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DRUM TYPE WASHING AND DRYING MACHINE

Field of the Invention

5 The present invention relates to a drum type washing and drying machine incorporating therein a rotary drum disposed in a water tub thereof such that its rotational axis is declined toward the rear portion of the washing machine.

10 Background of the Invention

 Referring to Fig. 8, there is shown a conventional drum type washing machine. As shown therein, housing 67 of the washing machine includes water tub 63, and rotary drum 61 is
15 disposed in water tub 63 such that the direction of its rotational axis is horizontally oriented. By opening door 64, which is installed at a front portion of housing 67, laundry is loaded into rotary drum 61 through laundry loading/unloading opening 68 formed in the front portion of water tub 63 to face
20 door 64. Then, when rotary drum 61 is driven to rotate by drum driving motor 65, the laundry articles in rotary drum 61 are lifted up by agitation blades 66 disposed on the inner cylindrical surface of rotary drum 61 and drop down upon reaching a specific height, thereby undergoing pounding motions
25 (see Japanese Patent Laid-Open Application No. 9-215894, pp. 2 to 6, Fig. 1).



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By adding a drying function to the drum type washing machine having the above-described configuration, a drum type washing and drying machine capable of drying laundry after completion of a water-extracting process or drying wet clothes without a particular process sequence can be realized. Specifically, by forming an air circulation channel for exhausting damp air in rotary drum 61 disposed in water tub 63 through drum perforations 62 disposed on the inner cylindrical surface of rotary drum 61, running thus exhausted damp air through a dehumidification unit to thereby dehumidify the damp air, heating thus dehumidified air by a heating unit and recirculating thus heated air back into water tub 63, the washing machine can also have the function of drying laundry accommodated in rotary drum 61.

Since, however, the conventional drum type washing machine or drum type washing and drying machine employs a structure of disposing the rotary drum horizontally and carrying laundry into and out of the rotary drum through an opening provided in the front surface of the washing machine, the user has to bend down to load and unload laundry articles; this is not only inconvenient but also unsuitable for a small place. To solve the problems, it has been suggested to have the rotational axis of the rotary drum slanted, while raising the opening of the rotary drum, to thereby facilitate loading and unloading of laundry and the installation of the drum type washing and drying machine in a small space (see Japanese

Patent Laid-Open Application No. 2003-053087, pp. 3 to 5, Fig. 2).

With regard to the conventional drum type washing and drying machine, however, there is no option offered for washing or drying course specifically adequate for an innerwear that is most frequently used in everyday life. Thus, since an innerwear has to be washed or dried in an operation course generally set as a standard course, it frequently happens that various types of laundry are mixed with the innerwear in the rotary drum, thereby making it difficult to perform an optimum washing or drying process for the mostly cotton-made innerwear.

Further, if the rotary drum is slanted with respect to the horizontal direction, an innerwear laundry including many items, each having a small volume, tends to pile up at the lower portion of the rotary drum. This tendency of laundry to pile up in the lower area is further augmented by the rotation of the rotary drum. As a result, it has been difficult to satisfactorily wash and dry each every laundry item.

Summary of the Invention

It is, therefore, an object of the present invention to provide a drum type washing and drying machine which provides an option for an innerwear washing and/or drying course for performing an operation control adequate specifically for the washing or the drying of an innerwear in a slanted rotary drum.

In accordance with a first preferred embodiment of the present invention, there is provided a drum type washing and drying machine including: a water tub having a rear portion and a front portion; a cylindrical rotary drum having a bottom surface and an opening and disposed in the water tub such that a rotational axis thereof is slanted toward the rear portion of the water tub opposite to the front portion where the opening of the rotary drum is formed; a drum driving motor for rotating the rotary drum; and an input setting unit for setting operation courses of the machine, the input setting unit including an innerwear washing and/or drying course in which an operation control for the washing and/or the drying of innerwear is automatically performed, wherein the washing and drying machine performs washing, rinsing and water-extracting processes by controlling water supply into and drain out of the water tub and by controlling the rotation of the drum driving motor, and a drying process by controlling an air circulation and the rotation of the drum driving motor such that damp air in the rotary drum is discharged and returned to the rotary drum after being dehumidified and heated.

In the above configuration, since the innerwear washing and/or drying course adequate specially for an innerwear that is most frequently used in everyday life is provided as an operation course of the drum type washing and drying machine, cleaning efficiency of a mostly cotton-made innerwear can be improved, and efficient washing and/or drying operation can be

performed without suffering from the problem that an innerwear laundry including many items, each having a small volume, is piled up at the lower rear portion of the rotary drum.

In accordance with a second preferred embodiment of the present invention, there is provided a drum type washing and drying machine including: a water tub having a rear portion and a front portion; a cylindrical rotary drum having a bottom surface and an opening and disposed in the water tub such that a rotational axis thereof is slanted toward the rear portion of the water tub opposite to the front portion where the opening of the rotary drum is formed; a drum driving motor for rotating the rotary drum; and an input setting unit for setting operation courses of the machine, the input setting unit including an innerwear washing and/or drying course in which an operation control for the washing and/or the drying of the innerwear is automatically performed, wherein the washing and drying machine performs washing, rinsing and water-extracting processes by controlling water supply into and drain out of the water tub and by controlling the rotation of the drum driving motor, and a drying process by controlling an air circulation and the rotation of the drum driving motor such that damp air in the rotary drum is discharged and returned to the rotary drum after being dehumidified and heated, the innerwear drying process of having at least a reference drying control process for controlling the rotation of the drum driving motor such that a plurality of rotation control modes are repeated for

predetermined time periods, respectively, the respective rotation control modes having a different rotational speed of the rotary drum capable of producing different displacement movements of laundry articles in the rotary drum by the rotation of the rotary drum, and each rotation control mode having a rotating period and an idle period of the rotary drum for each rotational direction for each rotational speed.

In case of washing an innerwear laundry including a relatively large number of items, each having a small volume, in a rotary drum which is slanted, the laundry articles tend to pile up in a lower rear portion of the rotary drum. Therefore, in the above configuration, by performing a rotation control such that the laundry articles are dispersed uniformly in the wider range of areas of the rotary drum and can change their positions therein, the problem of the laundry's being piled up at the lower rear portion of the rotary drum can be solved, and warm air is allowed to be blown to every part of the laundry articles uniformly. Thus, non-uniform drying performance can be prevented, thereby achieving a high efficient drying operation.

In the above configuration, in addition to the reference drying control process, an initial drying control process can be provided for controlling the rotation of the drum driving motor such that multiple rotation control modes are repeated for a predetermined time period, in the initial stage of the drying process. As a result, an agitation control adequate for

laundry with high water content can be carried out.

Further, in addition to the reference drying control process, it is also possible to set an initial drying control process for controlling the rotation of the drum driving motor such that multiple rotation control modes are repeated for a predetermined time period in the initial stage of the drying process and to set a final drying control process for controlling the rotation of the drum driving motor such that multiple rotation control modes are repeated for a preset time period, for controlling the heating of circulation air in the final stage of the drying process. As a result of combining the initial and final control process, a drying operation and an agitation control can be performed based on the degree of dryness of laundry.

Further, since the dryness of laundry can be estimated from elapsed time of the drying process, the transition from the initial drying control process to the reference drying control process and to the final drying control process can be controlled based on the elapsed time of the drying process. As a result, the control scheme can be simplified.

Furthermore, by controlling the transition from the initial drying control process to the reference drying control process and to the final drying control process based on the degree of the dryness of laundry, a control corresponding to the detected dryness of laundry can be performed.

Brief Description of the Drawings

The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawing, in which:

Fig. 1 is a cross sectional view illustrating the configuration of main components of a drum type washing and drying machine in accordance with a preferred embodiment of the present invention;

Fig. 2 shows a perspective view illustrating an external appearance of the drum type washing and drying machine in accordance with the preferred embodiment of the present invention;

Fig. 3 presents a cross sectional view illustrating a drying process and relevant components of the drum type washing and drying machine in accordance with the preferred embodiment of the present invention;

Fig. 4 sets forth a plan view of a heating duct which is one of the components used in the drying function;

Fig. 5 offers a plan view illustrating a configuration of a console;

Fig. 6 depicts a block diagram illustrating a configuration of a controller;

Figs. 7A to 7C are a flow chart that describes a rotation control sequence during a drying process; and

Fig. 8 is a cross sectional view for a configuration of a conventional drum type washing and drying machine.

Detailed Description of the Preferred Embodiments

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With reference to Fig. 1, there is described a configuration of major components of drum type washing and drying machine 1 in accordance with a preferred embodiment of the present invention. Housing 2 has therein water tub 3 supported on a suspension structure (not shown), and cylindrical rotary drum 5 having a bottom surface is disposed in water tub 3. Specifically, water tub 3 and rotary drum 5 are disposed such that their openings are positioned at a front portion of housing 2 while the bottom surfaces of water tub 3 and rotary drum 5 are disposed at a rear portion of housing 2. Further, rotary drum 5 is slanted such that its rotational axis R is declined toward the rear portion of housing 2 at a specific angle θ with respect to the horizontal direction H. Rotary drum 5 is driven to rotate by drum driving motor 4 installed at the rear portion of water tub 3.

Water tub 3 includes cylindrical main body 3a having a bottom surface and lid 3b connected to main body 3a, wherein lid 3b of water tub 3 extends in the negative radial direction (i.e., toward the center) to provide laundry loading/unloading opening 11 through which laundry is loaded into or unloaded from rotary drum 5. Further, door 8 is installed at inclined

surface 2a formed at a front surface portion of housing 2 such that it faces laundry loading/unloading opening 11. Laundry can be loaded into or unloaded from rotary drum 5 after door 8 is opened. Further, by forming door 8 partially or entirely with a transparent material, the inside of rotary drum 5 can be viewed from outside. Moreover, bellows 13, which is made of a flexible elastic body, is disposed around laundry loading/unloading opening 11. Accordingly, when door 8 is closed, the inner surface of door 8 makes a pressurized contact with an end of bellows 13, to thereby prevent splashed water by the rotation of rotary drum 5 from running over water tub 3.

As described above, by having rotary drum 5 slanted and installing door 8 on housing 2 to face the opening of rotary drum 5, door 8 is raised to face a user's face when a user stands in front of drum type washing and drying machine 1, and loading and unloading of laundry can be performed without the user having to bend down. Further, installation of drum type washing and drying machine 1 in a small space, e.g., bathroom, where a conventional vertical washing machine is typically installed, becomes easier because having a clearance space in front of washing machine 1 is no longer required. Therefore, drum type washing and drying machine 1 can be configured to be suitable for even a small house with limited space.

With regard to the location of laundry loading/unloading opening 11, it is formed such that its center lies above the rotational axis of rotary drum 5. Further, door 8 is disposed

to be substantially concentric with laundry loading/unloading opening 11. Since there is an optimum diameter of door 8 with respect to, e.g., an installation space of washing and drying machine 1, the diameter of door 8 is smaller than that of the rotary drum opening. Further, since the size of laundry loading/unloading opening 11 is determined based on the diameter of door 8, the diameter of laundry loading/unloading opening 11 is also formed to be smaller than that of the rotary drum opening. If laundry loading/unloading opening 11 and door 8 are disposed such that their centers are positioned above the rotational axis of rotary drum 5 as described, the blind spot area is made smaller when the inside of rotary drum 5 is looked into through laundry loading/unloading opening 11 after opening door 8. Thus, laundry accommodated in rotary drum 5 can be observed without being hidden from view. Therefore, it is highly unlikely that a user fails to take out any laundry article inside rotary drum 5. Particularly, by slanting rotary drum 5 and installing door 8 at inclined surface 2a formed to correspond to the angle of inclination of rotary drum 5 as in drum type washing and drying machine 1 in accordance with the preferred embodiment of the present invention, the inside of rotary drum 5 can be viewed more extensively.

Inventors of the present invention have conducted extensive research to find an optimum angle θ of inclination of rotary drum 5, and it has been found that the preferable angle is about 30 ± 5 degrees. By slanting rotary drum 5 at the

angle θ of about 30 ± 5 degrees, any user, i.e., a minor (not an infant), an adult, or a handicapped person using a wheelchair, can load and unload laundry conveniently regardless of their height. Further, by disposing laundry loading/unloading opening 11 and door 8 such that their centers are positioned above the rotational axis of rotary drum 5 while having rotary drum 5 slanted, loading/unloading of laundry becomes easier, and a user can easily inspect each washing operation step through transparent door 8.

However, when the diameter of laundry loading/unloading opening 11 is smaller than that of the opening of rotary drum 5 and laundry loading/unloading opening 11 is off-centered from the rotational axis of rotary drum 5, the lower portion of lid 3b of water tub 3 extends inward beyond the open end of rotary drum 5 to overlap with the rotary drum opening. Thus, in case some of laundry articles are bounced out of the open end of rotary drum 5, they may get caught between rotary drum 5 and lid 3b as rotary drum 5 rotates.

In order to solve the problem, crescent-shaped laundry anti-trap protrusion 14 for preventing laundry from being trapped between rotary drum 5 and lid 3b is installed at a lower half portion of lid 3b, where lid 3b overlaps with the rotary drum opening, such that protrusion 14 projects out toward the inside of rotary drum 5. That is, laundry loading/unloading opening 11 is disposed such that its center lies above the center of rotary drum 5 and laundry anti-trap

protrusion 14 having its central axis below the central axis of rotary drum 5 is formed in crescent shape and projected toward the inside of rotary drum 5. By having laundry anti-trap protrusion 14, laundry articles are prevented from falling into the space between rotary drum 5 and lid 3b. As a result, the problem of laundry articles being trapped due to the off-centered arrangement of laundry loading/unloading opening 11 can be prevented.

As illustrated in Fig. 2, when door opening button 56 installed next to door 8 is pressed, door 8 is opened as shown by imaginary lines, and laundry can be loaded into rotary drum 5 through laundry loading/unloading opening 11. Then, when door 8 is closed and power-on button 58f on console 35, which is arranged above door 8 as shown in Fig. 5, is pressed, power is supplied to drum type washing and drying machine 1, rendering washing and drying machine 1 ready to start operating. By sequentially pressing course setting button 58i, an operation course such as "automatic course", "quick course" "personal course"... "innerwear course" can be selected and a selected operation course is displayed on course display unit 59e. When the personal course is selected, a washing time period, a rinsing time period, a water-extracting time period and a drying time period can be manually set from washing time setting button 58a, rinsing time setting button 58b, water-extracting time setting button 58c and drying time setting button 58d, respectively. However, in case an operation course

other than the personal course is selected, each operating time is automatically set based on the amount of laundry accommodated in rotary drum 5.

As described above, drum type washing and drying machine 1 in accordance with the preferred embodiment of the present invention provides an innerwear washing and/or drying course as an operation course. Thus, if the innerwear course is selected by means of course setting button 58i, a washing and/or a drying operation adequate for an innerwear that is most frequently used in everyday life can be performed.

Fig. 6 shows a configuration of control unit 40 installed in drum type washing and drying machine 1. Controller 41 with a microcomputer outputs a control command to power switching unit 42 by using a control program, wherein the control program stored in storage unit 45 corresponds to a setting input such as a selection of an operation course inputted from input setting unit 43 corresponding to each setting button prepared on console 35. Power switching unit 42 made up of switching devices such as Silicon Controlled Rectifier(SCR) on-off controls drum driving motor 4, water supply valve 50, water drain pump 49, blower 15, heater 20, water flow valve 53, and so forth, in response to the control command outputted from controller 41. Further, detection outputs from laundry amount detector 46, water level detector 47 and temperature detector 54 are inputted to controller 41.

When the innerwear course is selected from console 35 and

the operation of washing and drying machine 1 is started by pressing start button 58e, controller 41 drives drum driving motor 4 to thereby rotate rotary drum 5, and calculates the amount of laundry accommodated in rotary drum 5 from a load exerted on drum driving motor 4 by means of laundry amount detector 46. A detection output from laundry amount detector 46 is inputted to controller 41. Then, controller 41 opens water supply valve 50 and keeps on-operating water supply valve 50 until water is supplied in water tub 3 up to a water level corresponding to the laundry amount inputted from laundry amount detector 46. The water level that indicates amount of water supplied to water tub 3 is detected by water level detector 47, and a detection output from water level detector 47 is inputted to controller 41. When the innerwear course is selected, controller 41 controls water supply valve 50 such that water is supplied in water tub 3 up to a water level higher than that in the case of washing other types of laundry. When rotary drum 5 is slanted, supplied water is stored in the lower rear portion of rotary drum 5, so that the innerwear laundry including many items, each having a small volume, would be piled up at the lower rear portion of rotary drum 5. However, by setting the water level to be higher than that in an ordinary case, the innerwear laundry can be prevented from being piled up in the rear portion of rotary drum 5. If the water is supplied up to the preset level, controller 41 controls each part of washing and drying machine 1 to perform

washing, rinsing and water-extracting processes in sequence based on a washing time period, a rinsing time period and a water-extracting time period automatically set based on the laundry amount.

5 The drum type washing and drying machine 1 having the above configuration can be set to perform a drying process after the completion of the washing, the rinsing and the water extracting process in order to dry water-extracted laundry or set to perform a drying process without a particular sequence
10 in order to dry wet clothes, etc.

Figs. 3 and 4 illustrate a drying function provided by drum type washing and drying machine 1. Dehumidification duct 16 and air flow duct 18 are formed as one body on the peripheral surface of water tub 3. Further, as shown in Fig. 4,
15 air heating duct 19 is installed on the rear portion of water tub 3. By the rotation of blower 15 disposed in air heating duct 19, damp air in rotary drum 5 is blown into water tub 3 through drum perforations 12 formed on the peripheral surface thereof and is directed therefrom into dehumidification duct 16.
20 Disposed in dehumidification duct 16 is dehumidification unit 38 including heat exchanger 51 and water flow nozzle 52. When water flow valve 53 is opened, water is sprayed onto heat exchanger 51 via water flow nozzle 52, whereby heat exchanger 51 is cooled down. Thus, the damp air introduced into
25 dehumidification duct 16 via air outlet 21 is cooled by heat exchanger 51 and dehumidified as moisture contained therein is

condensed. Water used to cool heat exchanger 51 and produced from the condensation of moisture flows into water tub 3 as indicated by dashed arrows in Fig. 3 and is discharged externally via drain groove 10.

5 Since dehumidification duct 16 and air flow duct 18 are connected to each other via connection duct 32 at the front portion of water tub 3, the dehumidified air is directed to air heating duct 19 installed on the rear portion of water tub 3 through connection duct 32, dust trap filter 17 and air flow
10 duct 18, sequentially, as shown by solid arrows in Fig. 3.

 Air heating duct 19 includes lower piping 23 and upper piping 24 joined to each other. Fig. 4 shows the configuration of air heating duct 19 from which lower piping 23 is separated to illustrate the inside of air heating duct 19. Disposed in
15 air heating duct 19 is heater 20, and the dehumidified air blown through air flow duct 18 is heated by heater 20. Thus heated warm air at a preset temperature is blown into water tub 3 from air inlet 22 and is introduced into rotary drum 5 through air circulation holes 39 formed at the rear side of
20 rotary drum 5 along the circumference thereof. As a result, the moisture in laundry in rotary drum 5 is evaporated by the warm air, and drying of laundry is therefore facilitated. Then, damp air containing the moisture from the laundry is exhausted into dehumidification duct 16 again, and by repeating such air
25 circulation process which includes dehumidification and heating processes the laundry is dried.

When an input of selecting a drying process is provided from input setting unit 43, controller 41 on- operates blower 15 and heater 20 while concurrently transmitting a control command to power switching unit 42 to open water flow valve 53. As a result, blower 15 rotates, so that a drying operation for circulating air from water tub 3 to water tub 3 again through a dry air circulation path is executed.

Since rotary drum 5 is slanted in drum type washing and drying machine 1 as in the above configuration, an innerwear laundry including a large number of items, each having a small volume, would have a stronger tendency to be piled up at the lowest point, which is the lower rear portion of rotary drum 5, compared to other types of laundry, and this innerwear's tendency to be piled up in the rear area is further augmented by rotation of rotary drum 5. For this reason, it becomes impossible to change positions of laundry items in rotary drum 5 and to blow warm air to every part of laundry articles during drying process. However, in drum type washing and drying machine 1 in accordance with the preferred embodiment of the present invention, position changes of laundry items are realized by controlling the rotation of rotary drum 5, and such position changes are enhanced by a structure prepared in rotary drum 5, which will be described hereinbelow.

First, structurally, corner cover 31 is disposed around a corner portion of rotary drum 5 such that the inner cylindrical surface of rotary drum 5 to the rear surface thereof is

connected by a curved surface of corner cover 31, as shown in Fig. 1. Thus, since the corner portion of rotary drum 5 is formed as an arc-shaped surface by the presence of corner cover 31, laundry which is dropped from the upper portion of rotary drum 5 is transferred toward the rotary drum opening. Moreover, back filter 30 for preventing laundry from falling into water tub 3 through the plurality of air circulation holes 39 provided on a rear portion of rotary drum 5 is formed to have a spherical surface with a gentle arc. Back filter 30 serves to slide the laundry being agitated by the rotation of rotary drum 5 toward the front portion of rotary drum 5. Back filter 30 is provided with a multiplicity of densely arranged small holes that allow the warm air to be blown through air circulation holes 39 to enter rotary drum 5 easily. The surface of back filter 30 that faces the inside of rotary drum 5 is formed as a smoothing surface that is capable of facilitating the sliding of laundry. Although it is possible to form back filter 30 to have the smoothing surface by using a material such as metal or resin, it is more preferable to use a material having a small coefficient of friction or to use such a material after coating the surface thereof.

Further, for the purpose of preventing non-uniform drying, it has been suggested to control the rotation of rotary drum 5 such that laundry articles are dispersed while changing their positions in rotary drum 5, to thereby allow warm air to be blown to every part of laundry articles uniformly. As shown in

Figs. 7A to 7C, in executing the rotation control of rotary drum 5 during the drying process, a forward and a reverse rotation period for each of a plurality of rotational speeds and a rotation stopping period are set in respective rotation control modes, and the respective rotation control modes are performed in plural stages based on the progressive drying of laundry.

Figs. 7A to 7C describe a rotation control sequence of rotary drum 5 in accordance with the preferred embodiment of the present invention. After dividing the time period required for the drying process into three stages, a rotation control of rotary drum 5 is performed in each of the three stages in accordance with a preset rotation control mode. First, in an initial stage of the drying process, a first rotation control mode is executed as follows. A first rotational speed is set (S1), and rotary drum 5 is forwardly rotated at the first rotational speed for a first preset time period (for example, 2 seconds) (S2). Thereafter, the rotation of rotary drum 5 is stopped for a second preset time period (for example, 1 second) (S3). Subsequently, rotary drum 5 is reversibly rotated at the first rotational speed for the first preset time period (S4) and, then, the rotation of rotary drum 5 is stopped again for the second preset time period (S5). Such drum rotation control is repeated for a time period set for the first rotation control mode (for example, 10 minutes) (S6). For example, with regard to rotary drum 5 having a diameter of about 500 ± 50 mm,

if rotary drum 5 is rotated at the first rotational speed of, e.g., 90 rpm, the laundry articles are stuck to the inner cylindrical surface of rotary drum 5. Then, by reversing the rotational direction of rotary drum 5 in forward and reverse direction alternately with a pause, the laundry articles stuck on the inner cylindrical surface of rotary drum 5 get dispersed due to the impact of sudden reversal of rotational direction. As a result, reversing the rotation of rotary drum 5 is accompanied by rearrangement of the positions of laundry articles with respect to the rotational axis thereof, so that every part of laundry articles can be uniformly exposed to warm air blown thereto.

After the completion of the first rotation control mode, a second rotation control mode is performed, and a second rotational speed (for example, 20 rpm with regard to rotary drum 5 having a diameter of about 500 ± 50 mm) is set (S7). Then, rotary drum 5 is forwardly rotated at the second rotational speed for a third preset time period (for example, 0.7 second) (S8), and then is stopped for a fourth preset time period (for example, 0.7 second) (S9). Thereafter, rotary drum 5 is reversibly rotated at the second rotational speed for the third preset time period (S10), and then is stopped for the fourth preset time period (S11). Such drum rotation control is repeated for a time period set for the second rotation control mode (for example, 30 seconds) (S12). In the second rotation control mode, since the second rotational speed of rotary drum

5 is low, the effect of lifting up the laundry articles in the rotational direction of rotary drum 5 is not realized and the laundry articles remain at the lower portion of rotary drum 5. At this state, by reversing the rotational direction forwardly and reversibly for a short period of time, laundry's movement of rolling in the lower portion of rotary drum 5 while being agitated in left/right and to-and-fro direction and the positions of laundry articles are rearranged with respect to the rotational axis of rotary drum 5. As a result, every part of laundry articles is heated uniformly by the warm air blown from the lower rear portion of rotary drum 5.

In the initial stage of the drying process, the first rotation control mode and the second rotation control mode are repeated for a predetermined time period (for example, 60 minutes). After the lapse of the time period for the initial stage (S13), a reference stage is started.

In the reference stage of the drying process, a third rotation control mode is performed. First, a third rotational speed (for example, 80 rpm with regard to rotary drum 5 having a diameter of about 500 ± 50 mm) is set (S14). Then, rotary drum 5 is forwardly rotated at the third rotational speed for a first reference preset time period (for example, 2 seconds) (S15), and then is stopped for a second reference preset time period (for example, 1 second) (S16). Thereafter, rotary drum 5 is reversibly rotated at the first reference rotational speed for the first reference preset time period (S17), and then is

stopped again for the second reference preset time period (S18). Such drum rotation control is repeated for a time period set for the third rotation control mode (for example, 10 minutes) (S19). In the reference stage, since the dryness of laundry is progressively achieved compared to that in the initial stage and, thus, the laundry articles are lighter than in the initial stage, the effect of sticking the laundry articles to the inner cylindrical surface of rotary drum 5 can be realized even though the third rotational speed (80 rpm) is set to be lower than the first rotational speed (90 rpm) in order to prevent wrinkles of the laundry articles. If rotary drum 5 is rotated at the third rotational speed of 80 rpm, the laundry articles become stuck on the inner cylindrical surface of rotary drum 5. Then, by reversing the rotational direction of rotary drum 5 in forward and reverse direction alternately with a pause, the laundry articles stuck on the inner cylindrical surface of rotary drum 5 get dispersed due to the impact of sudden reversal of rotational direction. As a result, the positions of the laundry articles are rearranged in rotary drum 5 with respect to rotational axis of rotary drum 5, so that warm air can be blown to every part of the laundry articles, thereby promoting the drying of the laundry.

Thereafter, the above-described second rotation control mode is performed again. The second rotational speed is set (S20), and rotary drum 5 is forwardly rotated at the second rotational speed for the third preset time period (S21), and

then is stopped for the fourth preset time period (S22).
Thereafter, rotary drum 5 is reversibly rotated at the second
rotational speed for the third preset time period (S23), and
then is stopped for the fourth preset time period (S24). Such
5 drum rotation control is repeated for a time period set for the
second rotation control mode (for example, 30 seconds) (S25).
In the second rotation control mode, since the second
rotational speed of rotary drum 5 is low, the effect of lifting
up the laundry articles in the rotational direction of rotary
10 drum 5 is not realized. Instead, by reversing the rotational
direction forwardly and reversibly for the short period of time,
laundry's rolling movement in the lower portion of rotary drum
5 while being agitated in left/right and to-and-fro direction
and the positions of laundry articles are rearranged with
15 respect to the rotational axis of rotary drum 5. As a result,
every part of laundry articles is heated uniformly by the warm
air blown from the lower rear portion of rotary drum 5.

In the reference stage of the drying process, the third
rotation control mode and the second rotation control mode are
20 repeated for a predetermined time period (for example, 70
minutes). After the lapse of the time period for the reference
stage, the process proceeds to a finishing stage (S26).

In the finishing stage, heating of circulation air by
heater 20 is stopped, and the drying process of laundry is
25 performed by using circulation air until the temperature of the
laundry is reduced down to a certain level. The rotary drum

rotation control sequence of the finishing stage is identical to that of the reference stage, and description thereof will not be repeated.

Although the rotation control of rotary drum 5 is conducted by dividing the drying process into the three stages, it is also possible to conduct either a combination of the first rotation control mode and the second rotation control mode or a combination of the third rotation control mode and the second rotation control mode over the whole period of time for the drying process. Furthermore, it is also possible to divide the drying process into a reference stage and a finishing stage depending on whether warm air or cooled air is blown into rotary drum 5. In addition, although the transition from one stage to another is carried out on a time basis in the preferred embodiment of the present invention, it can be performed based on a detection of dryness of laundry.

In case of washing an innerwear laundry including a relatively large number of items, each having a small volume, in a rotary drum which is slanted to improve usability, the innerwear tends to pile up at the lower rear portion of the rotary drum. However, by providing an innerwear washing and/or drying course capable of solving such problem, the drum type washing and drying machine in accordance with the present invention can control the washing and/or the drying operations automatically so as to obtain optimum washing and/or drying results of the innerwear most frequently utilized in everyday

life.

While the invention has been shown and described with respect to the preferred embodiment of the present invention, it will be understood by those skilled in the art that various
5 changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.

What is claimed is:

1. A drum type washing and drying machine comprising:

a water tub having a rear portion and a front portion;

5 a cylindrical rotary drum having a bottom surface and an opening and disposed in the water tub such that a rotational axis thereof is slanted toward the rear portion of the water tub opposite to the front portion where the opening of the rotary drum is formed;

10 a drum driving motor for rotating the rotary drum; and

an input setting unit for setting operation courses of the machine, the input setting unit including an innerwear washing and/or drying course in which an operation control for the washing and/or the drying of innerwear is automatically
15 performed,

wherein the washing and drying machine performs washing, rinsing and water-extracting processes by controlling water supply into and drain out of the water tub and by controlling the rotation of the drum driving motor, and a drying process by
20 controlling an air circulation and the rotation of the drum driving motor such that damp air in the rotary drum is discharged and returned to the rotary drum after being dehumidified and heated.

25 2. The washing and drying machine of claim 1, wherein a supply of water is controlled during a washing process of the

innerwear course such that a water level in the water tub is higher than that in a case of washing other types of laundry.

3. A drum type washing and drying machine comprising:

5 a water tub having a rear portion and a front portion;

a cylindrical rotary drum having a bottom surface and an opening and disposed in the water tub such that a rotational axis thereof is slanted toward the rear portion of the water tub opposite to the front portion where the opening of the rotary drum is formed;

a drum driving motor for rotating the rotary drum; and

an input setting unit for setting operation courses of the machine, the input setting unit including an innerwear washing and/or drying course in which an operation control for the washing and/or the drying of the innerwear is automatically performed,

wherein the washing and drying machine performs washing, rinsing and water-extracting processes by controlling water supply into and drain out of the water tub and by controlling the rotation of the drum driving motor, and a drying process by controlling an air circulation and the rotation of the drum driving motor such that damp air in the rotary drum is discharged and returned to the rotary drum after being dehumidified and heated, the innerwear drying process of having at least a reference drying control process for controlling the rotation of the drum driving motor such that a plurality of

rotation control modes are repeated for predetermined time periods, respectively, the respective rotation control modes having a different rotational speed of the rotary drum capable of producing different displacement movements of laundry articles in the rotary drum by the rotation of the rotary drum, and each rotation control mode having a rotating period and an idle period of the rotary drum for each rotational direction for each rotational speed.

4. The washing and drying machine of claim 3, wherein the drying process further has an initial drying control process for controlling the rotation of the drum driving motor in an initial stage of the drying process, and wherein the drying control process has a plurality of rotation control modes which are repeatedly executed for preset time periods, respectively.

5. The washing and drying machine of claim 3, wherein the drying process further has at a final stage a final drying control process for a plural number of rotation control modes and for controlling the heating of circulation air, the plural number of rotation control modes being respectively repeated for predetermined time periods.

6. The washing and drying machine of claim 3, wherein the drying process further has at an initial stage an initial drying control process at which a plurality of rotation control

modes are repeated for preset time periods, respectively, and at a final stage a final drying control process for a plural number of rotation control modes and for controlling the heating of circulation air, the plural number of rotation control modes being respectively repeated for predetermined
5 time periods.

7. The washing and drying machine of any one of claims 3 to 6, wherein a transition from a certain drying control process
10 to a next drying control process is controlled based on elapsed time of the drying process.

8. The washing and drying machine of any one of claims 3 to 6, wherein a transition from a certain drying control process
15 to a next drying control process is controlled based on a detection of the degree of dryness of the laundry.