 31a configured to lift the laundry are provided. At the drum front plate 32, an opening 32a configured to let the laundry be put into the drum 30 or be removed from the drum 30 is provided. A flange 34 to which the driving motor 40 is connected is installed at the drum rear plate 33.

[0036] The driving motor 40 includes a stator 41 fixed to the rear surface of the tub 20, a rotor 42 rotated by magnetic interaction with the stator 41, a rotation shaft 43 in which one side thereof is coupled to the rotor 42 and the other side thereof is coupled to the flange 34 by passing through the rear surface of the tub 20, and a hall sensor 45 configured to detect the rotational displacement of the rotor 42. In addition, the rotation shaft 43 is rotatably coupled to the tub 20 by the bearing 25 and the bearing housing 24 both of which are provided at the rear surface of the tub 20, as described above. The driving motor 40 may employ a BLDC (BrushLess Direct Current) motor capable of easily controlling a rotation speed, and an AC (Alternating Current) motor.

[0037] The supply water unit 50 is provided at the upper portion of the tub 20, and includes a supply water pipe 51 connecting an outside source (not shown) to the supply detergent unit 70, which will be describe later, and a water supply valve 52 disposed at the water supply pipe 51 to open/close the water supply pipe 51. The water supply valve 52 may employ a solenoid valve which opens and closes the water supply pipe 51 by an electric signal.

[0038] The supply detergent unit 70 is provided at the upper portion of the tub 20, and is connected to the tub 20 by the connection pipe 74. In addition, the supply detergent unit 70 includes a detergent storage 71 configured to store detergents and rinse additives, and a detergent storage housing 72 accommodating the detergent storage 71.

[0039] The drying unit 80 is disposed at the upper portion of the tub 20 and suctions the air to the inside of the tub 20 and the drum 30. In addition, the drying unit 80 exhausts to the tub 20 and the drum 30 after heating the air.

[0040] Hereinafter, the drying unit 80 will be described.

[0041] FIG. 3 is an exploded perspective view of a drying unit of the washing machine in accordance with an embodiment of the present disclosure, FIG. 4 is a perspective view of a lint filter of the drying unit of the washing machine in accordance with an embodiment of the present disclosure, FIG. 5 is a sectional view of the lint filter of the drying unit of the washing machine in accordance with an embodiment of the present disclosure, and FIG. 6 is a view of a washing water supplying pipe and a washing water supplying valve of the drying unit of the washing machine in accordance with an embodiment of the present disclosure.

[0042] Referring to FIGS 3 to 6, the drying unit 80 includes a drying duct 81 used as a flow path in which the air suctioned (drawn) from the tub 20 flows, a blowing member 84 suctioning (drawing) the air from the inside of the tub 20 and then blowing the same, a guide pipe 87 guiding the air suctioned from the tub 20 to the drying duct 81, and a connection member 85 connecting the drying duct 81 to the guide pipe 87.

[0043] As illustrated on FIG. 3, the drying duct 81 includes a duct top plate 81a and a duct bottom plate 81b, and extends from a proximal end of the tub 20 to a distal end of the tub 20. In addition, the front portion of the

drying duct 81 is connected to the air intake port 21b, and the rear portion of the drying duct 81 is connected to the air discharge port 22a by the connection pipe 87.

[0044] In addition, in the inside of the drying duct 81, a drying heater 82 heating the air passing through the drying duct 81, and a duct temperature sensor 83 detecting a temperature of the air passing through the drying duct 81 are provided. The duct temperature sensor 83 is disposed downstream of the drying duct 81 with respect to the airflow to detect the temperature of the air heated by the drying heater 82. In addition, the duct temperature sensor 83 may employ a thermistor whose electrical resistance varies according to the temperature.

[0045] As illustrated in FIG. 3, the blowing (circulation) member 84 includes a fan 84b (also referred to as a blowing fan) suctioning (drawing) the air from inside the tub 20, and a fan motor 84a driving the fan. The fan 84b may be disposed at an opening bottom plate 81d formed at the duct bottom plate 81b. The fan motor 84a may be disposed at an opening top plate 81c formed at the duct top plate 81a.

[0046] The blowing member 84 suctions (draws) the air from inside the tub 20 through the air discharge port 22a and the guide pipe 87, directs the suctioned (drawn in) air to the drying duct 81, and exhausts the air heated by the drying duct 81 into the tub 20 through the air intake port 21b of the tub. Thus the blowing member 84 allows the air inside the tub 20 to be circulated between the tub 20 and the drying duct 81.

[0047] As illustrated in FIG. 3, the guide pipe 87 is disposed between the drying duct 81 and the tub 20. One side of the guide pipe 87 is connected to the tub 20, and the other thereof is connected to the connection member 85. Thus the guide pipe 87 guides the air suctioned from the inside of the tub 20 to the drying duct 81.

[0048] As illustrated in FIGS. 4 and 5, the connection member 85 is formed in the shape of a cylinder having an upper surface thereof open and a lower surface thereof close. At the inside of the connection member 85, the blowing member 84 is disposed. In addition, at a lower portion of the connection member 85, a connection port opening 85a in which the air is introduced from the guide pipe 87 is provided, and a connection port 85c connecting the connection member 85 to the guide pipe 87 is provided. The connection port opening 85a at the lower portion of the connection member 85 includes a lint filter 85b configured to filter foreign substances contained in the air suctioned from the tub 20. The lint filter is provided with washing water injection nozzle 86a configured to inject washing water to remove foreign substances sticking to the lint filter 85b.

[0049] As illustrated in FIG. 6, the washing water injection nozzle 86a is connected to an outside water source (not shown) by a washing water supply pipe 86b. At the washing water supply pipe 86b, a washing water supply valve 86c opening/closing the washing water supply pipe 86b is provided. In addition, the washing water supply pipe 86b and the washing water supply valve 86c are separately provided from the water supply pipe 51 and the water supply valve 52, both of which supply the water to the tub 20, thereby supplying the washing water to the washing water injection nozzle 86a during the drying cycle, in which the water is not supplied to the tub 20. The washing water supply valve 86c may employ a solenoid valve which opens and closes the supply water pipe 51 by an electric signal.

[0050] FIG. 7 is a control block diagram illustrating the washing machine in accordance with an embodiment of the present disclosure.

[0051] Referring to FIG. 7, the washing machine 1 includes a control unit 100, a driving unit 110, and a storage unit 120 to drive and control the driving motor 40, the water supply unit 50, the water discharge unit 60, the drying unit 80, and the control panel 90.

[0052] The driving unit 110 supplies current to drive the driving motor 40, the water supply valve 52, the water discharge pump 62, the drying heater 89, the blowing fan motor 84a, and the washing water supply valve 86c by control signals of the control unit 100. In particular, the driving unit 110 may include an inverter (not shown) to drive the driving motor 40.

[0053] The storage unit 120 may include a non-volatile memory (not shown) for permanent storage of control programs and control data of the washing machine 1, such as a magnetic disc, a solid state disc, and the like, and a volatile memory (not shown) for temporary storage of data generated in the course of controlling the operation of the washing machine 1, such as a D-RAM, S-RAM, and the like.

[0054] The control unit 100 generates a control signal to control the driving motor 40, the water supply unit 50, the water discharge unit 60, the drying unit 80, and the control panel 90 according to an operation command by a user, a detected result by the duct temperature sensor 83 and the tub temperature sensor 26. For example, if the user selects a wash course via the control panel 90 and inputs a wash command, the control unit 100 transmits a supplying water command signal to the driving unit 120 so that the water supply unit 50 opens the water supply valve 52, and transmits a driving motor signal to the driving unit to drive the driving motor 40.

[0055] Heretofore, a configuration of the washing machine 1 according to an embodiment of the present disclosure has been described.

[0056] Hereinafter, a description will be given with respect to an operation of the washing machine that is, a drying operation, in accordance with an embodiment of the present disclosure.

[0057] Referring to FIG.2, as described above, with respect to the overall operations of the washing machine 1, the washing machine 1 performs a washing cycle separating pollutants from the laundry by driving the drum 30 after supplying detergents and water to the tub 20, a rinsing cycle rinsing the pollutant and the detergents from the laundry by driving the drum 30 after supplying rinse additives and water to the tub 20, a spin-drying cycle

removing water from the wet laundry by driving the drum 30 at high speed , and a drying cycle drying the laundry by heating air inside the tub 20 and the drum 30.

[0058] For example, during the washing cycle and the rinsing cycle, the washing machine 1 may supply detergents and water to the tub 20 and rotate the drum 30 clockwise and counterclockwise at a certain RPM. In particular, the washing machine 1 may repeat operations including rotating the drum 30 clockwise for approximately 20 seconds (on time), stopping the drum 30 for 5 seconds (off time), rotating the drum 30 counterclockwise for approximately 20 seconds (on time), and stopping the drum 30 for 5 seconds (off time). In addition, during the drying cycle, the washing machine 1 may rotate the drum 30 clockwise or counterclockwise at hundreds or thousands of RPM.

[0059] During the drying cycle, the washing machine 1 may rotate the drum 30 clockwise or counterclockwise at hundreds of RPM and drive the blowing member 84 (refer to FIG. 3) and the heating heater 82.

[0060] Hereinafter, detailed operations of the washing machine 1 during the drying cycle will be described.

[0061] FIG. 8 is a flow chart illustrating a drying cycle of the washing machine in accordance with an embodiment of the present disclosure, FIG. 9 is a view illustrating an air flow during the drying cycle of the washing machine in accordance with an embodiment of the present disclosure, and FIG. 10 is a graph illustrating a temperature of inside of the drying duct during the drying cycle of the washing machine in accordance with an embodiment of the present disclosure.

[0062] Referring to FIGS 8 and 10, when the drying cycle is started, the washing machine 1 detects the weight of laundry (410). For example, the washing machine$_1$ rotates the drum 30 at a predetermined RPM, and detects driving current supplied to the driving motor 40 when the drum is rotated at the predetermined RPM. The washing machine 1 calculates the amount (weight) of the laundry based on the detected driving current. In summary, the washing machine 1 calculates the amount of the laundry based on a load of the driving motor 40.

[0063] Thereafter, the washing machine 1 drives the blowing member 84 and the drying heater 82 (415). The washing machine 1 suctions the air inside of the drum 30 by driving the blowing member 84, heats the air suctioned to the driving duct 81 by driving the drying heater 82, and exhausts the heated air to the tub 20 and the drum 30. In particular, as illustrated in FIG. 9, the air inside the drum 30 is discharged to between the drum 30 and the tub 20 through holes 31b formed on an outer circumferential surface of the drum 30, and the air inside the tub 20 is suctioned to the drying duct 81 by the guide pipe 87 and the connection member 85 both of which are disposed at the rear of the tub 20. In addition, the air introduced to the drying duct 81 is directed to the front of the drying duct 81 by the blowing member 84, and then is heated by the heater 82. The heated air is discharged into the air intake port 21b disposed at the front of the tub 20. The air discharged into the air intake port 21b is introduced to the inside of the drum 30 and contacts with the laundry inside the drum 30 via the opening 32a (refer to FIG. 2) disposed at the front of the drum 30.

[0064] Next, the washing machine 1 detects a temperature (T) of the inside of the drying duct 81 (420). In particular, the washing machine 1 may detect the temperature (T) of the inside of the drying duct 81 by the duct temperature sensor 83 provided inside the drying duct 81. As described above, the duct temperature sensor 83 disposed at the lower portion of the drying heater 82 detects the temperature of the air heated by the drying heater 82.

[0065] The washing machine 1 determines whether the temperature (T) of the inside of the drying duct 81 is equal to or higher than a predetermined high temperature limit (TH) (425). When driving the blowing member 84 and the drying heater 82, the temperature of the drying duct 81 is increased, and then reaches the high temperature limit (TH), as illustrated in section o-t1 and section t_2-t_3 of FIG. 10. In particular, section o-t1 is a first time period of turning on the drying heater 82 after the washing machine 1 starts the drying cycle. Hereinafter, t1 will refer to a first period time of turning on the drying heater.

[0066] If the temperature (T) of the inside of the drying duct 81 is less than the high temperature limit (TH) (No in 425), the washing machine 1 repeatedly detects the temperature (T) of the inside of the drying duct 81 while driving the blowing member 84 and the drying heater 82.

[0067] If the temperature (T) of the inside of the drying duct 81 is equal to higher than the high temperature limit (TH) (Yes in 425) the washing machine 1 stops driving the drying heater 82 (430). If the temperature (T) of the inside of the drying duct 81 is steadily increased, there is a risk of fire. Therefore, if the temperature (T) of the inside of the drying duct 81 exceeds the high temperature limit (TH), the washing machine 1 stops driving the drying heater 82. At this time, the washing machine 1 maintains the driving of the blowing member 84 so that drying of the laundry may be performed when the drying heater 82 is not driven.

[0068] Next, the washing machine 1 once again detects the temperature (T) of the inside of the drying duct 81 (435). As described above, the washing machine 1 may detect the temperature (T) of the inside of the drying duct 81 by the duct temperature sensor 83 provided inside the drying duct 81.

[0069] The washing machine 1 determines whether the temperature (T) of the inside of the drying duct 81 is equal to or lower than a predetermined low temperature limit (TL) (440). When stopping driving of the heater 82 in a state where the blowing member 84 is driven, the temperature of the drying duct 81 is decreased, and then reaches the low temperature limit (TL), as illustrated in section t1-t2 of FIG. 10.

[0070] If the temperature (T) of the inside of the drying duct 81d is higher than the low temperature limit (TL) (No in 440), the washing machine 1 repeatedly detects the

temperature (T) of the inside of the drying duct 81 in a state where the drying heater 82 is not driven.

[0071] If the temperature (T) of the inside of the drying duct 81 is equal to or lower than the low temperature limit (TL) (Yes in 440) the washing machine 1 drives the drying heater 82 (415) again.

[0072] As in the above, the washing machine repeatedly drives the drying heater 82 and stops driving the drying heater 82 according to the temperature (T) of the inside of the drying duct 81 for a predetermined drying time based on the amount of the laundry.

[0073] While the washing machine 1 performs the drying cycle, the drum 30 provided inside the tub 20 continuously rotates, and pieces of textile fibers are separated from the laundry as the laundry inside the drum 30 is dried. That is, friction between the laundry is generated due to the rotation of the drum 30, so that the pieces of textile fibers are separated from the laundry. The pieces of textile fibers, as mentioned above, refer to lint. Lint is discharged to the tub 20 via holes 31a of the drum 30 (refer to FIG. 2), is moved along the guide pipe 87, and is filtered by the lint filter 85b provided at the connection member 85. In addition, as the drying cycle is performed, the lint filter 85b is slowly blocked by the lint.

[0074] If the lint filter 85b is slowly blocked by the lint, the air inside the tub 20 and the drum 30 is not introduced to the drying duct 81, thereby reducing the drying efficiency. To prevent reduction of the drying efficiency, the washing machine 1 determines whether the lint filter 85b is blocked, and washes the lint filter 85b when the filter 85b is determined to be blocked.

[0075] Hereinafter, a method of the washing machine 1 determining whether the lint filter 85b is blocked and a method of washing the lint filter 85b will be described.

[0076] FIG. 11 is a flow chart illustrating determining whether the lint filter is blocked by the washing machine in accordance with an embodiment of the present disclosure.

[0077] Referring to FIG. 11, during the drying cycle, the washing machine 1 detects the amount of the laundry (510), and drives the blowing member 84 and the drying heater 82 (515).

[0078] Next, the washing machine 1 initializes duct maximum temperature (Dmax) and tub maximum temperature (Wmax) (520). The duct maximum temperature (Dmax) refers to a maximum temperature of the inside of the drying duct 81 until driving the drying heater 82 is initially stopped after the washing machine 1 started to perform the drying cycle, and the tub maximum temperature (Wmax) refers to a maximum temperature of the inside of the tub 20 until driving the drying heater 82 is initially stopped after the washing machine 1 started to perform the drying cycle.

[0079] The washing machine 1 detects the temperature of the inside of the drying duct 81 (525). The temperature of the inside of the drying duct 81 may be detected by the duct temperature sensor 83, as described above.

[0080] Next, the washing machine 1 determines whether the temperature of the inside of the drying duct 81 detected through the operation 525 is higher than the duct maximum temperature (Dmax) (530).

[0081] If the temperature of the inside of the drying duct 81 is higher than the duct maximum temperature (Dmax) (Yes in 530), the washing machine 1 updates the duct maximum temperature (Dmax). That is, if the temperature of the inside of the drying duct 81 is higher than the duct maximum temperature (Dmax), the washing machine 1 inputs a present detected temperature of the inside of the drying duct 81 into the duct maximum temperature (Dmax). The temperature of the inside of the drying duct 81 is continuously increased until driving the drying heater 82 is initially stopped after the drying cycle was initiated (time t1), as illustrated in FIG. 10, and thereby the duct maximum temperature (Dmax) is updated while the drying heater 82 is driven.

[0082] The washing machine 1 detects the temperature of the inside of the tub 20 (540). The washing machine 1 may detect the temperature of the inside of the tub 20 by the tub temperature sensor provided inside the tub 20.

[0083] Next, the washing machine 1 determines whether the temperature of the inside of the tub 20 detected through the operation 540 is higher than the tub maximum temperature (Wmax) (545).

[0084] If the temperature of the inside of the tub 20 is higher than the tub maximum temperature (Wmax) (Yes in 545), the washing machine 1 updates the tub maximum temperature (Wmax). That is, if the temperature of the inside of the tub 21 is higher than the tub maximum temperature (Wmax), the washing machine 1 inputs a present detected temperature of the inside of the tub 20 into the tub maximum temperature (Wmax). If the temperature of the inside of the tub 20 is less than the tub maximum temperature (Wmax) (No in 545) the washing machine 1 does not update the tub maximum temperature (Wmax).

[0085] Next, the washing machine 1 detects the temperature of the inside of the drying duct 81, determines whether the temperature of the inside of the drying duct 81 is higher than the duct maximum temperature (Dmax), and repeatedly updates the duct maximum temperature (Dmax) if the temperature of the inside of the drying duct 81 is higher than the duct maximum temperature (Dmax). The washing machine 1 detects the temperature of the inside of the tub 20, determines whether the temperature of the inside of the tub 20 is higher than the tub maximum temperature (Wmax), and repeatedly updates the tub maximum temperature (Wmax) if the temperature of the inside of the tub 20 is higher than the tub maximum temperature (Wmax).

[0086] In a state where the duct maximum temperature (Dmax) and the tub maximum temperature (Wmax) are repeatedly updated, if the temperature of the inside of the drying duct 81 detected through the operation 530 is less than the duct maximum temperature (Dmax) (No in

530), the washing machine 1 determines whether a difference between the temperature of the inside of the drying duct 81 detected and the duct maximum temperature (Dmax) is equal to or greater than 2 degrees (555). There is a possibility that the temperature of the inside of the drying duct 81 may be incorrectly determined to be decreased since heat is not transmitted smoothly to the duct temperature sensor 83. Therefore, to confirm that the temperature of the inside of the drying duct 81 is decreased as a result of the drying heater 82 being switched off, the washing machine 1 determines that the temperature of the inside of the drying duct 81 is decreased only when a difference between the temperature of the inside of the drying duct 81 and the duct maximum temperature (Dmax) is equal to or greater than 2 degrees. In other words, 2 degrees is chosen as an appropriate threshold to ensure that the duct temperature is actually decreasing, but the threshold is not limited to this specific figure.

[0087] If the difference between the detected temperature of the inside of the drying duct 81 and the duct maximum temperature (Dmax) is less than 2 degrees (No in 555), the washing machine 1 does not update the duct maximum temperature (Dmax), detects the temperature of the inside of the tub 20 and updates the tub maximum temperature (Wmax) based on the detected temperature of the inside of the tub 20 (545, 550).

[0088] If the difference between the detected temperature of the inside of the drying duct 81 and the duct maximum temperature (Dmax) is equal to or greater than 2 degrees (Yes in 555), the washing machine 1 calculates a filter blockage index (F) (560). The filter blockage index (F) refers to whether the lint filter 85b is blocked, and the extent of the blockage of the lint filter 85b. The washing machine 1 determines whether to wash the lint filter 85b depending on the filter blockage index (F). The filter blockage index is a measure of how blocked the filter is based on a temperature difference between the drying duct temperature and the tub temperature.

[0089] More specifically, the filter blockage index (F) is calculated based on the duct maximum temperature (Dmax), the tub maximum temperature (Wmax) and the first turning on time of the drying heater (t1 of FIG. 10), that is, a period of time between the heater 82 being initially turned on until the heater 82 is turned off. In particular, the filter blockage index (F) is calculated by formula 1

Formula 1

$$F = \frac{Dmax - Wmax}{t1}$$

[0090] F refers to the filter blockage index, Dmax refers to the duct maximum temperature, Wmax refers to the tub maximum temperature, and t1 refers to the first turning on time of the drying heater.

[0091] If the lint filter 85b is blocked by the lint, the air is not smoothly being circulated between the drying duct 81 and the tub 20, and thus a difference between the temperature of the inside of the drying duct 81 and the temperature of the inside of the tub 20 is great. Therefore, the temperature of the inside of the drying duct 81 is rapidly increased so that the first turning on time of the drying heater (t1) is reduced. As a result, the filter blockage index (F) is great as the lint filter 85b is blocked by the lint. It may be determined that the lint filter 85b is severely blocked by the lint if the filter blockage index (F) is relatively large.

[0092] When the filter blockage index (F) is calculated, the washing machine 1 determines whether to wash the lint filter 85b according to the filter blockage index (F). It is contemplated that the washing machine 1 instantly washes the lint filter when the lint filter 85b is determined to be blocked based on the filter blockage index (F).

[0093] In accordance with an embodiment of the present disclosure, a method of determining whether the lint filter is blocked is carried out by determining the duct maximum temperature (Dmax) and the tub maximum temperature (Wmax) while the drying heater 82 is driven, and then when the temperature of the inside of the drying duct 81 is decreased as a result of the drying heater being turned off, using the duct maximum temperature (Dmax) and the tub maximum temperature (Wmax) to determine whether the filter is blocked.

[0094] FIG. 12 is a flow chart illustrating a washing of the lint filter by the washing machine in accordance with an embodiment of the present disclosure, and FIG. 13 is a view illustrating a rotation of a drum during the washing of the lint filter by the washing machine in accordance with an embodiment of the present disclosure.

[0095] Referring to FIG. 12, the washing machine 1 determines whether the filter blockage index (F) is equal to or larger than a first reference value (610). The first reference value refers to criteria to determine whether the lint filter 85b is blocked, and may be set through prior experiments.

[0096] If the filter blockage index (F) is less than the first reference value (No in 610), the washing machine 1 determines that the lint filter 85b is not blocked. That is, the washing machine 1 proceeds with the drying cycle without washing the lint filter 85b.

[0097] If the filter blockage index (F) is equal to or larger than the first reference value (Yes in 610), the washing machine 1 continuously drives the blowing fan 84b at a lower speed (620). As described above, if the filter blockage index (F) is equal to or larger than the first reference value, the washing machine 1 determines that the lint filter 85b is partially or completely blocked. Therefore, during the drying cycle, the washing machine 1 may inject the washing water to the lint filter 85b to wash the lint filter 85b. However, as described above, during the drying cycle, the injected washing water may be introduced to the drying duct 81 by the blowing fan 84b since the blowing fan is rotated at high speed. To prevent the injected washing water to be introduced to the drying duct

81, the rotation speed of the blowing fan 84 b is reduced before injecting the washing water to the lint filter 85b.

[0098] As illustrated in FIG. 13, if the guide pipe 87 of the drying unit 80 is disposed at an upper right portion of the tub 20, the washing machine may rotate the drum 30 clockwise at low speed. In addition, if the guide pipe 87 of the drying unit 80 is disposed at an upper left portion of the tub 20, the washing machine may rotate the drum 30 counter clockwise at low speed, contrary to what was illustrated in FIG. 13. By the rotation of the drum 30, as in the above, the washing water is smoothly discharged.

[0099] Next, the washing machine 1 determines whether the filter blockage index (F) is equal to or larger than a second reference value (625). The second reference value refers to criteria to determine whether the lint filter 85b is partially or completely blocked, and may be set through prior experiments.

[0100] If the filter blockage index (F) is equal to or larger than the second reference value (Yes in 625), the washing machine 1 injects the washing water to the lint filter 85b for a first washing time (630). At this time, if the filter blockage index (F) is equal to or larger than the second reference value, the washing machine 1 determines that the lint filter 85b is completely blocked. Therefore, the washing machine 1 may inject the washing water for the first washing time, which is enough time to wash the completely blocked lint filter 85b. That is, the washing machine 1 may open the washing water supply valve 86c during the first washing time.

[0101] If the filter blockage index (F) is less than the second reference value (No in 625), the washing machine 1 injects the washing water to the lint filter 85b for a second washing time (635). At this time, if the filter blockage index (F) is less than the second reference value, the washing machine 1 determines that the lint filter 85b is partially blocked. Therefore, the washing machine 1 may inject the washing water for the second washing time, which is enough time to wash the partially blocked lint filter 85b. That is, the washing machine 1 may open the washing water supply valve 86c during the second washing time. The second washing time is for example less than the first washing time.

[0102] Next, the washing machine 1 returns to the drying cycle (640). That is, the washing machine 1 completes washing the filter, and once again drives the blowing fan 84b at high speed.

[0103] Heretofore, in accordance with an embodiment of the present disclosure, the method of calculating the filter blockage index (F) and performing washing the lint filter 85b based on the calculated filter blockage index (F) by the washing machine 1 is described.

[0104] Hereinafter, in accordance with another embodiment of the present disclosure, and performing washing of the lint filter 85b based on the temperature of the inside of the drying duct 81 and the temperature of the inside of the tub 20 by the washing machine 1 will be described.

[0105] FIG 14A and 14B are flow charts illustrating determining whether a lint filter is blocked by a washing machine in accordance with another embodiment of the present disclosure.

[0106] Referring to FIGS. 14a and 14b, during a drying cycle, a washing machine 1 detects the amount of the laundry (710), and drives a blowing member 84 and a drying heater 82 (715).

[0107] Next, the washing machine 1 detects an initial temperature of the tub 20 (720). The initial temperature of the tub 20 refers to a temperature of the inside of the tub 20 when the washing machine 1 starts the drying cycle. When the drying cycle is initiated, the washing machine 1 may attain the initial temperature of the tub 20 by the tub temperature sensor 26.

[0108] Next, the washing machine detects a temperature of the inside of the drying duct 81 (725). The washing machine 1 may attain the temperature of the inside of the drying duct 81 by the duct temperature sensor 83 provided inside of the drying duct 81.

[0109] Next, the washing machine 1 determines whether the temperature of the inside of the drying duct 81 is equal to or higher than a reference temperature of the drying duct (730). The reference temperature of the drying duct may be changed according to the heat value of the drying duct 81 and capacities of the drying duct 81 and the tub 20, and may be set to be approximately 70 degrees to approximately 80 degrees.

[0110] If the temperature of the inside of the drying duct 81 is less than the reference temperature of the drying duct (No in 730), the washing machine 1 continuously detects the temperature of the inside of the drying duct 81.

[0111] If the temperature of the inside of the drying duct 81 is equal to or higher than the reference temperature of the drying duct (Yes in 730), the washing machine 1 determines whether a reference time expires from when the drying cycle was initiated (735). The reference time may be changed according to the heat value of the drying duct 81 and capacities of the drying duct 81 and the tub 20, and may be set to be approximately 5 minutes to approximately 10 minutes.

[0112] If the reference time expires from when the drying cycle was initiated (Yes in 735), the washing machine 1 determines that the lint filter 85b is not blocked, and proceeds with the drying cycle (780). If the air is circulated normally between the drying duct 81 and the tub 20, the temperature of the inside of the drying duct 81 is slowly increased together with the temperature of the inside of the tub 20, and thereby the washing machine 1 may determine that the lint filter 85b is not blocked except when the temperature of the inside of the drying duct 81 is quickly increased.

[0113] If the reference time does not expire from when the drying cycle was initiated (No in 735), the washing machine 1 determines whether a first drying time expires from when the drying cycle was initiated (740). The first drying time may be changed according to the heat value of the drying duct 81 and capacities of the drying duct 81 and the tub 20, and may be set to be approximately 10

minutes to approximately 20 minutes.

[0114] If the first drying time expires, the washing machine 1 detects the temperature of the inside of the tub 20 (745).

[0115] Next, the washing machine 1 determines whether a difference between the temperature of the inside of the tub 20 detected through the operation 745, and an initial temperature of the inside of the tub 20 is less than a reference temperature difference (750). The reference temperature difference may be changed according to the heat value of the drying duct 81 and capacities of the drying duct 81 and the tub 20, and may be set to be approximately 5 degrees to approximately 15 degrees.

[0116] If the difference between the temperature of the inside of the tub 20 and the initial temperature of the inside of the tub 20 is equal to or higher than the reference temperature difference (No in 750), the washing machine 1 determines that the lint filter 85b is not blocked, and proceeds with the drying cycle (780). The air is circulated normally between the drying duct 81 and the tub 20, the temperatures of the inside of the drying duct 81 is increased together with the temperature of the inside of the tub 20, and thereby the washing machine 1 may determine that the lint filter 85b is not blocked when the temperature of the inside of the tub 20 is properly increased as compared to when the drying cycle is initiated.

[0117] If the difference between the temperature of the inside of the tub 20 and the initial temperature of the inside of the tub 20 is less than the reference temperature difference (Yes in 750), the washing machine 1 determines whether the temperature of the inside of the tub 20 detected through the operation 745 is less than a first tub reference temperature (755). The first tub reference temperature may be changed according to heat value of the drying duct 81 and capacities of the drying duct 81 and the tub 20, and may be set to be approximately 25 degree to approximately 35 degree.

[0118] If the temperature of the inside of the tub 20 is equal to or higher than the first tub reference temperature (No in 755), the washing machine 1 determines that the lint filter is not blocked, and proceeds with the drying cycle (780). The air is circulated normally between the drying duct 81 and the tub 20, the temperatures of the inside of the tub 20 is increased together with the temperature of the drying duct 81, and thereby the washing machine 1 may determine that the lint filter 85b is not blocked when the temperature of the inside of the tub 20 is properly increased.

[0119] If the temperature of the inside of the tub 20 is less than the first tub reference temperature (Yes in 755), the washing machine 1 determines whether a second drying time expires from when the drying cycle was initiated (760). The second drying time may be changed according to the heat value of the drying duct 81 and capacities of the drying duct 81 and the tub 20, and may be set to be approximately 20 minutes to approximately 30 minutes.

[0120] If the second drying time expires, the washing machine 1 detects the temperature of the inside of the tub 20 (765).

[0121] Next, the washing machine 1 determines whether the temperature of the inside of the tub 20 detected through the operation 765 is less than a second tub reference temperature (770). The second tub reference temperature may be changed according to the heat value of the drying duct 81 and capacities of the drying duct 81 and the tub 20, and may be set to be approximately 35 degrees to approximately 45 degrees.

[0122] If the temperature of the inside of the tub 20 is equal to or higher than the second tub reference temperature (No in 770), the washing machine 1 determines that the lint filter is not blocked, and proceeds with the drying cycle (780). The air is circulated normally between the drying duct 81 and the tub 20, the temperatures of the inside of the tub 20 is increased together with the temperature of the drying duct 81, and thereby the washing machine 1 may determine that the lint filter 85b is not blocked when the temperature of the inside of the tub 20 is properly increased.

[0123] If the temperature of the inside of the tub 20 is less than the second tub reference temperature (Yes in 770), the washing machine 1 determines that the lint filter 85b is blocked by the lint (775).

[0124] If the lint filter 85b is determined to be blocked, the washing machine 1 performs washing the lint filter, which will be described later, and then proceeds with the drying cycle.

[0125] FIG. 15 is a flow chart illustrating a washing of a lint filter by a washing machine in accordance with another embodiment of the present disclosure.

[0126] Referring to FIG. 15, the washing machine 1 rotates the blowing fan 84b at low speed (810). If the lint filter 85b is determined to be blocked, the washing machine 1 injects the washing water to the lint filter 86b to wash during the drying cycle. However, as described above, during the drying cycle, the injected washing water may be introduced to the drying duct 81 by the blowing fan 84b since the blowing fan is rotated at high speed. To prevent the injected washing water to be introduced to the drying duct 81, the rotation speed of the blowing fan 84 b is reduced before injecting the washing water to the lint filter 85b. In addition, as illustrated in FIG. 13, if the guide pipe 87 of the drying unit 80 is disposed at an upper right portion of the tub 20, the washing machine may rotate the drum 30 clockwise at low speed. In addition, if the guide pipe 87 of the drying unit 80 is disposed at an upper left portion of the tub 20, the washing machine may rotate the drum 30 counter clockwise at low speed, on the contrary to as illustrated in FIG. 13. By the rotation of the drum 30, as in the above, the washing water is smoothly discharged.

[0127] Next, the washing machine 1 injects the washing water to the lint filter 85b for the filter washing time (630). That is, the washing machine 1 may open the washing water supply valve 86c during the first washing

time.

[0128] Next, the washing machine 1 returns to the drying cycle (830). That is, the washing machine 1 completes washing the filter, and rotates again the blowing fan 84b at high speed.

[0129] As in the above, the washing machine 1 determines whether the lint filter is blocked during the drying cycle, washes the lint filter 85b according to the determined result, and thereby the optimal drying efficiency may be attained.

[0130] As is apparent from the above description, according to an aspect of the present disclosure, a washing machine may receive information of filter blockage and wash a lint filter according to the information of filter blockage during a drying cycle. In addition, the washing of the lint filter during the drying cycle allows the lint filter to be washed without performing a washing cycle, a rinsing cycle, or a spin cycle, and the air to be circulated between a drying duct and a tub.

[0131] Although a few embodiments of the present disclosure have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles of the invention, the scope of which is defined in the claims.

Claims

1. A washing machine, comprising:

a tub;
a drum rotatably installed inside the tub;
a drying unit comprising a fan configured to draw air from the tub and the drum into a drying duct, and a heater configured to heat the drawn in air;
a lint filter configured to filter foreign substances contained in the drawn in air; and
a control unit configured to turn the heater and the fan on or off according to the temperature of the drying duct;
wherein the control unit is arranged to determine whether to wash the lint filter based on the difference between the temperature of the drying duct and the temperature of the tub.

2. The washing machine of claim 1, wherein:

the control unit is arranged to calculate a filter blockage index based on the difference between the temperature of the drying duct and the temperature of the tub and an initial time period for which the heater was on, and is arranged to wash the lint filter according to the filter blockage index.

3. The washing machine of claim 2, wherein:

the control unit is arranged to calculate the filter blockage index by dividing the difference between the temperature of the drying duct and the temperature of the tub by the initial time period.

4. The washing machine of claim 2 or 3, wherein:

the control unit is arranged to wash the lint filter for a filter washing time according to the filter blockage index when the filter blockage index is equal to or larger than a predetermined reference value.

5. The washing machine of any one of the preceding claims, wherein:

the control unit is arranged to reduce a rotation speed of the fan during washing of the lint filter.

6. The washing machine of any one of the preceding claims, wherein:

the control unit is arranged to reduce a rotation speed of the drum during washing of the lint filter.

7. The washing machine of any one of the preceding claims, further comprising:

a washing water injection nozzle configured to inject washing water to the lint filter;
a washing water supply pipe configured to supply the washing water to the washing water injection nozzle; and
a washing water supply valve configured to open/close the washing water supply pipe.

8. The washing machine of claim 7, wherein:

the control unit is arranged to open the washing water supply valve depending on whether to wash the lint filter, after the start of a drying cycle when the drying heater is initially turned off.

9. A method of controlling a washing machine, the method comprising:

driving a fan configured to introduce air in a tub into a drying duct;
driving a heater configured to heat the air in the drying duct;
turning off the drying heater when a temperature of the drying duct is equal to or higher than a high temperature limit, and
washing the lint filter according to a difference between the temperature of the drying duct and the temperature of the tub.

10. The method of claim 9, wherein:

the washing of the lint filter comprises:

calculating a filter blockage index based on a difference between the temperature of the drying duct and the temperature of the tub and an initial time period for which the heater was on, and washing the lint filter according to the filter blockage index calculated.

11. The method of claim 10, wherein:

the calculation of the filter blockage index comprises dividing the difference between the temperature of the drying duct and the temperature of the tub by the initial time period.

12. The method of claim 10 or 11, wherein:

the washing of the lint filter according to the filter blockage index calculation comprises washing the lint filter for a filter washing time according to the filter blockage index if the filter blockage index is equal to or larger than a predetermined reference value.

13. The method of any one of claims 9 to 12, wherein:

the washing of the lint filter comprises supplying the washing water to a washing water injection nozzle injecting the washing water to the lint filter.

14. The method of any one of claims 9 to 13, wherein:

the washing of the lint filter comprises reducing a rotation speed of the fan.

15. The method of any one of claims 9 to 14, wherein:

the washing of the lint filter comprises reducing a rotation speed of the drum.

FIG. 1

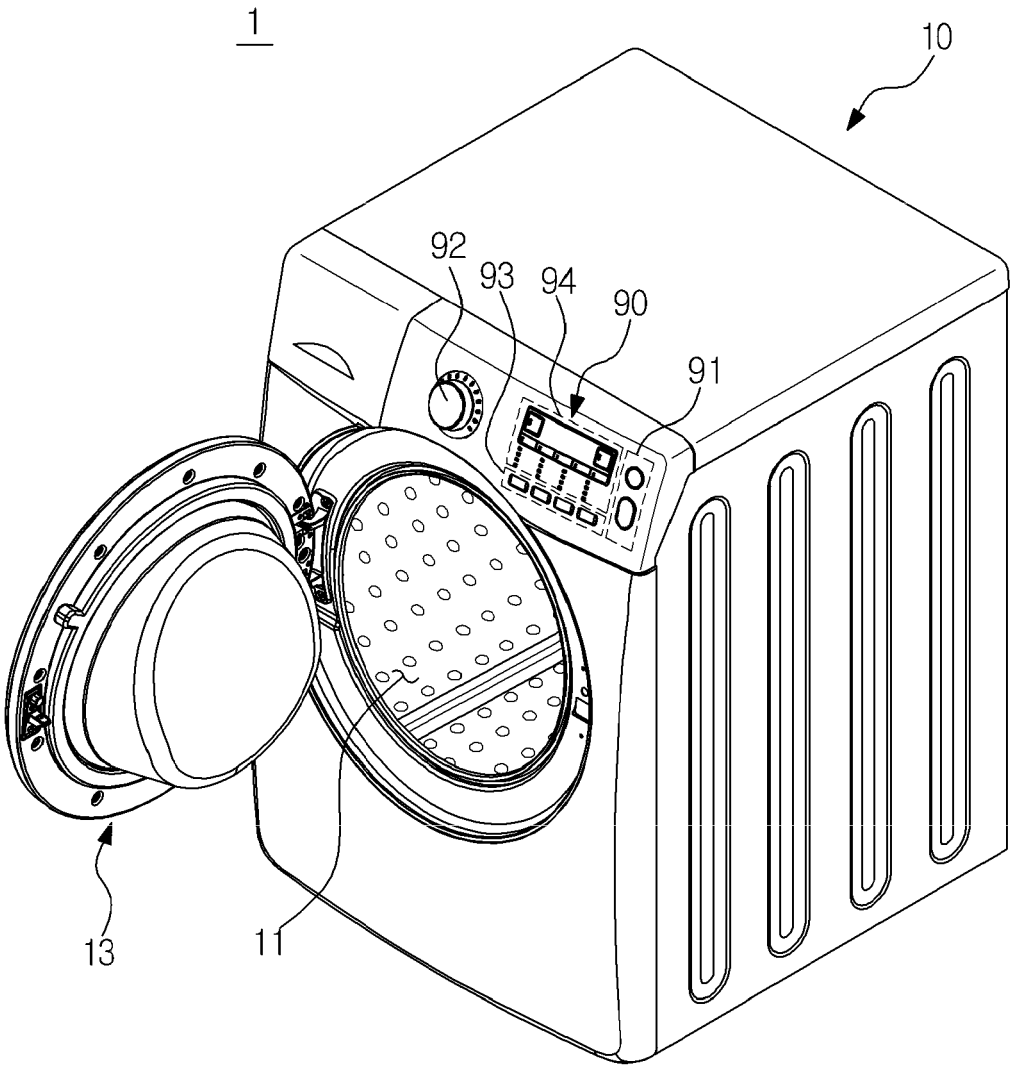
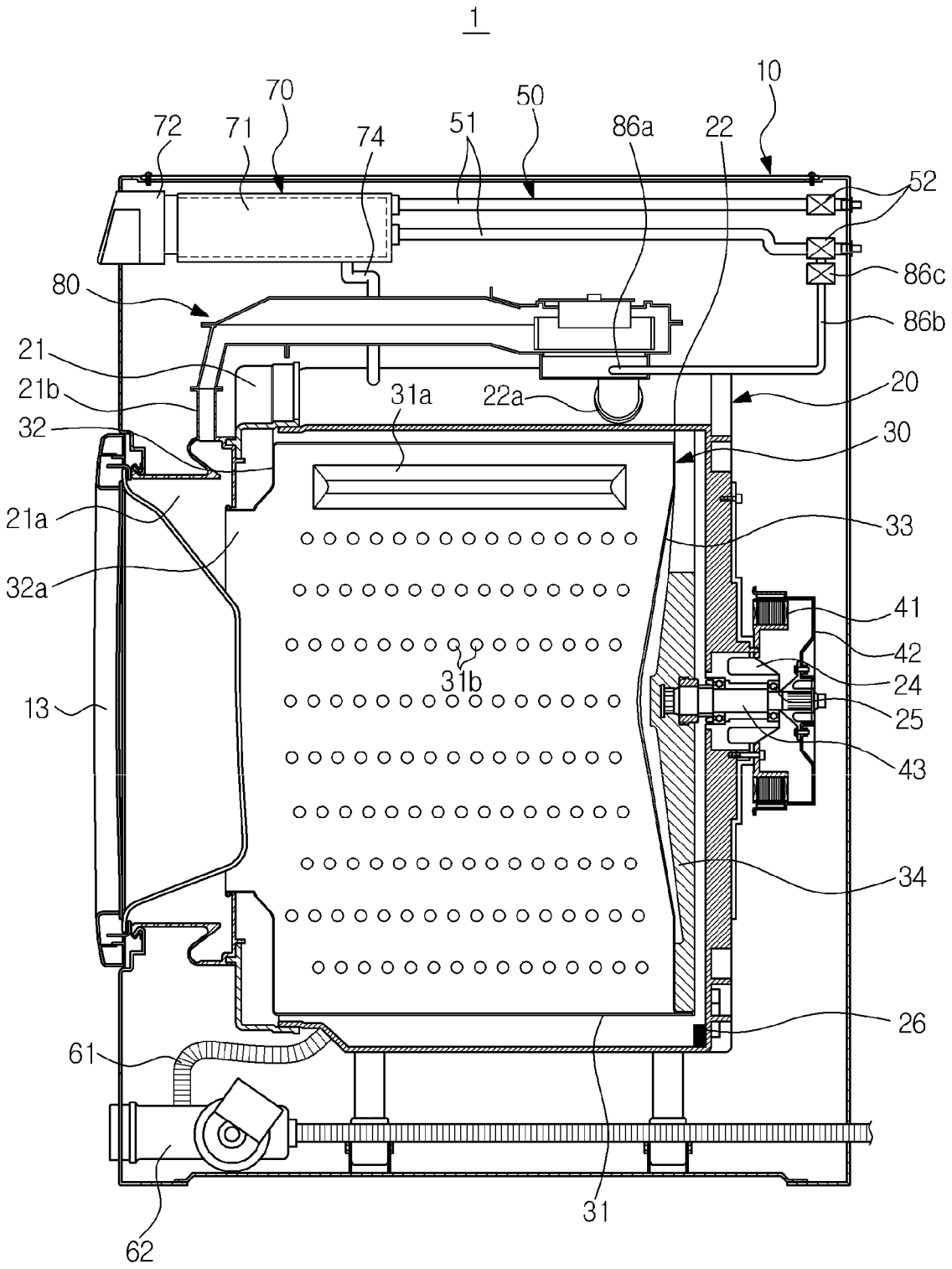


FIG. 2


1
10
70
72
71
74
51
50
86a
22
52
86c
86b
80
21
21b
32
31a
22a
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31b
24
13
25
43
34
26
61
62
31

FIG. 3

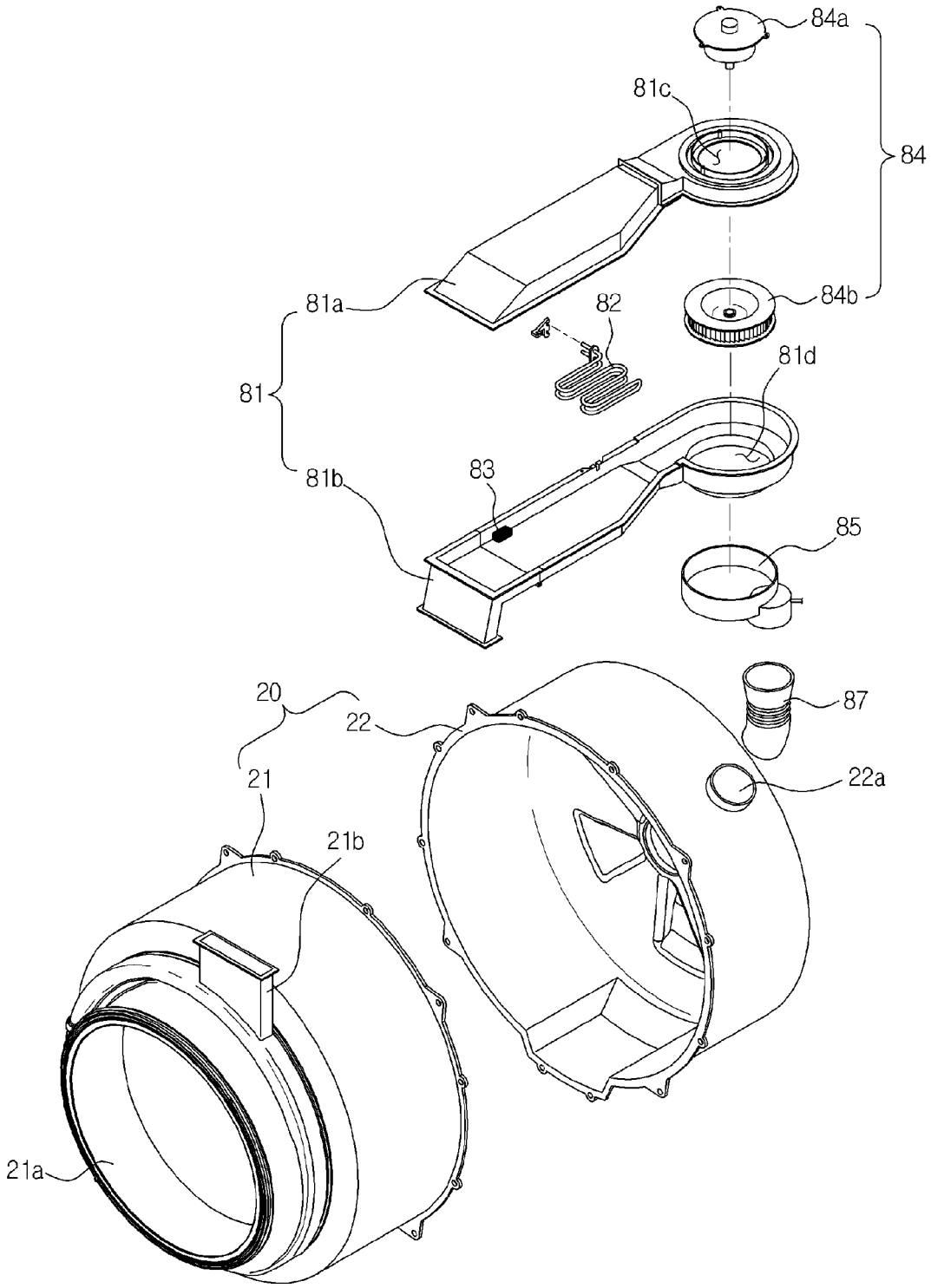


FIG. 4

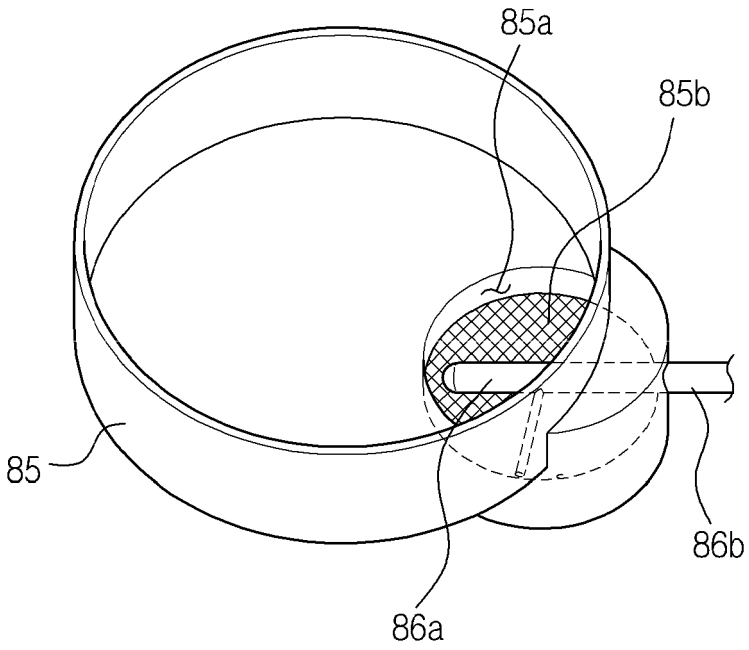


FIG. 5

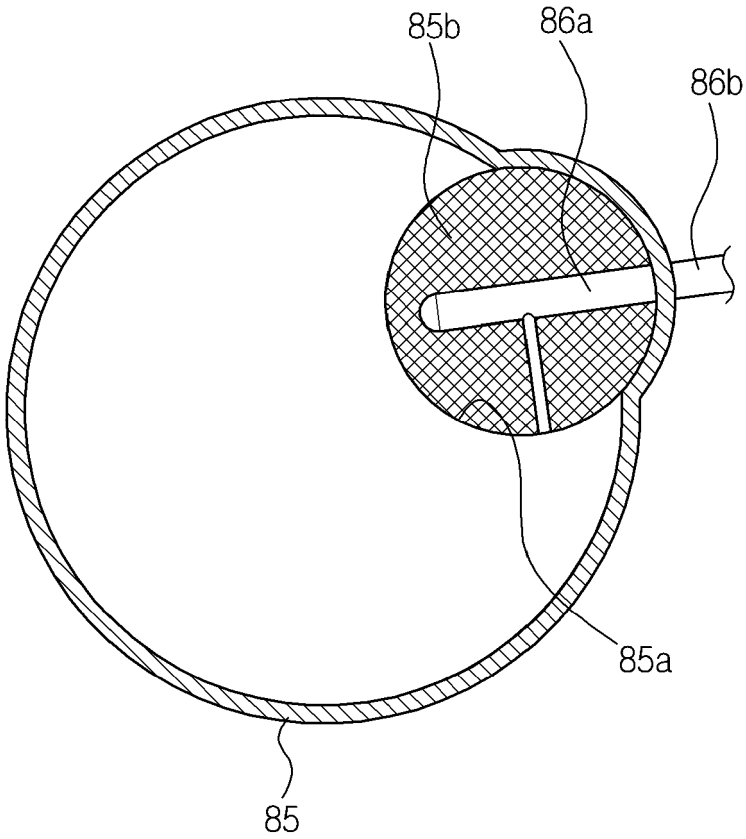


FIG. 6

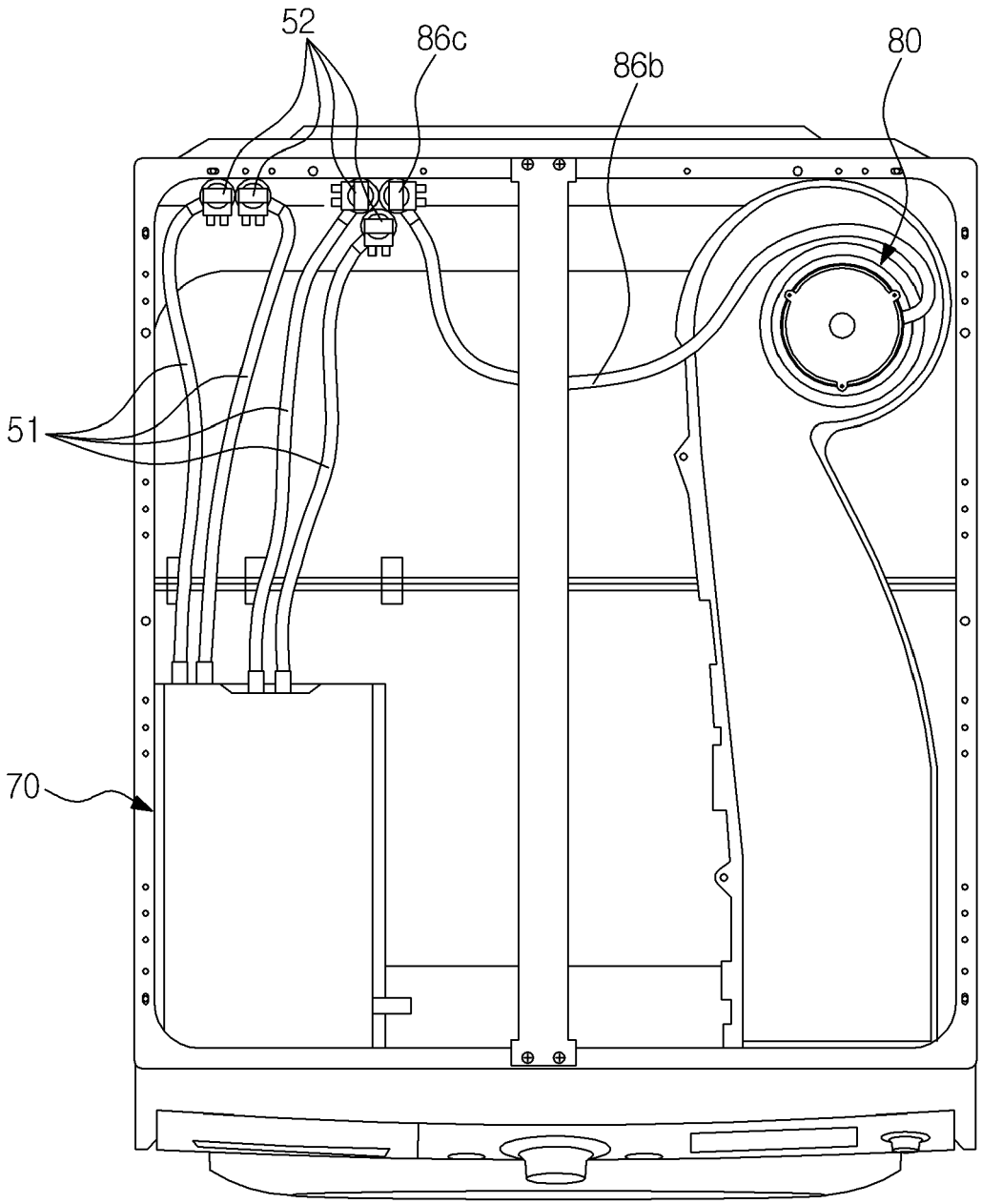


FIG. 7

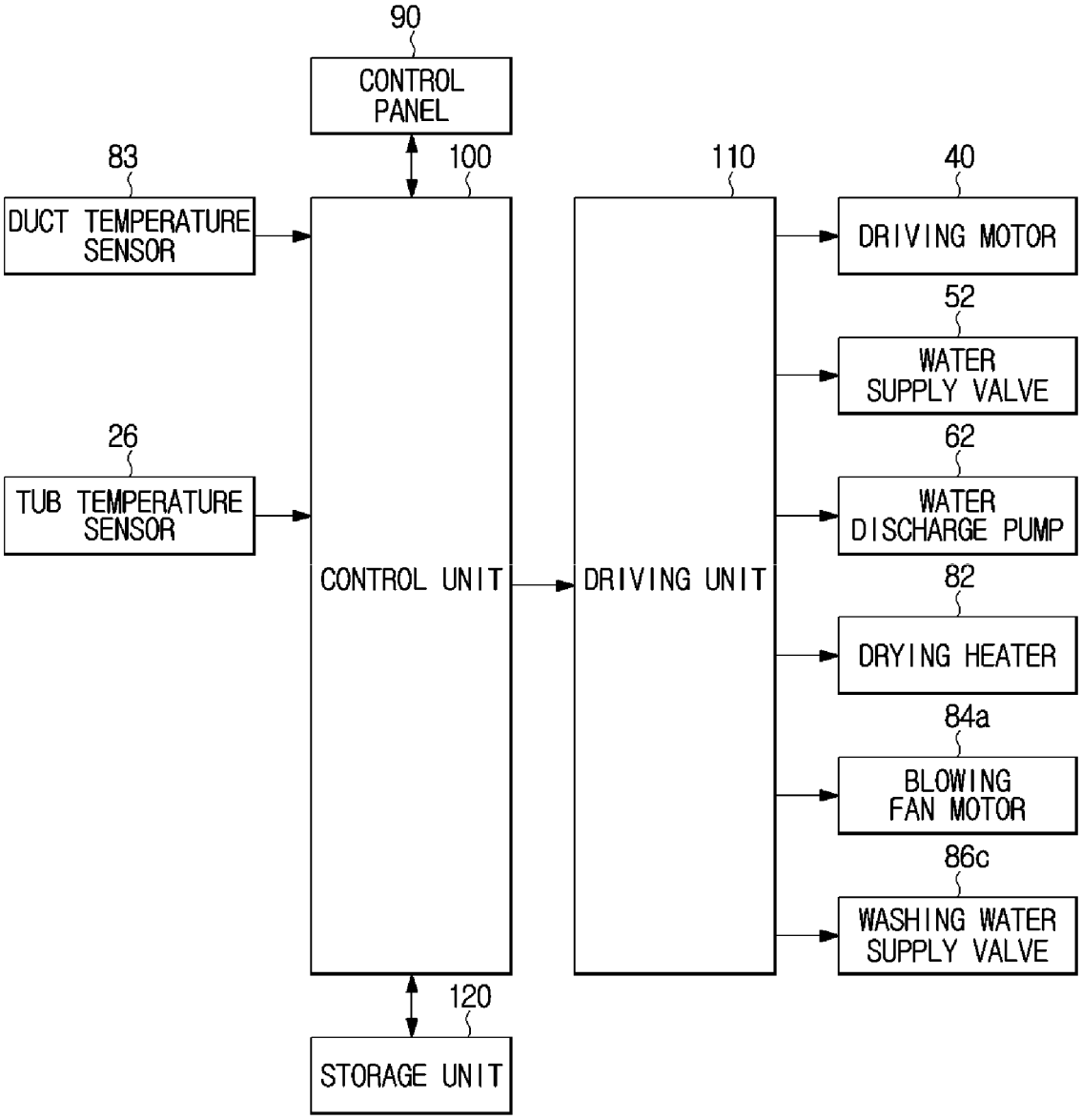

90
CONTROL PANEL
83
DUCT TEMPERATURE SENSOR
100
26
TUB TEMPERATURE SENSOR
CONTROL UNIT
120
STORAGE UNIT
110
DRIVING UNIT
40
DRIVING MOTOR
52
WATER SUPPLY VALVE
62
WATER DISCHARGE PUMP
82
DRYING HEATER
84a
BLOWING FAN MOTOR
86c
WASHING WATER SUPPLY VALVE

FIG. 8

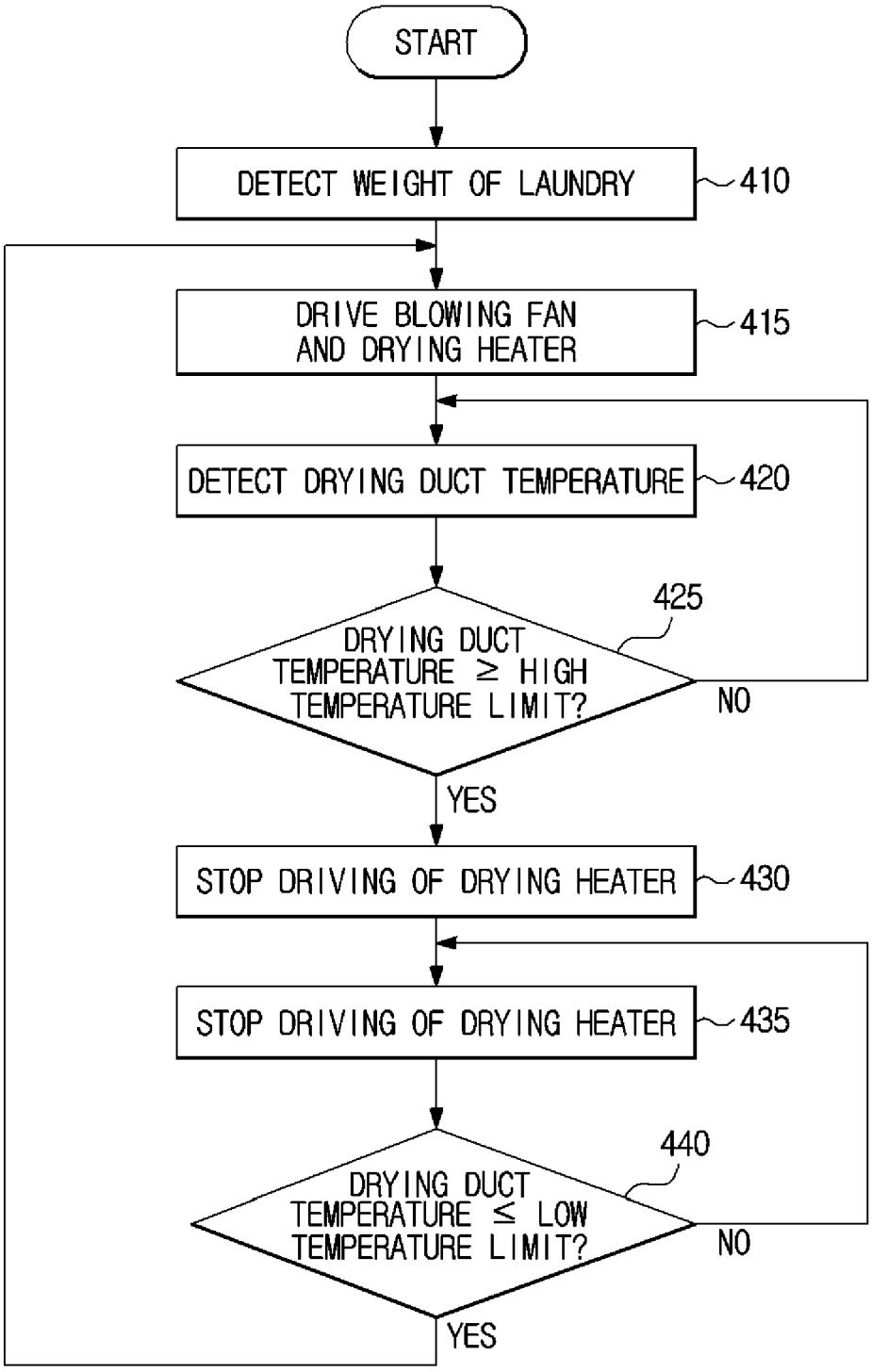

START
DETECT WEIGHT OF LAUNDRY
410
DRIVE BLOWING FAN AND DRYING HEATER
415
DETECT DRYING DUCT TEMPERATURE
420
425
DRYING DUCT TEMPERATURE ≥ HIGH TEMPERATURE LIMIT?
NO
YES
STOP DRIVING OF DRYING HEATER
430
STOP DRIVING OF DRYING HEATER
435
440
DRYING DUCT TEMPERATURE ≤ LOW TEMPERATURE LIMIT?
NO
YES

FIG. 9

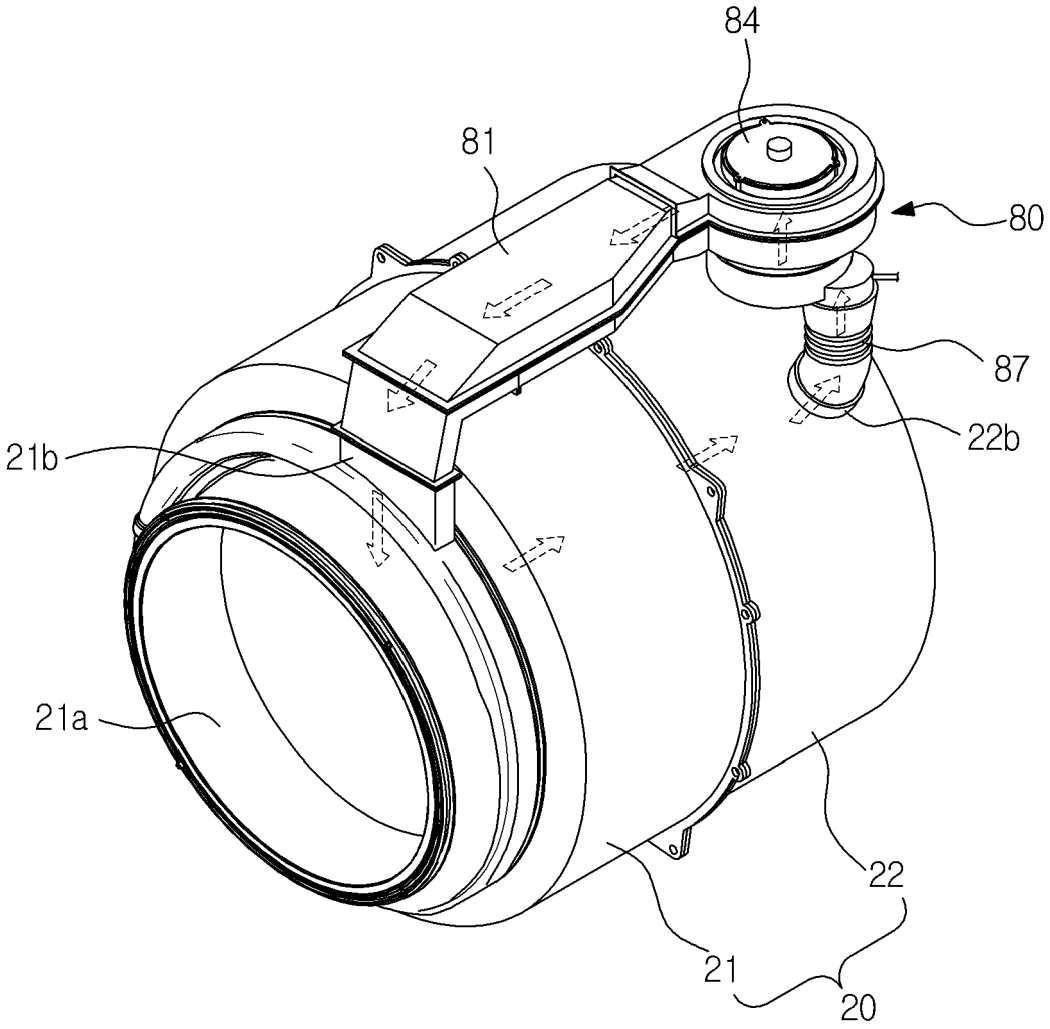


FIG. 10

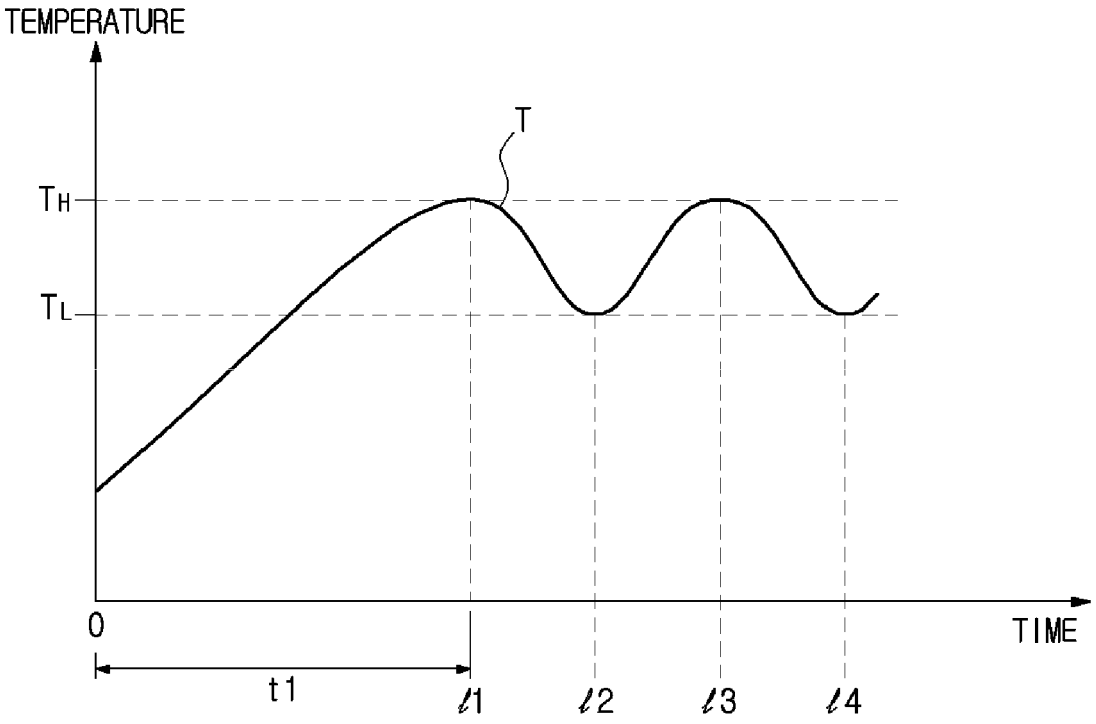


FIG. 11

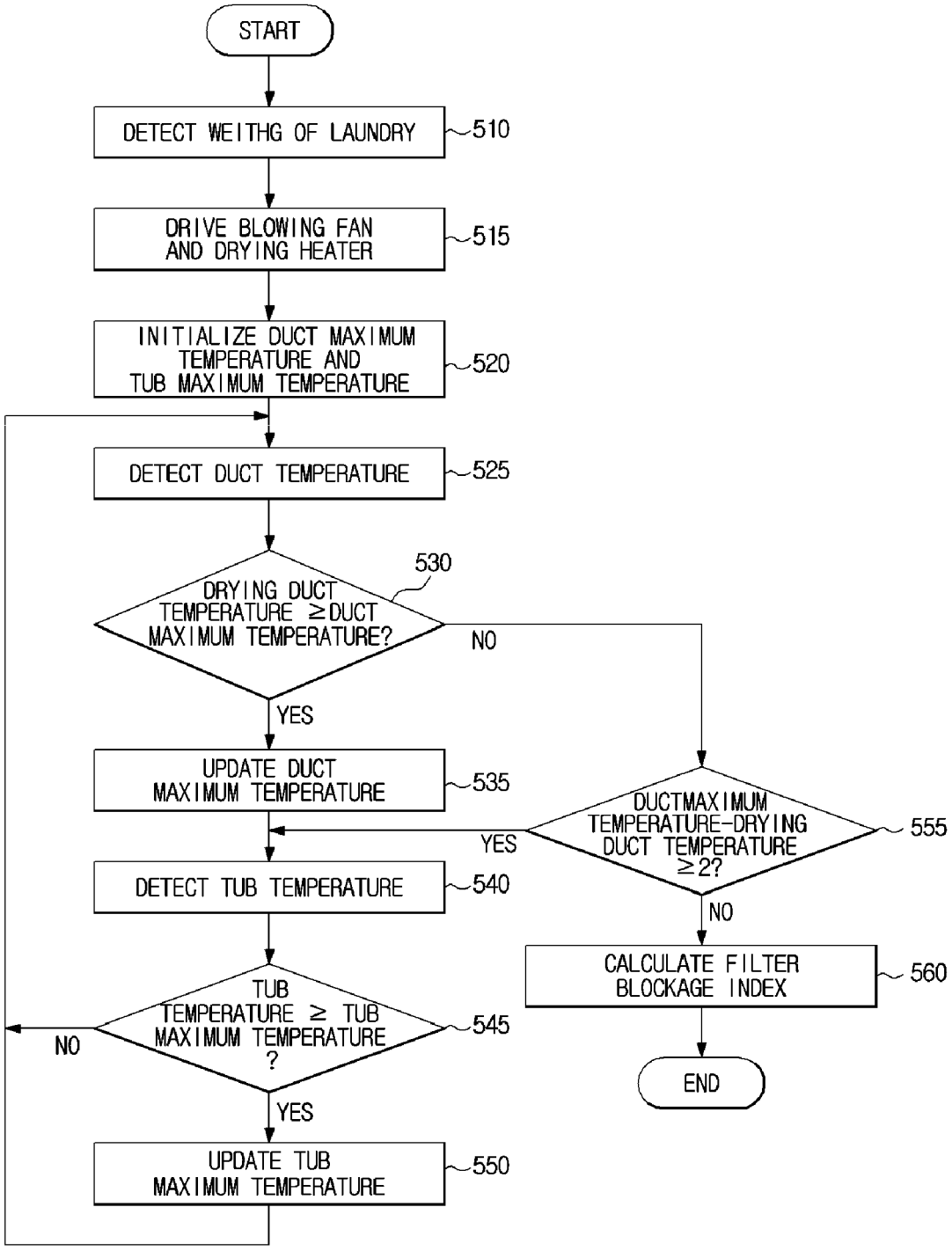

START
DETECT WEITHG OF LAUNDRY
510
DRIVE BLOWING FAN AND DRYING HEATER
515
INITIALIZE DUCT MAXIMUM TEMPERATURE AND TUB MAXIMUM TEMPERATURE
520
DETECT DUCT TEMPERATURE
525
530
DRYING DUCT TEMPERATURE ≥DUCT MAXIMUM TEMPERATURE?
NO
YES
UPDATE DUCT MAXIMUM TEMPERATURE
535
DUCTMAXIMUM TEMPERATURE-DRYING DUCT TEMPERATURE ≥2?
555
YES
NO
DETECT TUB TEMPERATURE
540
CALCULATE FILTER BLOCKAGE INDEX
560
TUB TEMPERATURE ≥ TUB MAXIMUM TEMPERATURE ?
545
NO
END
YES
UPDATE TUB MAXIMUM TEMPERATURE
550

FIG. 12

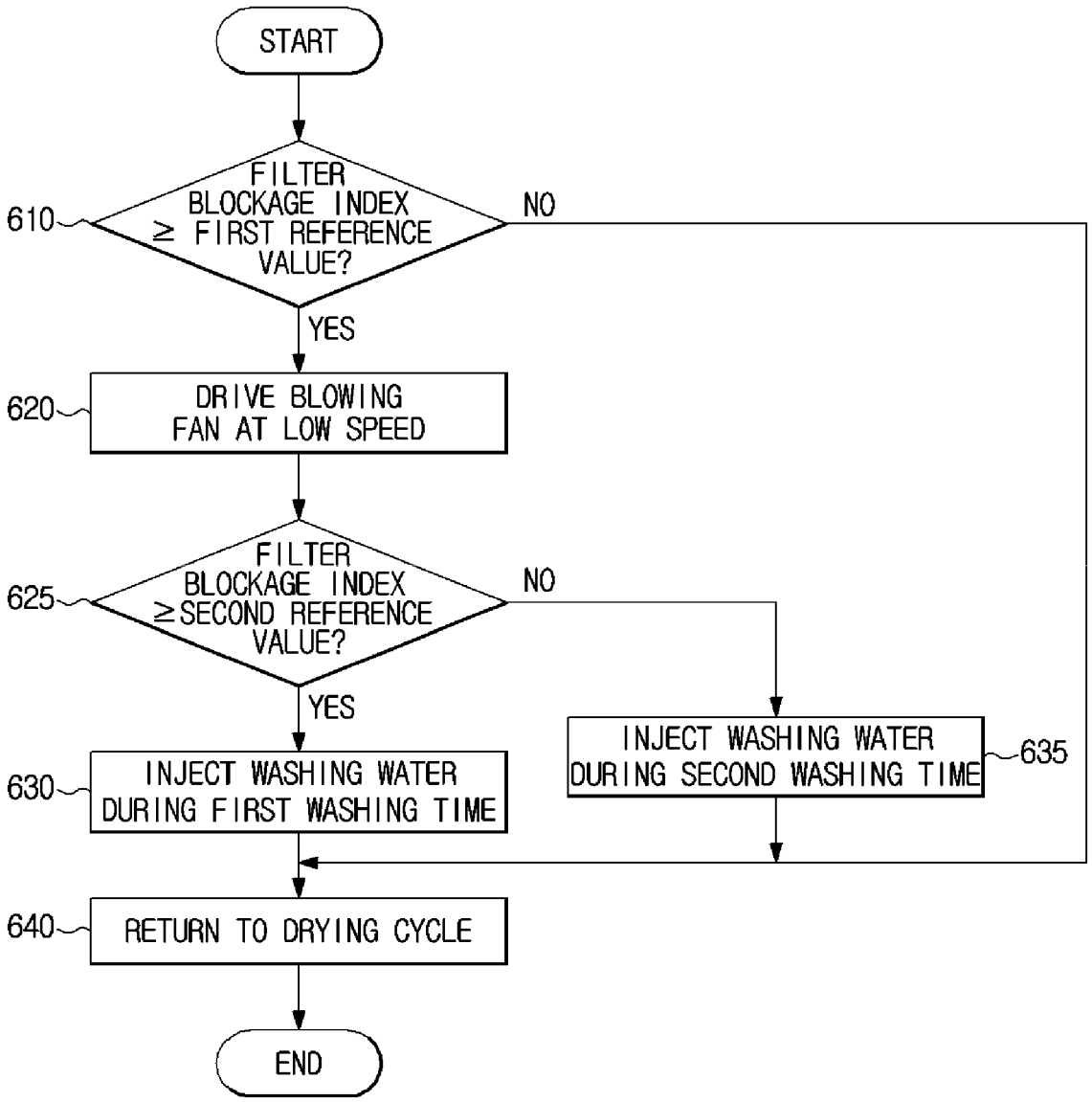

START
610
FILTER BLOCKAGE INDEX ≥ FIRST REFERENCE VALUE?
NO
YES
620
DRIVE BLOWING FAN AT LOW SPEED
625
FILTER BLOCKAGE INDEX ≥SECOND REFERENCE VALUE?
NO
YES
630
INJECT WASHING WATER DURING FIRST WASHING TIME
INJECT WASHING WATER DURING SECOND WASHING TIME
635
640
RETURN TO DRYING CYCLE
END

FIG. 13

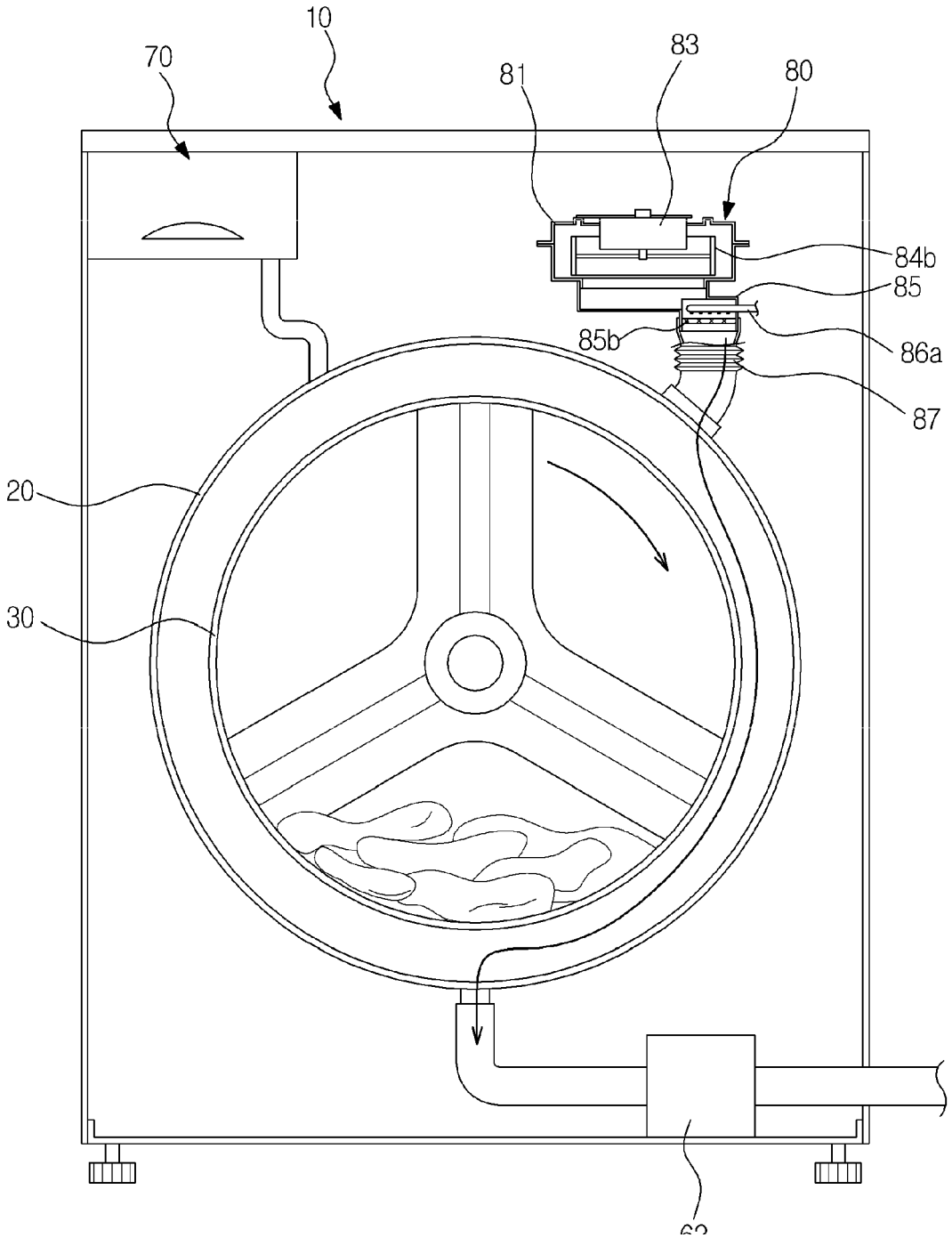


FIG. 14A

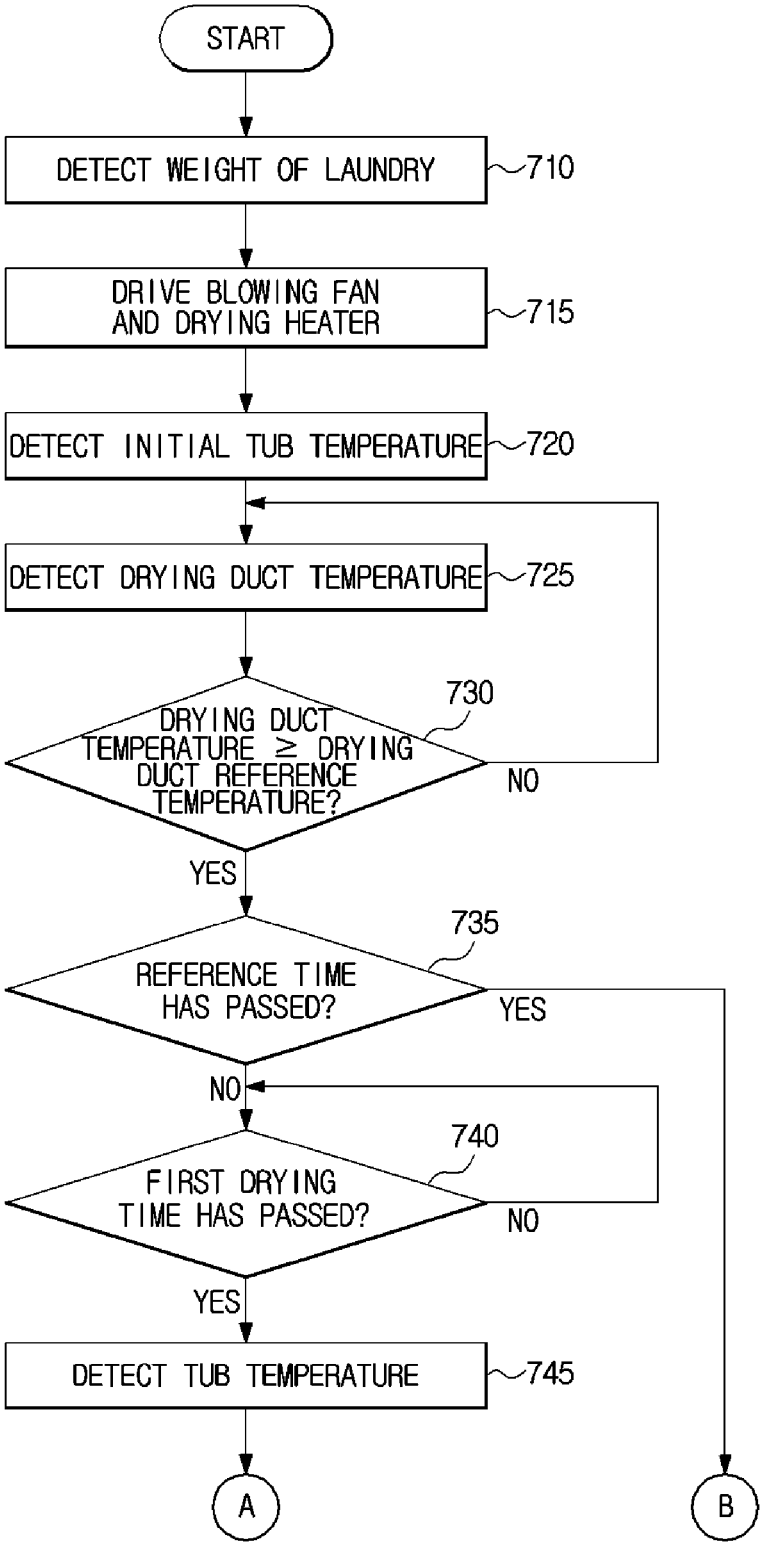

START
DETECT WEIGHT OF LAUNDRY
710
DRIVE BLOWING FAN AND DRYING HEATER
715
DETECT INITIAL TUB TEMPERATURE
720
DETECT DRYING DUCT TEMPERATURE
725
730
DRYING DUCT TEMPERATURE ≥ DRYING DUCT REFERENCE TEMPERATURE?
NO
YES
735
REFERENCE TIME HAS PASSED?
YES
NO
740
FIRST DRYING TIME HAS PASSED?
NO
YES
DETECT TUB TEMPERATURE
745
A
B

FIG. 14B

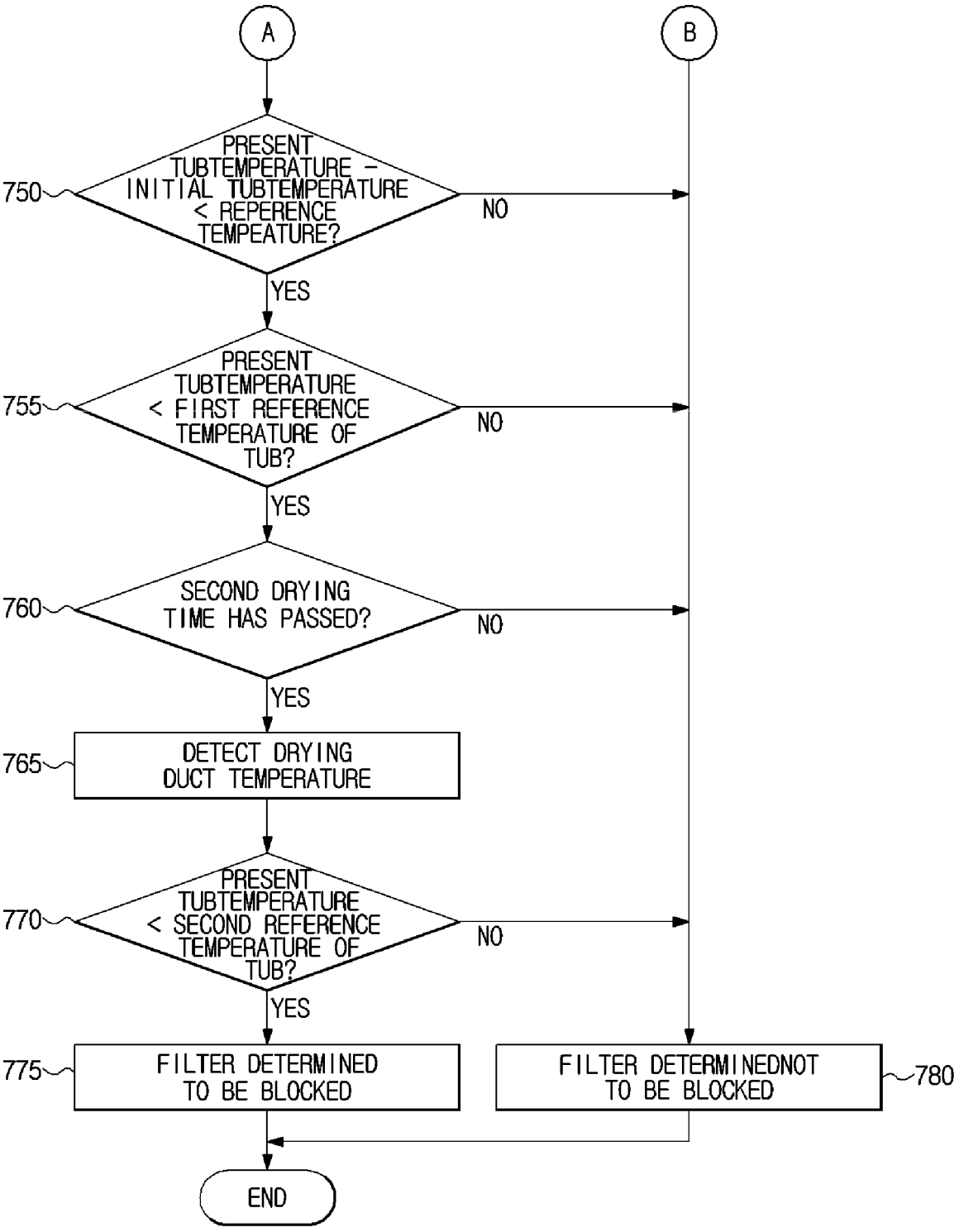
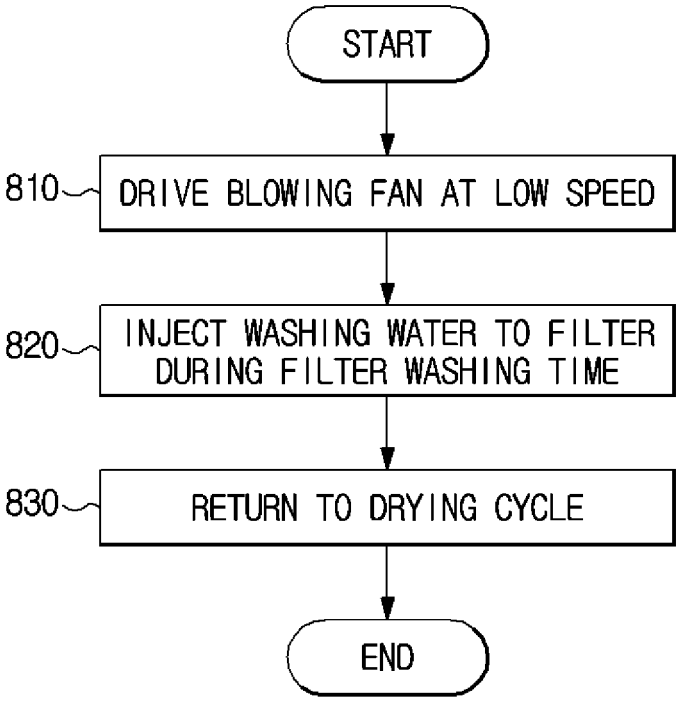

A
B
750
PRESENT TUBTEMPERATURE - INITIAL TUBTEMPERATURE < REPERENCE TEMPEATURE?
NO
YES
755
PRESENT TUBTEMPERATURE < FIRST REFERENCE TEMPERATURE OF TUB?
NO
YES
760
SECOND DRYING TIME HAS PASSED?
NO
YES
765
DETECT DRYING DUCT TEMPERATURE
770
PRESENT TUBTEMPERATURE < SECOND REFERENCE TEMPERATURE OF TUB?
NO
YES
775
FILTER DETERMINED TO BE BLOCKED
FILTER DETERMINEDNOT TO BE BLOCKED
780
END

FIG. 15


START
810
DRIVE BLOWING FAN AT LOW SPEED
820
INJECT WASHING WATER TO FILTER DURING FILTER WASHING TIME
830
RETURN TO DRYING CYCLE
END

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EUROPEAN SEARCH REPORT

Application Number
EP 14 17 8420

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 607 546 A2 (LG ELECTRONICS INC [KR]) 26 June 2013 (2013-06-26)	1-4,7-13	INV. D06F25/00
A	* the whole document *	5,6,14, 15	

Y	EP 2 581 490 A1 (LG ELECTRONICS [KR]) 17 April 2013 (2013-04-17)	1-4,7-13	
A	* the whole document *	5,6,14, 15	

Y	US 2012/090189 A1 (KWON IG GEUN [KR] ET AL) 19 April 2012 (2012-04-19)	1-4,7-13	
A	* the whole document *	5,6,14, 15	

A	US 2008/276656 A1 (KITAMURA SUSUMU [JP] ET AL) 13 November 2008 (2008-11-13) * the whole document *	1-15	

A	US 2013/212894 A1 (KIM HYOJUN [KR] ET AL) 22 August 2013 (2013-08-22) * the whole document *	1-15	
	-----		TECHNICAL FIELDS SEARCHED (IPC) D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 November 2014	Jezierski, Krzysztof

CATEGORY OF CITED DOCUMENTS

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26-11-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2607546 A2	26-06-2013	CN 103080410 A	01-05-2013
		EP 2607546 A2	26-06-2013
		US 2013139402 A1	06-06-2013
		WO 2012023824 A2	23-02-2012
EP 2581490 A1	17-04-2013	CN 103046298 A	17-04-2013
		EP 2581490 A1	17-04-2013
		US 2013091726 A1	18-04-2013
US 2012090189 A1	19-04-2012	CN 102428226 A	25-04-2012
		CN 103911833 A	09-07-2014
		CN 103911834 A	09-07-2014
		CN 103911835 A	09-07-2014
		CN 103938409 A	23-07-2014
		EP 2435626 A2	04-04-2012
		EP 2711449 A2	26-03-2014
		EP 2711450 A2	26-03-2014
		EP 2711451 A2	26-03-2014
		EP 2719810 A1	16-04-2014
		KR 101349839 B1	09-01-2014
		KR 20100129116 A	08-12-2010
		KR 20100129117 A	08-12-2010
		KR 20100129140 A	08-12-2010
		KR 20100129151 A	08-12-2010
		KR 20100129242 A	08-12-2010
		KR 20130071461 A	28-06-2013
		KR 20130072235 A	01-07-2013
		KR 20130074791 A	04-07-2013
		KR 20130075756 A	05-07-2013
		US 2012090189 A1	19-04-2012
		US 2014150276 A1	05-06-2014
		US 2014150277 A1	05-06-2014
US 2008276656 A1	13-11-2008	KR 20070112863 A	27-11-2007
		TW I312822 B	01-08-2009
		US 2008276656 A1	13-11-2008
		WO 2007013327 A1	01-02-2007
US 2013212894 A1	22-08-2013	AU 2013223005 A1	18-09-2014
		KR 20130096437 A	30-08-2013
		US 2013212894 A1	22-08-2013
		WO 2013125794 A1	29-08-2013

EPO FORM P0459

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