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(54) **Clothes dryer**

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(56) References cited:
EP-A1- 0 575 759
GB-A- 2 265 699
JP-A- 7 185 196

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a clothes dryer which dries clothes and the like.

2. Description of the Related Art

[0002] Conventionally, such a clothes dryer blows drying air through an air passage into a drum, brings the drying air into contact with clothes and the like thrown into the drum to absorb moisture from the clothes for drying the clothes, and discharges the drying air which contains moisture so as to have a high humidity, to an air passage outside the drum.

[0003] However, since the clothes are dried in a limited and small space of the drum, the clothes are tangled each other during drying so that the drying air cannot be brought into contact with the tangled portions of the clothes. Thus, it takes long time to dry tangled portions of the clothes, thereby increasing the required drying time.

[0004] Further, after the tangled clothes are dried, strong wrinkles are formed in them. Its solving method is disclosed in, e.g., Unexamined Japanese Patent Publication No. H07-185196 (hereinafter, described as "Patent Document 1").

[0005] The clothes dryer disclosed in Patent Document 1 will be described below.

[0006] The conventional drum type washer dryer disclosed in Patent Document 1 includes a drum which accommodates clothes to be dried, a motor which rotates the drum in forward and reverse directions, and a warm air supplying device mainly having a fan which supplies warm air into the drum and a heater.

[0007] The drum type washer dryer has load fluctuation amount detection means which detects a load fluctuation amount of the motor per one rotation of the drum. When the load fluctuation amount of the motor per one rotation of the drum is above a predetermined value, the load fluctuation amount detection means judges that tangling of clothes to be dried occurs, thereby reversely rotating the motor.

[0008] In other words, the drum is driven reversely only when tangling of clothes to be dried occurs, so that a motor driving stop time for reversely rotating the drum is minimum to reduce the drying time.

[0009] However, in the conventional configuration, in particular, when long clothes such as long-sleeved shirts and trousers are strongly tangled each other, only reverse rotation of the drum is insufficient to untangle the clothes.

[0010] In addition, each time tangling of clothes occurs, the drum is required to be driven reversely. Thus, the clothes cannot be moved temporarily at the time of the reverse rotation of the drum, so that the drying warm air cannot be brought into contact with the clothes or can be brought into contact with part of them. As a result, the drying time becomes longer.

SUMMARY OF THE INVENTION

[0011] The clothes dryer of the present invention is disclosed in claim 1.

[0012] This can realize the clothes dryer which can effectively eliminate fixed wrinkles in clothes and tangling of clothes in the drying process with low power consumption, thereby enabling shortening of the drying time and reduction of occurrence of wrinkles in clothes.

BRIEF DESCRIPTION OF DRAWINGS

[0013]

Fig. 1 shows a cross-sectional view of an essential portion of a drum type washer dryer according to a first embodiment of the present invention;
Fig. 2 shows a block circuit diagram of the drum type washer dryer;
Fig. 3 shows a time chart showing an operation of the drum type washer dryer;
Fig. 4 shows a time chart showing drum rotation sequence 1 shown in Fig. 3;
Fig. 5 shows a time chart showing drum rotation sequence 2 shown in Fig. 3; and
Fig. 6 shows a time chart showing another example of drum rotation sequence 2 shown in Fig. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] Hereinafter, exemplary embodiments of the present invention will be described with reference to the drawings. It should be noted that the present invention is not limited to the embodiments.

FIRST EMBODIMENT

[0015] Fig. 1 is a cross-sectional view of an essential portion of a drum type washer dryer according to a first embodiment of the present invention, and Fig. 2 is a block circuit diagram of the drum type washer dryer.

[0016] In Figs. 1 and 2, cylindrical drum 1 formed with an opening and having a bottom surface accommodates clothes to be washed. Drum 1 is enclosed in water tub 2 which becomes a cylindrical water tank reserving washing water. Water tub 2 is supported in housing 100.

[0017] In drum 1, the side formed with the opening is a front side, and the side having the bottom surface is a rear side; in Fig. 1, the left side is the front side, and the right side is the rear side. With the front and rear sides defined in this manner, the present invention will be described below with reference to the drawings.

[0018] Rotational shaft 1a is attached to the bottom surface of drum 1 so as to be tilted forwardly and upwardly. Drum driving motor 3 (drum driving unit) is attached to a back surface of water tub 2 and rotates rotational shaft 1a of drum 1. In addition, water tub 2 is connected to a water supply pipe (not shown) having water supply valve 25 (see Fig. 2), and water discharge pipe 40 having water discharge valve 27.

[0019] Door 35 opposite the opening of drum 1 is provided on a front surface side of housing 100. A user can put clothes etc. to be washed into drum 1 or can take out them therefrom by opening door 35.

[0020] A plurality of inward projections (not shown) is provided on an inner circumference wall surface of drum 1.

[0021] Drum 1 is rotated at low speed to enable clothes to be washed to perform an agitating operation (tumbling operation) in which the clothes to be washed are engaged with the projections so as to be lifted and fallen from an appropriate height.

[0022] Drying air for drying clothes is blown into drum 1 by air blowing unit 4. The drying air absorbs moisture from clothes to be washed in drum 1 so as to have a high humidity, and is discharged from a large number of small holes 1b provided in a circumference side surface of drum 1 to an outside of drum 1.

[0023] The drying air discharged to the outside of drum 1 is discharged from discharge port 5 provided on the front side of an upper portion of water tub 2 to the outside of water tub 2. The drying air discharged to an outside of water tub 2 is dehumidified by dehumidifying unit 6 and is heated by heating unit 7.

[0024] The dehumidified and heated drying air is guided to first air passage 9 or second air passage 11 by air blowing unit 4, and is blown into drum 1 again.

[0025] First air passage 9 has first blow-out port 8 opened to the rear side of drum 1. Second air passage 11 has second blow-out port 10 opened to the front side of drum 1 on the circumference side surface on the front side of drum 1.

[0026] First blow-out port 8 of first air passage 9 is formed so as to have a larger air passage cross-sectional area than second blow-out port 10, and has a lower pressure loss than second air passage 11. For this reason, a large amount of drying air can be blown out from first blow-out port 8 into drum 1.

[0027] Second blow-out port 10 of second air passage 11 has a smaller air passage cross-sectional area than first blow-out port 8. For this reason, higher-pressure and higher-speed drying air than first blow-out port 8 can be blown from second blow-out port 10 into drum 1.

[0028] Typically, in the drum type washer dryer, a gap between the front side of rotating drum 1 and water tub 2 is formed to be minimum possible so as not to engage clothes thereinto. Although it is spacedly difficult to provide a blow-out port which has a large opening and a low pressure loss in the small gap, second blow-out port 10 which has a relatively small air passage cross-sectional area and blows out the high-pressure and high-speed air can be provided in the gap.

[0029] On the other hand, the bottom surface side on the rear side of drum 1 has a space for providing first blow-out port 8 having a relatively large opening. When first blow-out port 8 is covered with cover 26 which has a high open-area rate and includes a large number of small-diameter ventable holes, it cannot engage clothes thereinto. Therefore, first blow-out port 8 which has a low pressure loss can be provided on the bottom surface on the rear side of drum 1.

[0030] In addition, when drum 1 is rotated so as to be tilted forwardly and upwardly for agitating clothes, small clothes such as socks, handkerchiefs, and briefs are easily shifted to the rear side of drum 1, and long clothes such as long-sleeved underwear, long underpants, long-sleeved shirts, and long-sleeved pajamas are easily shifted to the front side of drum 1.

[0031] Therefore, when the small clothes and the long clothes are mixed and dried, a large amount of drying air is blown out from first blow-out port 8 located on the rear side of drum 1, so that the drying air is brought into contact with the small clothes shifted to the rear side of drum 1 earlier than with the long clothes.

[0032] Further, since a large number of gaps are formed between the small clothes, the drying air passes through the small clothes to reach the long clothes on the front side of drum 1. Therefore, both the small clothes and the long clothes can be dried efficiently. In particular, since tangling of the small clothes is less than the long clothes, they can be dried with relatively fewer wrinkles.

[0033] On the other hand, in the agitation during drying, since the long clothes in which their sleeves are easily twisted so that wrinkles occur easily are easily shifted to the front side of drum 1, the drying air is brought into contact with them

from second blow-out port 10 located on the front side of drum 1, which can increase the drying speed.

[0034] Further, the high-pressure and high-speed drying air blown out from second blow-out port 10 is brought into contact with the long clothes, so that the long clothes can be easily stretched, and since the long clothes can be moved well by the drying air, they can be untangled. The effect of reducing occurrence of wrinkles is high.

[0035] Air passage switching unit 12 includes valve 12a which is rotatably pivoted in a branching portion of first air passage 9 and second air passage 11, and a driving unit, not shown, which rotationally drives valve 12a.

[0036] Air passage switching unit 12 is provided in the branching portion of first air passage 9 and second air passage 11, which is formed on a downstream side of air blowing unit 4. Air passage switching unit 12 switches between first air passage 9 and second air passage 11 as the drying air passage.

[0037] When valve 12a is rotated to "a" side in Fig. 1 to close second air passage 11, first air passage 9 is opened so that the drying air blown by air blowing unit 4 passes through first air passage 9.

[0038] On the other hand, when valve 12a is rotated to "b" side in Fig. 1 to close first air passage 9, second air passage 11 is opened so that the drying air blown by air blowing unit 4 passes through second air passage 11.

[0039] Circulation air passage 13 has air blowing unit 4 and air passage switching unit 12 therein, and circulates the drying air in the drum type washer dryer in such a manner that the drying air passes from drum 1 through discharge port 5, dehumidifying unit 6, and heating unit 7 in this order, and is delivered again from first blow-out port 8 or second blow-out port 10 into drum 1.

[0040] Air blowing unit 4 includes air blowing fan 4a and air blowing fan motor 4b. At the time of switching to first air passage 9 by air passage switching unit 12, air blowing unit 4 rotates air blowing fan 4a so that an air amount passing through first air passage 9 is larger than that of second air passage 11.

[0041] In addition, at the time of switching to second air passage 11 by air passage switching unit 12, air blowing unit 4 rotates air blowing fan 4a so that an air speed passing through second blow-out port 10 of second air passage 11 is higher than that passing through first blow-out port 8. For instance, the air speed passing through first blow-out port 8 is about 10 m/s, and the air speed passing through second blow-out port 10 is 50 m/s or more.

[0042] Further, the air speeds passing through first blow-out port 8 and second blow-out port 10 are not limited to these, and can be set to any air speed which satisfies a condition in which the air speed in second blow-out port 10 is higher than that in first blow-out port 8.

[0043] In the drum type washer dryer of this embodiment, the air amount passing through first air passage 9 is larger than that passing through second air passage 11, the air speed passing through second blow-out port 10 of second air passage 11 is higher than that passing through first blow-out port 8 of first air passage 9, and in the drying process, air passage switching unit 12 is operated to switch between first air passage 9 and second air passage 11.

[0044] Discharge port 5 is disposed in a position in which a distance from first blow-out port 8 to discharge port 5 is relatively longer than that from second blow-out port 10 to discharge port 5. In other words, relatively, discharge port 5 is close to second blow-out port 10, and is far from first blow-out port 8.

[0045] Therefore, discharge port 5 is provided so as to be closer to the front side of drum 1 than to the rear side thereof. Further, discharge port 5 may be provided near second blow-out port 10 on the front side of drum 1 so that the distance from first blow-out port 8 to discharge port 5 is longest.

[0046] As described above, discharge port 5 is disposed near second blow-out port 10 on the front side of drum 1 and is far from first blow-out port 8, so that the distance from first blow-out port 8 to discharge port 5 becomes longer.

[0047] Discharge port 5 is arranged in this manner, so that during blowing from first blow-out port 8 on the rear side of drum 1, the drying air blown out from first blow-out port 8 is widely spread into drum 1 before being discharged from discharge port 5 to the outside of drum 1. Thereby, clothes and the drying air can be efficiently brought into contact with each other in drum 1, so that the clothes can be dried with low power consumption.

[0048] In addition, even when discharge port 5 is disposed near second blow-out port 10, since the high-pressure and high-speed drying air is blown out from second blow-out port 10 during blowing from second blow-out port 10 on the front side of drum 1, the drying air can reach the rear side of drum 1 from the front side thereof before being discharged from discharge port 5 to the outside of drum 1.

[0049] Thereby, contact of the drying air with the clothes cannot be poor, so that an effect of smoothening out wrinkles can be maintained by the high-pressure and high-speed drying air.

[0050] In addition, discharge port 5 is disposed on an upper side of drum 1, and can effectively and upwardly discharge the drying air which has been brought into contact with the clothes. Further, in the drum type clothes dryer without a washing function, discharge port 5 may be provided in a place different from the upper side of drum 1. On the other hand, in the drum type washer dryer, since discharge port 5 is affected by washing water, it is desirably provided above a water level of the washing water.

[0051] Further, second blow-out port 10 is opened to the upper portion on the front side of drum 1. Thereby, the high-pressure and high-speed drying air can be effectively blown to clothes lifted and moved by rotation of drum 1, so that an effect of reducing occurrence of wrinkles can be increased.

[0052] Although in this embodiment, only one first blow-out port 8 of first air passage 9 is provided, a plurality of first

blow-out ports 8 can be provided. In the same manner, although only one second blow-out port 10 of second air passage 11 is provided, a plurality of second blow-out ports 10 can be provided.

[0053] With this configuration, since the drying air can be blown to a large number of portions of clothes and can be blown to clothes from various directions, the drying time can be shortened.

[0054] Damper 34 supporting water tub 2 is provided on a lower side of water tub 2. Damper 34 attenuates vibration of water tub 2 caused at the time of rotation of drum 1 in a weight unbalanced state due to shift of clothes in drum 1 caused during spin-drying.

[0055] Clothes amount detecting unit 15 is attached to damper 34, and detects a shift amount in which a shaft of damper 34 is shifted up and down due to changes in weight of clothes in supported water tub 2 to detect a clothes amount.

[0056] The drum type washer dryer of this embodiment is of a heat pump type to perform dehumidification and heating, and has heat pump device 50.

[0057] Heat pump device 50 includes compressor 16 which compresses a refrigerant, heat radiator 17 which radiates heat of the refrigerant which has been compressed so as to be hot and to have a high pressure, expansion mechanism 18 which reduces the pressure of the high-pressure refrigerant, heat absorber 19 which absorbs heat from surroundings by the refrigerant which has been pressure-reduced so as to have a low pressure, and pipe line 20 which couples compressor 16, heat radiator 17, expansion mechanism 18, and heat absorber 19 to circulate the refrigerant.

[0058] In heat pump device 50, heat absorber 19 corresponds to dehumidifying unit 6, and heat radiator 17 corresponds to heating unit 7.

[0059] It should be noted that the drum type washer dryer is not limited to the configuration which is of a heat pump type to dry clothes. For instance, dehumidifying unit 6 may be of a water cooling type which directly sprays water to the drying air, and heating unit 7 may be a heater.

[0060] Hereinafter, a circuit configuration of the drum type washer dryer of this embodiment will be described with reference to Fig. 2.

[0061] As shown in Fig. 2, the drum type washer dryer has controller 70. Controller 70 controls a series of driving operations including washing, rinsing, spin-drying, and drying based on setting information inputted from a user via input setting unit 32 and operated state monitoring of each unit.

[0062] For instance, in the drying process, controller 70 controls rotation of drum driving motor 3, controls operation of air blowing unit 4, dehumidifying unit 6, and heating unit 7, and controls air passage switching unit 12 to switch between first air passage 9 and second air passage 11.

[0063] Controller 70 has, e.g., a CPU (Central Processing Unit), a ROM (Read Only Memory) which stores a program, a RAM (Random Access Memory) which stores a program and data at the time of execution of various processes, an input/output interface, and a bus connecting these, which are not shown.

[0064] In addition, controller 70 has timer 71 which performs timekeeping of a first predetermined time and a second predetermined time described later. As timer 71, an internal timer incorporated into controller 70 can be used. As timer 71, a timer device independent from controller 70 may be used.

[0065] In the drum type washer dryer, alternating current electricity 23 is rectified by rectifier 28, and then, is smoothened by a smoothening circuit including choke coil 29 and smoothening capacitor 30 to generate direct current electricity. Using the direct current electricity as driving electricity, drum driving motor 3 is rotationally driven by inverter circuit 22.

[0066] Controller 70 controls rotation of drum driving motor 3 based on a driving instruction inputted from input setting unit 32 and driven state monitoring information detected by each detecting unit.

[0067] Setting contents inputted from input setting unit 32 are displayed on displaying unit 33. Further, controller 70 controls load operation of water supply valve 25, water discharge valve 27, air blowing unit 4, dehumidifying unit 6, and heating unit 7 via load driving unit 24.

[0068] Controller 70 detects washing water supplied into water tub 2 by water level detecting unit 31 at the time of washing and rinsing, and closes water supply valve 25 when the washing water in an amount set according to a clothes amount to be washed detected by clothes amount detecting unit 15 is reserved.

[0069] Drum driving motor 3 has, e.g., a stator having three-phase windings 3a, 3b, and 3c, and a rotor having a bipolar permanent magnet, and can be configured as a direct current brushless motor having three position detection elements 19a, 19b, and 19c. Drum driving motor 3 is rotation-controlled by inverter circuit 22 which can be PWM-controlled by switching elements 22a to 22f.

[0070] Here, rotor position detection signals detected by position detection elements 19a to 19c are inputted to controller 70. Controller 70 outputs a control signal to inverter driving circuit 21 based on the rotor position detection signals, and PWM-controls on and off states of switching elements 22a to 22f via inverter driving circuit 21.

[0071] In this manner, controller 70 controls energization with respect to three-phase windings 3a, 3b, and 3c of the stator, and rotates the rotor of drum driving motor 3 at a desired rotation speed. Further, each time a state of one of signals of three position detection elements 19a to 19c is changed, controller 70 detects its period, and calculates a rotation speed of the rotor by rotation speed detecting unit 72 from the period.

[0072] Operations and operation effects of the drum type washer dryer configured as described above will be described

below in detail.

[0073] First, occurrence of wrinkles in clothes drying will be described. When clothes are dried in space-limited drum 1, a large number of wrinkles occur and are left in the clothes, which can dissatisfy the user.

[0074] This is caused because the clothes cannot be dried in a straightly stretched state in space-limited drum 1. In particular, a large number of wrinkles occur in clothes including much cotton, so that drying finishing tends to be poor.

[0075] Cotton fibers containing moisture can be freely moved each other. Even when the clothes are agitated by rotation of drum 1 so as to be folded by a mechanical force, the folded portion is stretched by application of a force in the next stretching direction, so that no wrinkles can be left.

[0076] However, when drying is advanced to reduce moisture in the cotton fibers, a joining force of the fibers can be increased to make movement of the fibers poor. When the fibers are folded by the mechanical force at this time, this state can be easily maintained.

[0077] When drying is advanced to reduce more moisture in the fibers, the fibers remain folded and cannot be stretched even by application of the force in the next stretching direction. This state will be called fixed wrinkles. A contrary phenomenon in which although moisture is required to be vaporized to dry clothes, the reduced moisture fixes wrinkles, occurs. As the number of fixed wrinkles is higher, the drying finishing is poor.

[0078] In space-limited drum 1, the folded state of the fibers is inevitable. Therefore, to reduce wrinkling, it is important that the number of wrinkles be required to be reduced and that acute-angled folded and strongly fixed fibers be avoided.

[0079] Therefore, in such a manner that a fiber folded portion is stretched and a different portion is folded, it is desirable to advance drying with the fibers stretched and folded by frequent folded position change.

[0080] On the other hand, in the state that drying is advanced with the fibers stretched so that there is little moisture, joining of the fibers is strong even when the mechanical force acts in the next folding direction. Thus, the fibers are hard to be folded, resulting in occurrence of different wrinkles.

[0081] From the above, in the drying process, according to a dried state of clothes, there are a region in which wrinkles are easily fixed and a region in which wrinkles are not easily fixed. The region in which wrinkles are easily fixed and the region in which wrinkles are not easily fixed will be described using a drying percentage defined by expression 1 shown below.

[0082] The drying percentage (%) is expressed by

$$\text{drying percentage} = (\text{mass of standard clothes} / \text{mass of clothes containing moisture}) \times 100 \quad \text{(Expression 1)}$$

[0083] Here, the mass of standard clothes is a mass of clothes equilibrated at a temperature of 20°C and a humidity of 65%. For this reason, when drying of clothes is advanced, the mass of clothes containing moisture can be smaller than the mass of standard clothes, so that the drying percentage (%) can be above 100%.

[0084] In the drying percentage based on clothes which are made of cotton fibers in which wrinkles occur most easily, a region in the range from approximately 85% (around 85%) to approximately 100% (around 100%) is the region in which wrinkles are easily fixed into clothes. In particular, a region in which the drying percentage based on clothes which are made of cotton fibers is in the range from approximately 90% (around 90%) to approximately 100% (around 100%) causes wrinkles to be fixed into the clothes most easily.

[0085] In the drying state of one clothes piece, it cannot be dried uniformly, so that non-uniform drying occurs partially. For instance, drying of an underarm portion of a long-sleeved shirt is slowest.

[0086] For this reason, typically, the drying percentage at completion of drying is not targeted to 100%, but is set to the drying percentage which brings an excessive drying state exceeding 100% (e.g., the drying percentage in the range from 102% to 105%) at completion of the drying process.

[0087] Therefore, based on the drying percentage, the drying process is sectioned into a drying start period region in which wrinkles are hard to be fixed in the range from a time immediately after spin-drying to the drying percentage of up to around 90%, a drying middle period region in which wrinkles occur and the number of fixed wrinkles is easily increased in the range from the drying percentage of around 90% to around 100%, and a drying end period region in which wrinkles are hard to occur at the drying percentage exceeding 100%.

[0088] Accordingly, in this embodiment, in the drying middle period region, the high-pressure and high-speed air which is effective for greatly stretching clothes to reduce wrinkles is blown out from second blow-out port 10 of second air passage 11 so as to be brought into contact with the clothes.

[0089] In at least one of the drying start period region and the drying end period region, a large amount of air is blown from first blow-out port 8 of first air passage 9. In this manner, in the drying process, first air passage 9 which blows out a large amount of air with low power consumption and second air passage 11 which blows out the high-pressure and

high-speed air effective for reducing wrinkles are switched, enabling reduction of occurrence of wrinkles and electricity saving.

[0090] The drying start period, the drying middle period, and the drying end period in the drying process can be assumed based on a time from start of the drying process. Accordingly, in this embodiment, controller 70 judges the drying start period, the drying middle period, and the drying end period in the drying process based on the time from start of the drying process subjected to timekeeping of timer 71, and controls air passage switching unit 12 to switch between first air passage 9 and second air passage 11 with good timing.

[0091] More specifically, controller 70 judges a period from start of the drying process to a first predetermined time, e.g., a period until the drying percentage of clothes in the drum reaches 90%, as the drying start period. In addition, controller 70 judges a period from elapse of the first predetermined time to a second predetermined time, e.g., a period until the drying percentage of clothes in the drum reaches 100%, as the drying middle period. Further, controller 70 judges a period from elapse of the second predetermined time to completion of the drying process, as the drying end period.

[0092] As described above, the air passage switching unit 12 is controlled during the drying process to switch between first air passage 9 and second air passage 11 with good timing, so that occurrence of wrinkles can be effectively reduced by one air blowing unit 4.

[0093] Further, the regions in which drying is performed in a larger air amount and with lower power consumption than the high-speed air during the drying process are provided. For this reason, this can reduce a total power consumption, as compared with when the high-pressure and high-speed drying air is blown into the drum at all times, and with when the number of air blowing fan motors is increased by two to increase the air amount and they are driven at all times.

[0094] In this way, the drum type washer dryer of this embodiment can realize good drying finishing with less occurrence of wrinkles in clothes while saving electricity.

[0095] In addition, in this embodiment, in the drying start period, the drying middle period, and the drying end period in the drying process, drum rotation sequences are changed according to timing to switch between first air passage 9 and second air passage 11.

[0096] As described above, this performs efficient drying by increasing the air speed and the air amount to remove wrinkles according to each drying period, thereby realizing an energy saving operation. However, methods in which the air acts on clothes are different according to the respective air speeds (air amounts). Accordingly, rotation of drum 1 is controlled by the optimum sequence according to each drying stage and each air blowing method to clothes, thereby realizing the further energy saving operation.

[0097] Hereinafter, a relation between the rotation sequences of drum 1 and the methods in which the air acts on clothes will be described.

[0098] First, in the drying start period to the drying percentage of around 90%, since the number of fixed wrinkles into clothes is relatively low, the air amount is increased (but, the air speed is low) to efficiently dry the clothes. At this time, poor contact of the drying air with all the clothes due to tangling of the clothes should be prevented.

[0099] A rotation direction of drum 1 is reversed in forward and reverse directions in a relatively short time cycle. This can reduce tangling of the clothes and can untangle the tangled clothes. As a result, in the drying start period, the drum rotation sequence has a pattern in which a reversal frequency is relatively high, thereby allowing an efficient drying operation in a large amount of air while reducing tangling of the clothes.

[0100] Next, in the drying middle period in the range from the drying percentage of around 90% to around 100%, since wrinkles are easily fixed into clothes, the drying air in which the air speed is increased (but, the air amount is reduced) is blown out for drying.

[0101] At this time, the high-pressure and high-speed air acts on the clothes so that wrinkles can be smoothened out, and the high-pressure air is brought into contact with the tangled portions of the clothes so that the clothes can be untangled.

[0102] The air amount is reduced so that the drying (dehumidifying) ability becomes slightly lower. In this period, therefore, it is important that poor contact of the drying air with the clothes be prevented to the extent possible.

[0103] Further, in the rotation sequence of drum 1, which reverses the rotation direction of drum 1 in a short time, like the drying start period, a series of movements in which the clothes are lifted and fallen by rotation of drum 1 are stopped once in a period before and after the reverse timing of the drum rotation. For this reason, the clothes are collected in the bottom portion, so that the drying air is hard to be brought into contact with the clothes, and a position in which the drying air is brought into contact with the clothes is concentrated on one portion.

[0104] In other words, as the rate at which the rotation direction of drum 1 is reversed is higher with respect to the drying time, the efficiency is lowered, so that the drying time increases. To prevent this, the reversal frequency of the drum rotation in the drying middle period is lower than that in the drying start period.

[0105] As described above, the high-pressure and high-speed air acts on the clothes to reduce wrinkles and tangling. For this reason, since it is not necessary to reverse the rotation direction of drum 1 to reduce wrinkles and tangling, the reversal frequency of drum 1 can be lowered.

[0106] Accordingly, in this embodiment, the drying middle period has the drum rotation pattern in which the frequency at which the rotation direction of drum 1 is reversed is lower than that of the drying start period. This can perform the drying operation with less wrinkles and tangling while the contact efficiency of the drying air with the clothes is increased to shorten the drying time.

[0107] Further, in the drying middle period, fixed wrinkles which have been formed once are advanced abruptly with advance of drying (dehumidification). Therefore, it is necessary to prevent advance of fixed wrinkles by uniformly bringing the drying air having the highest pressure and the highest speed into contact with a large number of clothes for drying throughout the period.

[0108] Accordingly, the frequency at which the drum rotation is reversed is lowered, so that the time in which drum 1 is rotated in the same direction can be made longer, and while the clothes lifted by rotation of drum 1 are stretched, the frequency at which the high-pressure and high-speed air is brought into contact with the clothes can be increased, thereby increasing the effect of smoothening out wrinkles.

[0109] In addition, at the time of start immediately after the drum rotation is reversed, the clothes are collected in the bottom portion by stopping the drum 1. The necessary electricity in lifting the heavy clothes collected in the bottom portion is larger than when drum 1 is rotated at a fixed speed.

[0110] Accordingly, the frequency at which drum 1 is reversed is lowered so that power consumption of drum driving motor 3 is reduced, and temperature increase of drum driving motor 3 is inhibited so that the energy saving operation can be performed.

[0111] As in the drying start period, in the drying end period in which the drying percentage exceeds 100%, the number of fixed wrinkles into the clothes is relatively low. The amount of drying air is increased (but, the air speed is low) to efficiently perform drying.

[0112] As in the drying start period, in the drum rotation, the rotation direction is reversed in the forward and reverse directions in a relatively short time cycle. Therefore, tangling of the clothes can be reduced and contact with the clothes can be improved for efficient drying. Consequently, in the drying end period, the drum rotation sequence has the pattern in which the reversal frequency is relatively high.

[0113] As described above, according to this embodiment, the amount and speed of the drying air are optimally switched according to the periods in which wrinkles and tangling of the clothes occur. In addition, the drum rotation sequences have the optimum rotation patterns which can reduce wrinkles and tangling of the clothes and can increase the contact efficiency of the drying air with the clothes. This can realize good drying finishing in which occurrence of wrinkles in the clothes is reduced while saving electricity.

[0114] Hereinafter, referring to Figs. 3, 4, and 5, operations of the drum type washer dryer when the air passages and the drum rotation sequence switching timings shown in the drawings are applied will be described.

[0115] Fig. 3 is a time chart showing an example of the air passages and the drum rotation sequence switching timings according to the drying start period, the drying middle period, and the drying end period as described above.

[0116] As shown in Fig. 3, in the drying process, in the drying start period from start of the drying operation to elapse of the first predetermined time, first air passage 9 which has a large air passage cross-sectional area and a low pressure loss is used, and a large amount of drying air is blown out from first blow-out port 8 on the rear side of drum 1 and is brought into contact with clothes.

[0117] In other words, controller 70 controls air passage switching unit 12 to open first air passage 9, thereby starting the drying operation. In addition, controller 70 starts timekeeping of timer 71 with start of the drying operation to continue the opened state of first air passage 9 until the first predetermined time elapses.

[0118] In this case, since the pressure loss of first air passage 9 is low, even when the rotation speed of air blowing fan motor 4b is relatively low to drive air blowing unit 4 with low power consumption, a large amount of air can be obtained.

[0119] Therefore, shortening of the drying time and reduction of the power consumption in the drying start period are enabled. At this time, the drum rotation sequence has the pattern in which the rotation direction is reversed in the forward and reverse directions in a relatively short time cycle.

[0120] By way of example, the drum rotation is a repeating operation in a pattern of drum rotation sequence 1 as shown in Fig. 4 "rotation for 15 seconds in the forward direction (a rotation speed of 47 rpm)- stop for 3 seconds - rotation for 15 seconds in the reverse direction (a rotation speed of 47 rpm) - stop for 3 seconds ... ". Thereby, shortening of the drying time and reduction of the power consumption in a large amount of drying air are enabled while tangling of the clothes can be reduced.

[0121] As shown in Fig. 3, in the drying middle period after elapse of the first predetermined time from start of the drying operation, air passage switching unit 12 performs switching to second air passage 11 to increase the rotation speed of air blowing fan motor 4b.

[0122] Thereby, in the drying middle period, the high-pressure and high-speed drying air obtained by rotating air blowing fan motor 4b at a high rotation speed is blown from second blow-out port 10 having a smaller air passage cross-sectional area than first blow-out port 8.

[0123] In other words, when the first predetermined time elapses from start of the drying operation, controller 70

controls air passage switching unit 12 to open second air passage 11 and controls air blowing unit 4 to increase the rotation speed of air blowing fan motor 4b.

[0124] Thereafter, controller 70 continues the opened state of second air passage 11 until the second predetermined time elapses. In this case, since the clothes are stretched at all times by the high-pressure and high-speed drying air, occurrence of wrinkles can be reduced.

[0125] At this time, in the drying middle period, the drum rotation sequence has the pattern in which the frequency at which the rotation direction is reversed is lower than that of the drying start period. By way of example, the drum rotation is a repeating operation in a pattern of drum rotation sequence 2 as shown in Fig. 5 "rotation for 60 seconds in the forward direction (a rotation speed of 47 rpm) - stop for 3 seconds - rotation for 60 seconds in the reverse direction (a rotation speed of 47 rpm) - stop for 3 seconds ... ". Thereby, the clothes can be dried without stopping movement thereof, so that the drying air can continue to be brought into contact with the clothes moved in drum 1. Accordingly, the drying time can be shortest in a smaller air amount than the drying start period, so that the power consumption during this can be reduced.

[0126] Further, as shown in Fig. 3, in the drying end period after the second predetermined time elapses, air passage switching unit 12 performs switching to first air passage 9. In the drying end period, the amount of moisture contained in the clothes is small, and the small amount of moisture is brought into contact with the drying air and is vaporized, which takes long time.

[0127] For this reason, it is necessary to blow a large amount of drying air into drum 1 to increase an opportunity of bringing moisture into contact with the drying air, and it is desirable to obtain a large amount of air with low power consumption.

[0128] Accordingly, first air passage 9 having a large air passage cross-sectional area and a low pressure loss is used to blow a large amount of drying air from first blow-out port 8 on the rear side of drum 1 so that it is brought into contact with the clothes. In other words, when the second predetermined time elapses from start of the drying operation, controller 70 controls air passage switching unit 12 to open first air passage 9, and controls air blowing unit 4 to lower the rotation speed of air blowing fan motor 4b.

[0129] Thereafter, controller 70 continues the opened state of first air passage 9 until the drying process is completed. In this case, since the pressure loss of first air passage 9 is low, even when the rotation speed of air blowing fan motor 4b is made relatively low to drive air blowing unit 4 with low power consumption, a large amount of air can be obtained. Therefore, shortening of the drying time in the drying end period and reduction of the power consumption during this are enabled.

[0130] At this time, as in the drying start period, the drum rotation sequence has the pattern in which the rotation direction is reversed in the forward and rearward directions in a relatively short time cycle. The drum rotation is a repeating operation in the pattern of drum rotation sequence 1 as shown in Fig. 4 "rotation for 15 seconds in the forward direction (a rotation speed of 47 rpm) - stop for 3 seconds - rotation for 15 seconds in the reverse direction (a rotation speed of 47 rpm) - stop for 3 seconds ...". Accordingly, shortening of the drying time and reduction of the power consumption in a large amount of drying warm air are enabled while tangling of the clothes can be prevented.

[0131] Further, the drum rotation sequence of the drying end period may be a sequence different from the drying start period. For instance, it may have a rotation pattern "rotation for 30 seconds in the forward direction (a rotation speed of 47 rpm) - stop for 3 seconds - rotation for 30 seconds in the reverse direction (a rotation speed of 47 rpm) - stop for 3 seconds ... ".

[0132] The reversal frequency is lowered so that the load of the motor can be reduced, and a life of the motor increase. Since drying of the clothes is advanced in the drying end period, tangling of the clothes tends to be hard to occur as compared with the drying start period, so that the reversal frequency of the motor can be lowered.

[0133] As described above, in this embodiment, not only the blow-out ports, amounts, and speeds of the drying air can be optimally switched based on the periods in which wrinkles and tangling of the clothes are hard to occur and the period in which wrinkles and tangling of the clothes easily occur, but also rotation of drum 1 has the optimum rotation sequences which can reduce occurrence of wrinkles and tangling of the clothes and increase the contact efficiency of drying air with the clothes. This can realize good drying finishing in which occurrence of tangling and wrinkles of the clothes are less while saving electricity.

[0134] Fig. 6 is a time chart showing another example of drum rotation sequence 2 in the drying middle period shown in Fig. 5. Hereinafter, an operation of the drum type washer dryer in the drying middle period when the drum rotation sequence shown in Fig. 6 is applied will be described.

[0135] In the drying middle period after the first predetermined time elapses from start of the drying operation, air passage switching unit 12 performs switching to second air passage 11 to increase the rotation speed of air blowing fan motor 4b.

[0136] Thereby, in the drying middle period, the high-pressure and high-speed drying air obtained by rotating air blowing fan motor 4b at a high rotation speed is blown from second blow-out port 10 having a smaller air passage cross-sectional area than first blow-out port 8.

[0137] In other words, when the first predetermined time elapses from start of the drying operation, controller 70 controls air passage switching unit 12 to open second air passage 11 and controls air blowing unit 4 to increase the rotation speed of air blowing fan motor 4b. Thereafter, controller 70 continues the opened state of second air passage 11 until the second predetermined time elapses.

[0138] In this case, since the clothes are stretched at all times by the high-pressure and high-speed air, wrinkles are reduced. The drum rotation sequence during this has a pattern in which drum 1 is rotated at a rotation speed varied in each predetermined time with respect to the drying start period in which drum 1 is rotated at the predetermined rotation speed. In addition, the drum rotation sequence has a pattern in which the rotation speed is higher than that of the drying start period.

[0139] By way of example, the drum rotation has a pattern in which the drum rotation sequence as shown in Fig. 6 "rotation for 60 seconds in the forward direction (in which 10 seconds at a rotation speed of 47 rpm → 30 seconds at a rotation speed of 55 rpm → 20 seconds at a rotation speed of 65 rpm) - stop for 3 seconds - rotation for 60 seconds in the reverse direction (in which 10 seconds at a rotation speed of 47 rpm → 30 seconds at a rotation speed of 55 rpm → 20 seconds at a rotation speed of 65 rpm) → stop for 3 seconds ... " is repeated.

[0140] At this time, first, drum 1 is rotated at substantially the same rotation speed as the drying start period, so that the clothes are fallen by gravitation slightly earlier. Thereafter, drum 1 is rotated so that the rotation speed of drum 1 is gradually higher than that of the drying start period, whereby the clothes tend to adhere to the inner wall of drum 1.

[0141] Thereby, the position of the clothes in drum 1 can be changed up and down during drum rotation, so that the drying air at high pressure and high speed in the limited range can be uniformly brought into contact with the clothes. As a result, the contact efficiency of the drying air with the clothes can be increased to shorten the drying time, and wrinkles in the clothes can be efficiently smoothened out, so that drying with fewer wrinkles can be performed with low power consumption.

[0142] In addition, although in this embodiment, the drum type washer dryer including the washing function and the clothes drying function has been described, the present invention is not limited to this and is applicable to the clothes dryer without the washing function.

[0143] As a configuration example of the clothes dryer, the washing function can be removed from the drum type washer dryer shown in Fig. 1. For instance, as the clothes dryer without the washing function, water tub 2 as a water tank in Fig. 1 is not required to be connected to the water supply pipe and water discharge pipe 40, and is configured as a simple outer tank of drum 1, and other basic configuration should be the same as the drum type washer dryer in Fig. 1.

Claims

1. A clothes dryer comprising:

a drum which accommodates an article to be dried;
a drum driving unit which rotationally drives the drum;
a first air passage (9) having a first blow-out port (8) opened to the drum;
a second air passage (11) having a second blow-out port (10) opened to the drum and having a smaller air passage cross-sectional area than the first blow-out port;
an air passage switching unit (12) which selectively switches between the first air passage and the second air passage;
an air blowing unit (4) which blows drying air into the first air passage or the second air passage; and
a controller which controls the drum driving unit, wherein
the air blowing unit blows out the drying air of a larger amount into the drum from the first blow-out port when the first air passage is selected than when the second air passage is selected, and the air blowing unit blows out the drying air at a higher pressure and a higher speed into the drum from the second blow-out port when the second air passage is selected than when the first air passage is selected, and
the controller changes rotation sequences of the drum by controlling the drum driving unit according to the selected one of the first air passage and the second air passage.

2. The clothes dryer according to claim 1, wherein
the second blow-out port is opened to a front side of the drum.

3. The clothes dryer according to claim 1 or 2, wherein
the controller makes less a frequency per unit time of reversing a rotation direction of the drum when the second air passage is selected than when the first air passage is selected.

4. The clothes dryer according to claim 1 or 2, wherein
the controller changes a rotation speed of the drum at predetermined intervals by controlling the drum driving unit when the second air passage is selected.

5. The clothes dryer according to claim 1 or 2, wherein
the controller makes higher a rotation speed of the drum when the second air passage is selected than when the first air passage is selected.

6. The clothes dryer according to claim 1 or 2, further comprising a water tank which encloses the drum and reserves washing water, a water supply pipe which has a water supply valve for supplying the washing water into the water tank, and a water discharge pipe having a water discharge valve for discharging the washing water in the water tank, whereby the dryer has a washing function.

Patentansprüche

1. Wäschetrockner, der umfasst:

eine Trommel, die den zu trocknenden Artikel aufnimmt;
eine Trommelantriebseinheit, die die Trommel rotatorisch antreibt;
einen ersten Luftdurchlass (9), der eine erste Ausblasöffnung (8) besitzt, die in die Trommel mündet;
einen zweiten Luftdurchlass (11), der eine zweite Ausblasöffnung (10) besitzt, die in die Trommel mündet und die eine kleinere Luftdurchlassquerschnittsfläche als die erste Ausblasöffnung besitzt;
eine Luftdurchlassschalteinheit (12), die wahlweise zwischen dem ersten Luftdurchlass und dem zweiten Luftdurchlass schaltet;
eine Luftblaseinheit (4), die Trocknungsluft in den ersten Luftdurchlass oder den zweiten Luftdurchlass ausbläst; und
eine Steuereinheit, die die Trommelantriebseinheit steuert, wobei
die Luftblaseinheit die Trocknungsluft einer größeren Menge in die Trommel von der ersten Ausblasöffnung bläst, wenn der erste Luftdurchlass ausgewählt ist, als wenn der zweite Luftdurchlass ausgewählt ist, und die Luftblaseinheit die Trocknungsluft mit einem höheren Druck und einer höheren Geschwindigkeit von der zweiten Ausblasöffnung in die Trommel ausbläst, wenn der zweite Luftdurchlass ausgewählt ist, als wenn der erste Luftdurchlass ausgewählt ist, und
die Steuereinheit Drehabläufe der Trommel durch Steuern der Trommelantriebseinheit entsprechend dem Ausgewählten des ersten Luftdurchlasses und des zweiten Luftdurchlasses steuert.

2. Wäschetrockner nach Anspruch 1, wobei
die zweite Ausblasöffnung in eine Vorderseite der Trommel mündet.

3. Wäschetrockner nach Anspruch 1 oder 2, wobei
die Steuereinheit eine geringere Häufigkeit pro Zeiteinheit des Umkehrens einer Drehrichtung der Trommel bewirkt, wenn der zweite Luftdurchlass ausgewählt ist, als wenn der erste Luftdurchlass ausgewählt ist.

4. Wäschetrockner nach Anspruch 1 oder 2, wobei
die Steuereinheit eine Drehzahl der Trommel in vorgegebenen Intervallen durch Steuern der Trommelantriebseinheit ändert, wenn der zweite Luftdurchlass ausgewählt ist.

5. Wäschetrockner nach Anspruch 1 oder 2, wobei
die Steuereinheit eine höhere Drehzahl der Trommel bewirkt, wenn der zweite Luftdurchlass ausgewählt ist, als wenn der erste Luftdurchlass ausgewählt ist.

6. Wäschetrockner nach Anspruch 1 oder 2, der ferner einen Wassertank, der die Trommel umschließt und Waschwasser aufbewahrt, eine Wasserzuführungsleitung, die ein Wasserzuführungsventil zum Zuführen des Waschwassers in den Wassertank besitzt, und eine Wasserabführungsleitung, die ein Wasserabführungsventil zum Abführen des Waschwassers in dem Wassertank besitzt, umfasst, wodurch der Trockner eine Waschfunktion besitzt.

Revendications

1. Sèche-linge comprenant :

un tambour qui loge un article à sécher ;
une unité d'entraînement de tambour qui entraîne le tambour en rotation ;
un premier passage d'air (9) doté d'un premier orifice de soufflage (8) ouvert vers le tambour ;
un second passage d'air (11) doté d'un second orifice de soufflage (10) ouvert vers le tambour et doté d'une superficie de section de passage d'air plus petite que celle du premier orifice de soufflage ;
une unité de commutation de passage d'air (12) qui commute de manière sélective entre le premier passage d'air et le second passage d'air ;
une unité de soufflage d'air (4) qui insuffle de l'air de séchage dans le premier passage d'air ou le second passage d'air ; et
un contrôleur qui contrôle l'unité d'entraînement du tambour, dans lequel l'unité de soufflage d'air insuffle une plus grande quantité d'air de séchage dans le tambour depuis le premier orifice de soufflage lorsque le premier passage d'air est sélectionné que lorsque le second passage d'air est sélectionné, et l'unité de soufflage d'air insuffle l'air de séchage à une pression et une vitesse plus grandes dans le tambour depuis le second orifice de soufflage lorsque le second passage d'air est sélectionné que lorsque le premier passage d'air est sélectionné, et
le contrôleur change les séquences de rotation du tambour en contrôlant l'unité d'entraînement de tambour selon le passage sélectionné parmi le premier passage d'air et le second passage d'air.

2. Sèche-linge selon la revendication 1, dans lequel
le second orifice de soufflage est ouvert sur un côté avant du tambour.

3. Sèche-linge selon la revendication 1 ou 2, dans lequel
le contrôleur réalise moins d'une fréquence par unité de temps pour l'inversion d'une direction de rotation du tambour lorsque le second passage d'air est sélectionné que lorsque le premier passage d'air est sélectionné.

4. Sèche-linge selon la revendication 1 ou 2, dans lequel
le contrôleur modifie une vitesse de rotation du tambour à des intervalles prédéterminés en contrôlant l'unité d'entraînement de tambour lorsque le second passage d'air est sélectionné.

5. Sèche-linge selon la revendication 1 ou 2, dans lequel
le contrôleur augmente une vitesse de rotation du tambour lorsque le second passage d'air est sélectionné plutôt que lorsque le premier passage d'air est sélectionné.

6. Sèche-linge selon la revendication 1 ou 2, comprenant un réservoir d'eau qui entoure le tambour et stocke de l'eau de lavage, un tuyau d'alimentation en eau qui présente une valve d'alimentation en eau pour l'alimentation en eau de lavage du réservoir d'eau, et un tuyau d'évacuation d'eau qui présente une valve d'évacuation d'eau pour l'évacuation de l'eau de lavage dans le réservoir d'eau, moyennant quoi le sèche-linge possède une fonction de lavage.

FIG. 1

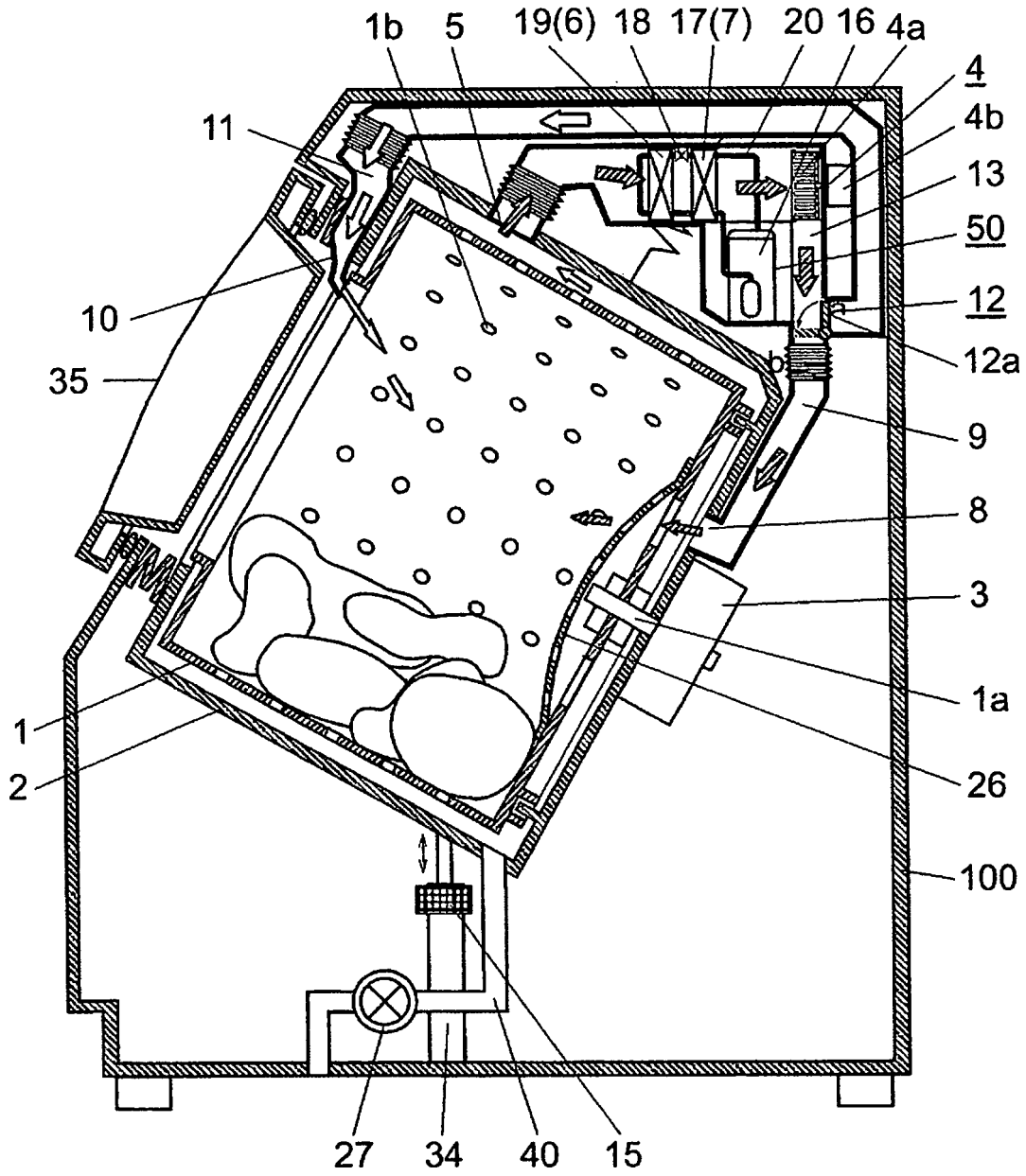

1b
5
19(6)
18
17(7)
20
16
4a
4
4b
13
50
12
12a
11
10
35
9
8
3
1a
26
1
2
100
27
34
40
15

FIG. 2

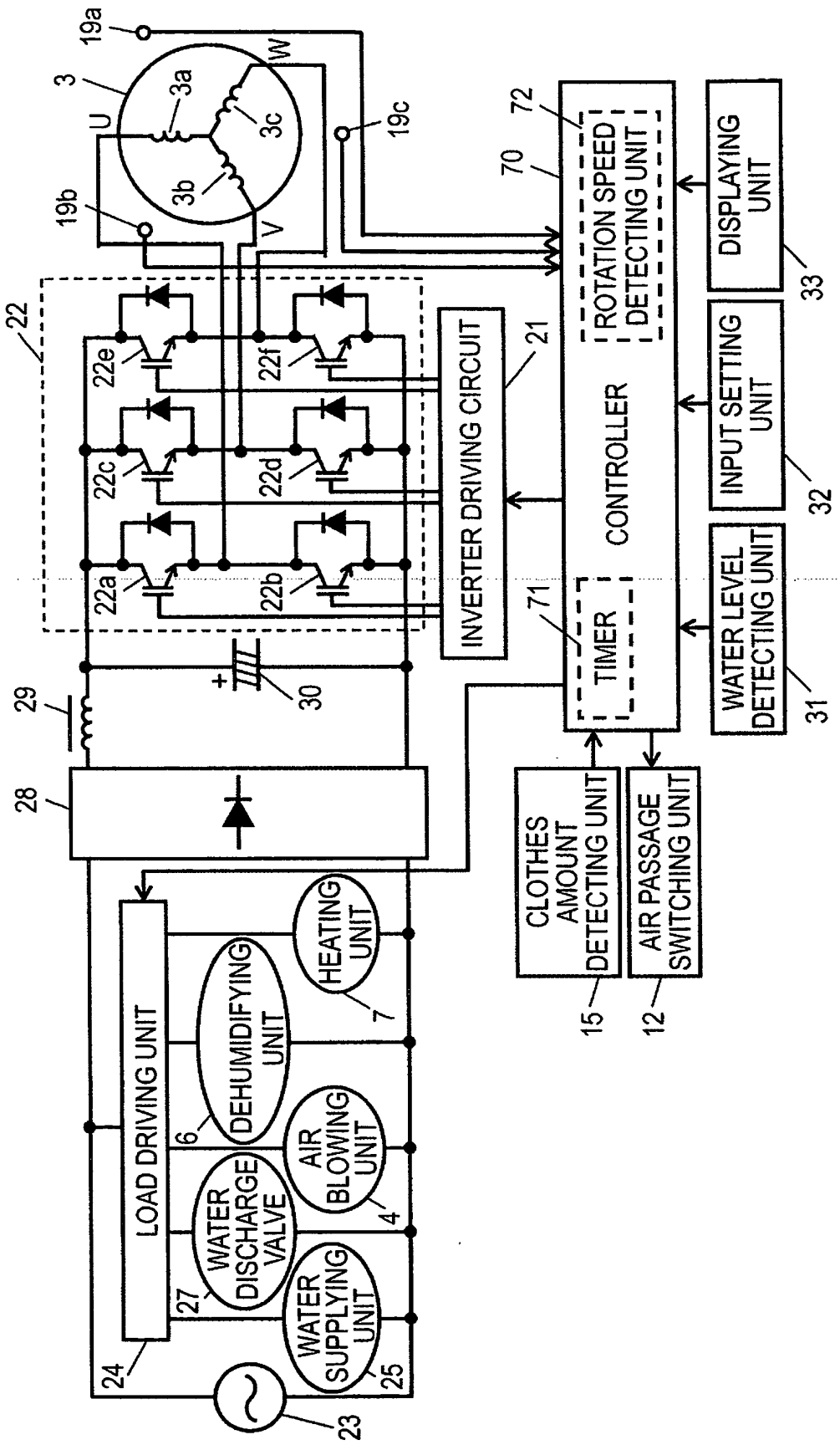

19a
3
U
V
W
3a
3b
3c
19b
19c
22
22a
22b
22c
22d
22e
22f
INVERTER DRIVING CIRCUIT
21
70
72
CONTROLLER
ROTATION SPEED DETECTING UNIT
DISPLAYING UNIT
33
INPUT SETTING UNIT
32
WATER LEVEL DETECTING UNIT
31
TIMER
71
29
30
28
LOAD DRIVING UNIT
HEATING UNIT
7
DEHUMIDIFYING UNIT
6
AIR BLOWING UNIT
4
WATER DISCHARGE VALVE
27
WATER SUPPLYING UNIT
25
24
23
CLOTHES AMOUNT DETECTING UNIT
15
AIR PASSAGE SWITCHING UNIT
12

FIG. 3

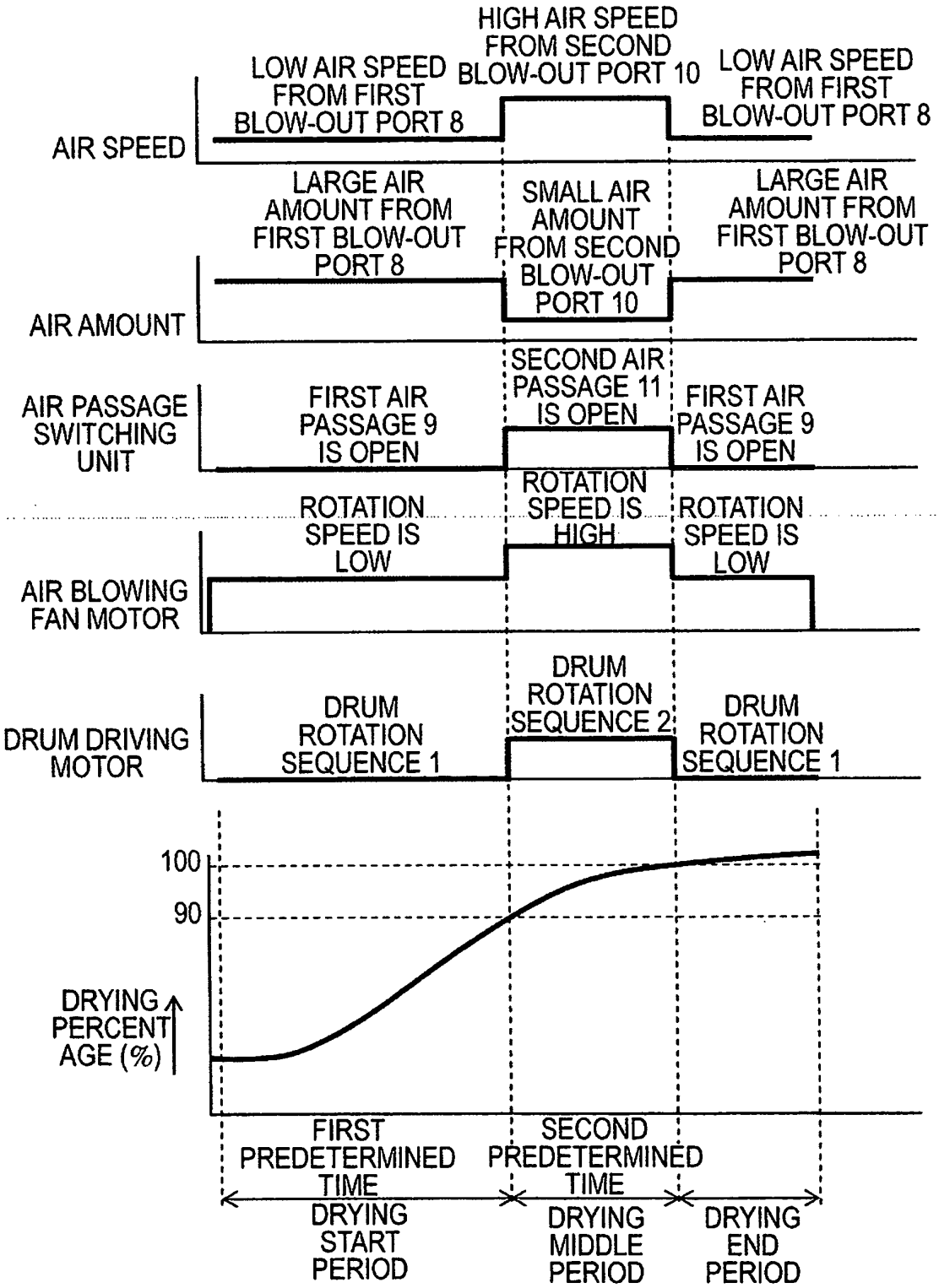

AIR SPEED
LOW AIR SPEED FROM FIRST BLOW-OUT PORT 8
HIGH AIR SPEED FROM SECOND BLOW-OUT PORT 10
LOW AIR SPEED FROM FIRST BLOW-OUT PORT 8
AIR AMOUNT
LARGE AIR AMOUNT FROM FIRST BLOW-OUT PORT 8
SMALL AIR AMOUNT FROM SECOND BLOW-OUT PORT 10
LARGE AIR AMOUNT FROM FIRST BLOW-OUT PORT 8
AIR PASSAGE SWITCHING UNIT
FIRST AIR PASSAGE 9 IS OPEN
SECOND AIR PASSAGE 11 IS OPEN
FIRST AIR PASSAGE 9 IS OPEN
AIR BLOWING FAN MOTOR
ROTATION SPEED IS LOW
ROTATION SPEED IS HIGH
ROTATION SPEED IS LOW
DRUM DRIVING MOTOR
DRUM ROTATION SEQUENCE 1
DRUM ROTATION SEQUENCE 2
DRUM ROTATION SEQUENCE 1
100
90
DRYING PERCENTAGE (%)
FIRST PREDETERMINED TIME
SECOND PREDETERMINED TIME
DRYING START PERIOD
DRYING MIDDLE PERIOD
DRYING END PERIOD

FIG. 4

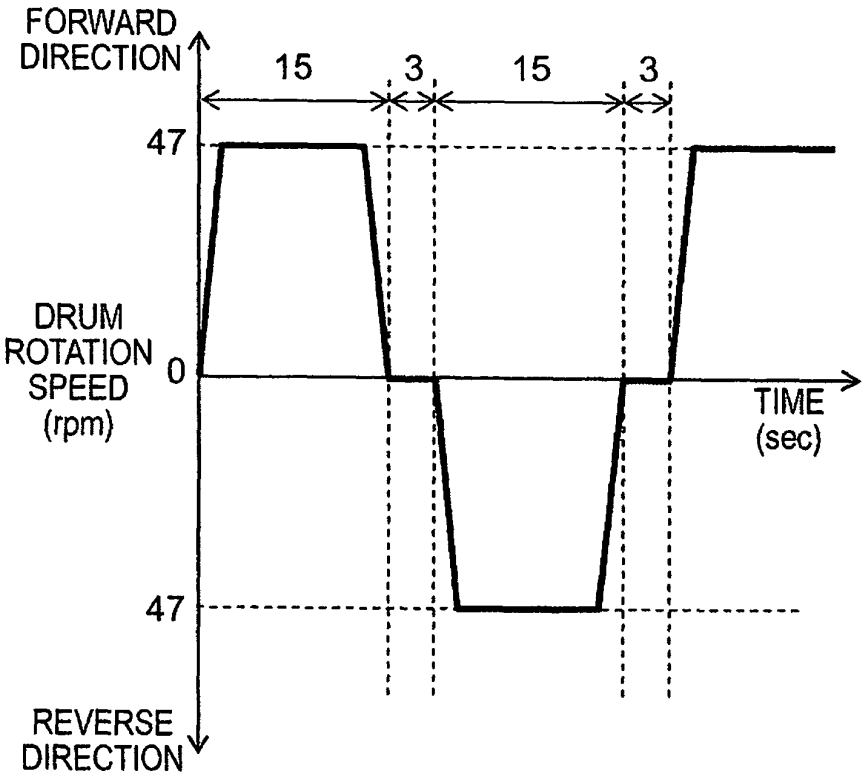

FORWARD DIRECTION
15
3
15
3
47
DRUM ROTATION SPEED (rpm)
0
TIME (sec)
47
REVERSE DIRECTION

FIG. 5

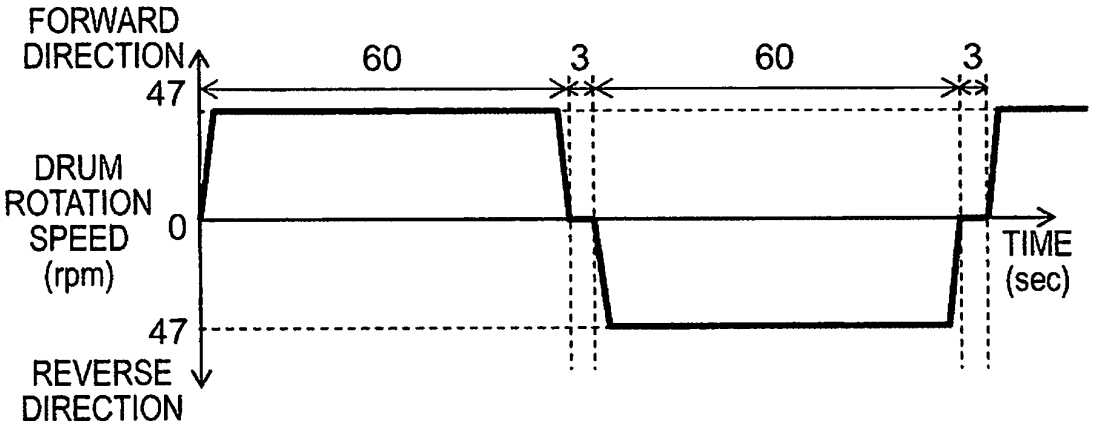
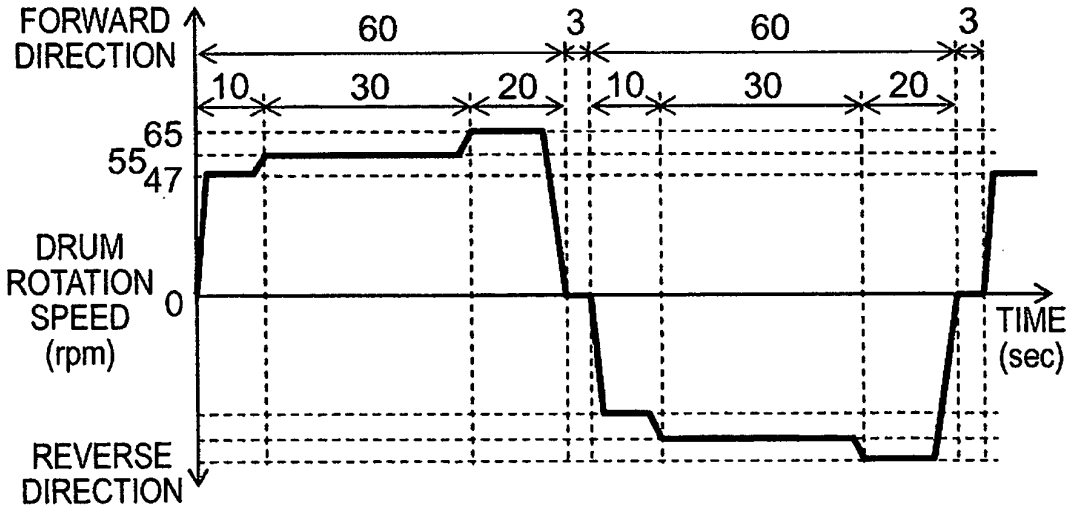

FORWARD DIRECTION
60
3
60
3
47
DRUM ROTATION SPEED (rpm)
0
TIME (sec)
47
REVERSE DIRECTION

FIG. 6


FORWARD DIRECTION
60
3
60
3
10
30
20
10
30
20
65
55
47
DRUM ROTATION SPEED (rpm)
0
TIME (sec)
REVERSE DIRECTION

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H07185196 B **[0004]**