

DRUM TYPE WASHING MACHINE

Field of the Invention

5 The present invention relates to a drum type washing machine for washing laundry articles accommodated in a rotary drum by rotating the rotary drum installed in a water tub.

10 Background of the Invention

 During the wash cycle of a washing machine including a drum type washing machine, a water temperature is an important factor in achieving an optimum cleaning efficiency. By performing the wash cycle while maintaining
15 an optimum water temperature suitable for laundry article, at which the maximum cleaning power of a detergent is obtained, the optimum cleaning efficiency can be achieved. This is especially true when a detergent based on enzyme
20 action is used, an effectiveness of the enzyme is determined by the water temperature. And also, by intentionally increasing the water temperature, it is possible to sterilize laundry articles or get rid of harmful insects attached to the laundry articles, such as
25 ticks or the like.

 Among drum type washing machines equipped with a

structure for heating washing water mixed with a detergent up to a target level during the wash cycle, there is known a drum type washing machine capable of improving the cleaning efficiency thereof by heating supplied water with a heater and controlling the heating operation to maintain a water temperature at a required level using a detected water temperature, wherein the heater is installed inside a recess formed on a lower peripheral surface of a water tub for accommodating therein a rotary drum in approximately parallel with a peripheral surface of the water tub (see Japanese Patent Laid-open Application No. H10-263284).

In the conventional washing machines provided with a capability to heat the washing water as described above, steam is generated in the water tub during the heating thereof. In such a washing machine, since the water tub is tightly sealed by closing a front door of the washing machine, the generated steam increases an internal pressure of the water tub. In such a washing machine, however, there is a need to maintain the pressure inside the water tub at an atmospheric pressure level for an accurate detection of the supplied water level. Accordingly, an air duct has been conventionally provided to discharge the air inside the water tub, including the generated steam, to the outside. However, if the moist air is discharged to the outside, the generated steam in the moist air may get condensed into water and fall near a water exhaust opening where the moist

air comes in contact with the outside air, which is visually and functionally not preferable.

Summary of the Invention

5

Embodiments of the present invention seek to provide a drum type washing machine capable of maintaining a pressure inside a water tub at a constant level without discharging steam generated in the water tub to the outside.

10

In accordance with a first aspect of the present invention, there is provided a drum type washing machine comprising: a cylindrical rotary drum having a closed bottom; a cylindrical water tub having a closed bottom and accommodating therein the rotary drum; a detergent dispenser for loading therein a detergent, wherein a detergent-mixed water obtained by supplying water into the detergent dispenser is supplied into the water tub; and a heater for heating the detergent-mixed water up to a target temperature, the heater being installed in a washing water heating bath provided at a lower portion of the water tub, wherein near a path of the water supplied into the detergent dispenser, the detergent dispenser is provided with a condensing unit for condensing water from moist air drawn therethrough, and an opening of an air flow path communicating with the water tub is provided at an upstream side of the condensing unit, and wherein the condensing

15

20

25

unit has a bent passageway through which the moist air flows, and the moist air is cooled and the water is condensed therefrom while the moist air flows along the bent passageway.

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
5 with the accompanying drawings, in which:

Fig. 1 shows a cross sectional view illustrating a configuration of a drum type washing machine in accordance with a preferred embodiment of the present invention;

10 Fig. 2 describes a side view depicting a configuration of a detergent case in accordance with a preferred embodiment; and

Fig. 3 provides a top view showing an internal structure of a water injection cover.

15

Detailed Description of the Preferred Embodiment

Fig. 1 shows a cross sectional view illustrating a configuration of drum type washing machine 1 in accordance with a preferred embodiment of the present invention. Such
20 drum type washing machine 1 is configured to have an inclined drum type structure. To be more specific, rotary drum 5 and water tub 3 for accommodating therein rotary drum 5 are upwardly inclined at an angle of θ with respect to the
25 horizontal direction and disposed in housing 2 with their openings facing upward with respect to the horizontal

direction. Accordingly, laundry articles can be easily loaded into and unloaded from rotary drum 5 through door 8 provided on an upwardly inclined front surface of housing 2. Inventors of the present invention conducted extensive researches to find an optimum angle of inclination, θ , of rotary drum 5, and it was disclosed that it was preferable to be about 25 ± 5 degrees. By slanting rotary drum 5 at the angle θ of about 25 ± 5 degrees, any users, whether they are children (not infants), adults or disabled person using a wheelchair, can conveniently load and unload laundry articles by opening door 8 without having to bend down regardless of their height, making it possible to easily install this type of the washing machines in areas with limited spaces such as a bathroom or the likes.

Rotary drum 5 is installed in water tub 3 such that its opening is positioned at the front side of housing 2 while the bottom surface of rotary drum 5 is disposed at the rear side of housing 2. Further, rotary drum 5 is slanted such that rotation axis R thereof is declined toward the rear side of housing 2 at a specific angle θ . Rotational shaft 15 of rotary drum 5 is supported by bearing 16 provided on a rear surface of water tub 3 in such a way that it is allowed to rotate. Moreover, a belt driving structure is formed by installing driving belt 19 between idler pulley 18 provided on rotational shaft 15 and driving pulley 17 installed on a rotational driving shaft of drum driving

motor 4 adhered on a bottom surface of water tub 3, so that rotary drum 5 is driven to rotate by drum driving motor 4. Furthermore, rotary drum 5 is provided with a number of drum perforations 20 on its peripheral surface to allow water to circulate inside water tub 3. Agitation blades 21 provided on the inner peripheral surface of rotary drum 5 are designed to make the laundry articles undergo pounding motions by lifting up and dropping down the laundry articles with the rotation of rotary drum 5.

Water tub 3 having water tub main body 3a and water tub cover 3b, which are connected to each other, has a cylindrical shape having a bottom portion. Housing 2 incorporates therein water tub 3 installed via a suspension structure (not shown) such that water tub 3 is declined toward a rear portion thereof together with rotary drum 5 accommodated therein. Water tub 3 is made by molding resin for an easy installation and connection of various components as well as for a light weight. Laundry loading/unloading opening 6 is provided at a front portion of water tub 3, wherein center C thereof is upwardly eccentric with respect to an opening center of rotary drum 5 (corresponding to rotation axis R). Therefore, a center of door 8 approximately coincides with a central line of laundry loading/unloading opening 6. In this manner, in case center C of laundry loading/unloading opening 6 and that of door 8 are configured to be upwardly eccentric with

respect to rotation axis R of rotary drum 5, even though a diameter of circular door 8 or an opening diameter of laundry loading/unloading opening 6 are limited, a dead zone is reduced when a user looks into rotary drum 5 through laundry loading/unloading opening 6 after opening door 8. Accordingly, the user can see and take out all of the laundry articles accommodated in rotary drum 5. In case of a configuration in which rotary drum 5 is inclined and door 8 is disposed on a surface of housing 2 provided at an inclined angle of rotary drum 5 as in drum type washing machine 1 in accordance with the preferred embodiment, this is especially true, making it easy for the user to see an inner space of rotary drum 5.

However, in case an opening diameter of laundry loading/unloading opening 6 is smaller than that of rotary drum 5 and, also, center C of laundry loading/unloading opening 6 is upwardly eccentric from above rotation axis R of rotary drum 5, a lower portion of laundry loading/unloading opening 6 is overlapped with an opening end portion of rotary drum 5, as shown in Fig. 1. In such configuration, if some of laundry articles are out of rotary drum 5 through the opening thereof, the laundry articles out of rotary drum 5 may be trapped between rotary drum 5 and water tub 3 by the rotation of rotary drum 5. In order to prevent the laundry articles from being trapped, provided at the portion overlapped with the opening of rotary drum 5 is

loading/unloading opening frame body 14 having laundry anti-trap protrusion 13 protruded toward an inner portion of rotary drum 5, wherein loading/unloading opening frame body 14 covers a peripheral portion of laundry loading/unloading opening 6. Laundry anti-trap protrusion 13 is so formed as to increase a protruding amount of its lower portion largely overlapped with the opening of rotary drum 5. Further, due to laundry anti-trap protrusion 13 protruded from the opening of rotary drum 5 toward the inner portion of rotary drum 5, when the amount of laundry articles is substantial, the laundry articles can be prevented from being forced out of the opening during the rotation of rotary drum 5, which, in turn, prevent thereof from being trapped between rotary drum 5 and water tub 3.

Laundry anti-trap protrusion 13 tends to be in contact with the laundry articles agitated by rotary drum 5. Herein, since a contact resistance increases due to adherence of the laundry articles as a contact area with the laundry articles increases, contact friction between the laundry articles and laundry anti-trap protrusion 13 increases. As a result, a soft textile may be damaged by the repetitive contact frictions. To that end, as shown in the cross sectional view of Fig. 1, a surface of laundry anti-trap protrusion 13 has a radial shape without flat surface. Due to the radial shape of the surface of laundry anti-trap protrusion 13, the contact area with the laundry articles is reduced, thereby

suppressing damages inflicted on the laundry articles.
Furthermore, laundry anti-trap protrusion 13 may be provided
with a plurality of holes or recesses to reduce the contact
resistance as well as the contact area with the laundry
5 articles.

In drum type washing machine 1 in accordance with the
preferred embodiment, washing water heating bath 10 for
heating detergent-mixed water (the washing water being mixed
with the detergent) supplied into water tub 3 is installed
10 at a lowest portion of water tub 3 to thereby heat the
detergent-mixed water up to a temperature at which cleaning
efficiency can be optimized in terms of the types of laundry
articles being washed and cleaning power of the detergent.
Water drain outlet 22 is opened on a bottom surface of
15 washing water heating bath 10, and heater 11 for heating
water is disposed in washing water heating bath 10. Further,
washing water heating bath 10 has the approximately
horizontal bottom surface and is slightly inclined so that
water drain outlet 22 can be opened at a lowest portion.
20 Heater 11 is disposed in approximately parallel with the
bottom surface of washing water heating bath 10.

Washing water heating bath 10 has an inner wall
surface covered by heat protection plate 33 made of a thin
stainless steel. A leading end portion of heater 11 formed
25 to be bent is supported by heater protection fitting 34
attached to heat protection plate 33. Therefore, even in

case a temperature of heater 11 is abnormally increased by heater 11 being constantly powered on due to a breakdown or an control abnormality in absence of the washing water in washing water heating bath 10, the inner peripheral wall of washing water heating bath 10 is covered with heat protection plate 33, thereby preventing a high heat from being radiated to washing water heating bath 10 and causing a deformation or a melting thereof. Further, since upper and lower surfaces of a portion of heater 11 are covered by heater protection fitting 34, the portion being located above water drain outlet 22, heat radiation of heater 11 is not directly transferred, thereby preventing resin member of water drain outlet 22 and water drain pipe attached thereto from being detrimentally affected. Moreover, due to heater protection fitting 34, it is possible to prevent a radiant heat from heater 11, which is reflected by rotary drum 5 having a mirror surface, from affecting a portion of water tub 3, which is uncovered by heat protection plate 33.

For a drum type washing machine provided with a capability to heat washing water, steam is generated in water tub 3 by the heating. When door 8 is closed, water tub 3 is airtightly sealed by press-contacting bellows 12 provided at laundry loading/unloading opening 6 with door 8. Consequently, the generated steam increases a pressure inside water tub 3. However, the pressure change inside water tub 3 is not preferable, which will be described

hereinafter. To be more specific, a water level detector is provided to supply the proper amount of water for laundry articles accommodated in rotary drum 5 into water tub 3 with first and second water supply valves 29 and 30 to be described later. However, in case the water level is detected based on the pressure in water tub 3, the water level detection is hindered by the pressure variance according to the amount of water supplied into water tub 3. Accordingly, in drum type washing machine 1 in accordance with the preferred embodiment of the present invention, air in air trap 45 communicating with water drain outlet 22, the air being compressed according to a supplied water level, is guided to water level detector 46 through air pipe 47 and, then, water level detector 46 detects the supplied water level based on a pressure of the compressed air, requiring the pressure inside water tub 3 to be maintained at an atmospheric pressure, meaning that in case if pressure increases due to the steam generated by the heating, the pressure inside water tub 3 must be relieved by releasing the moist to the outside. However, when the steam is discharged to the outside, it is cooled and condensed by outside air, which is visually not preferable and may cause a malfunction. Therefore, as a means of relieving the pressure build-up inside water tub 3 due to steam, drum type washing machine 1 in accordance with the preferred embodiment is provided with an exhaust path and a structure

for condensing and collecting steam being discharged from water tub 3.

As illustrated in Fig. 1, one end of air exhaust pipe (air flow path) 48 is connected to an upper portion of water tub 3, whereas the other end thereof is connected with detergent dispenser 27. Fig. 2 presents a detailed configuration of detergent dispenser 27. To be more specific, detergent dispenser 27 includes detergent storage unit 61 and water injection cover 62 for covering an upper portion of detergent storage unit 61. Connected to a lower portion of detergent storage unit 61 is water supply pipe (water supply passageway) 7 connected to water tub 3. Provided at a side portion of detergent storage unit 61 is second water supply valve 30 for dispensing tap water supplied from water supplying port 26 while air exhaust pipe 48 is connected to water injection cover 62. Detergent storage unit 61 has an extractable/retractable container (not shown) at a front portion of housing 2. By inputting the required amount of detergent and supplementary washing aids such as fabric softner or the like into the extracted container and then pushing the extractable/retractable container into detergent storage unit 61, detergent or the supplementary washing aids can be set.

Hereinafter, an operation of drum type washing machine 1 configured as described above will be briefly explained. Further, a configuration and an operation for condensing the

steam generated in water tub 3 and then returning it to water tub 3 will be described. Herein, a series of operations from a wash cycle to a rinse cycle is automatically performed by inputting instructions to a manipulation/display panel provided on an upper front portion of housing 2 under the control of a controller (not shown).

After opening door 8 and loading laundry articles into rotary drum 5, a proper amount of detergent corresponding to the laundry article load is loaded into detergent dispenser 27. Once an operating start is manipulated on the manipulation/display panel, water drain valve 28 is closed, whereas first water supply valve 29 is opened to supply water. The supplied water is sprayed from shower nozzle 31 into rotary drum 5 to soak the laundry articles, allowing washing water containing dissolved detergent to be also soaked thereinto. Thereafter, second water supply valve 30 is opened. In this configuration, second water supply valve 30 includes detergent supply valve 30a for supplying water mixed with detergent into water tub 3 in starting the wash cycle and supplementary washing aid supply valve 30b for supplying supplementary washing aid mixed with water into water tub 3 after completing the wash cycle. When the wash cycle is started, detergent supply valve 30a is opened.

Fig. 3 illustrates an internal structure of water injection cover 62 of detergent dispenser 27. To be more

specific, with opening of detergent supply valve 30a, water supplied from water supplying port 26 enters water injection cover 62 through first inlet port 63. Next, water is injected in a shower-like pattern into detergent storage unit 61 through a plurality of water injection holes 65 provided at path 64 for diverging water to a plurality of branch lines. Thereafter, the injected water is mixed with the detergent-mixed water loaded into detergent storage unit 61 to pass along water supply pipe 7 connected to a bottom portion thereof and then supplied into water tub 3 through water inlet 9.

Since water inlet 9 is provided near an upper rear surface of water tub 3 and water tub 3 is inclined, the detergent-mixed water falls along the rear surface of water tub 3 and then enters washing water heating bath 10 from a lowest portion thereof. As described above, washing water heating bath 10 has an approximately horizontal bottom surface and is inclined at a slight angle (e.g., 2 to 3 degrees) toward an opening position of water drain opening 22. Accordingly, the detergent in the detergent-mixed water injected into washing water heating bath 10 remains on a bottom surface thereof as a consequence of a friction resistance with the bottom surface, whereas the water is exclusively injected into water drain opening 22. At this time, since water drain valve 28 is closed, water drain opening 22 is quickly filled with water so that detergent is

collected on the bottom of washing water heating bath 10. Further, since the detergent-mixed water is supplied by first water supply valve 29 up to a level corresponding to the laundry article load in water tub 3, the detergent becomes soluble in water when the detergent-mixed water is heated by heater 11 up to a predetermined temperature.

Next, once rotary drum 5 is driven to rotate by drum driving motor 4, an intensive water flow generated in water tub 3 forms a vortex and, thus, water is mixed with detergent in washing water heating bath 10. Further, due to the interaction with the heating operation of heater 11, it is possible to obtain the washing water with detergent sufficiently dissolved therein. The washing water enters rotary drum 5 through drum perforations 20, allowing it to effectively penetrate and get absorbed by the laundry articles soaked with water. Agitation blades 21 provided on the inner peripheral surface of rotary drum 5 make the laundry articles undergo pounding motion by lifting up and dropping down the laundry articles with the rotation of rotary drum 5. Accordingly, the laundry articles are agitated by the repetitive pounding motions, resulting in the effective washing operation. Although an opening of rotary drum 5 and laundry loading/unloading opening of water tub 3 are provided, as a consequence of bellows 12 attached to loading/unloading opening frame body 14 getting firmly adhered to an inner portion of door 8 when door 8 is closed,

the washing water is prevented from being splattered to outside.

When the washing water is heated by heater 11, steam is generated in water tub 3, increasing an internal pressure of water tub 3 and to relieve the pressure, it is introduced
5 into water injection cover 62 through air exhaust pipe 48. As depicted in Fig. 3, the introduced steam flows from steam inlet opening 66 connected to the other end of air exhaust pipe 48 toward cooling unit (condensing unit) 67 for
10 allowing the steam to flow along a bent passageway, cooling unit 67 being provided near water injection path 64. Further, cooling unit 67 is configured to have a bent passageway where a plurality of wall portions 67a are protruded from both side walls of a passageway extending
15 from steam inlet opening 66 to collection port 68 communicating with an inner bottom portion of detergent storage unit 61. Since water injection cover 62 is cooled by the water flowing on an entire surface thereof while water is supplied, the steam introduced from steam inlet
20 opening 66 is cooled and condensed while flowing along the bent passageway of cooling unit 67 as indicated by an arrow. The condensed air is discharged into detergent storage unit 61 through collection port 68. Further, the condensed water falls from collection port 68 into detergent storage unit 61
25 to return to water tub 3 through water supply pipe 7. In this manner, in case the steam generated by heating the

washing water increases the internal pressure of water tub 3, the steam is discharged to detergent dispenser 27 and then returned to water tub 3 as condensed water. Accordingly, the pressure inside water tub 3 is uniformly maintained without steam being discharged to the outside. Moreover, since trap 7a formed by bending a passageway in a U-shape is formed at water inlet 9 of water supply pipe 7, water collected in trap 7a prevents the steam generated in water tub 3 from being introduced into detergent storage unit 61 through water supply pipe 7 instead of air exhaust pipe 48.

In using supplementary washing aids, e.g., treating the laundry articles with a fabric softener, the supplementary washing aid is inputted into a supplementary washing aid accommodating space separately provided from a detergent accommodating space in the extractable/retractable container. Then, if a cycle for treating the laundry articles with the fabric softner is selected on the manipulation/display panel, after the wash cycle is completed, supplementary washing aid supply valve 30b is opened so that water containing the supplementary washing aid is supplied into water tub 3. Once supplementary washing aid supply valve 30b is opened, water supplied from water supplying port 26 is introduced into water injection cover 62 through second inlet port 69, as shown in Fig. 3. Thereafter, the water flows along water injection path 70 for the supplementary washing aid to be injected into

detergent storage unit 61 through water injection hole 71. Then, the water is mixed with the fabric softener and then supplied into water tub 3 through water supply pipe 7.

After the wash cycle is completed, dirty washing water is discharged to the outside by opening water drain valve 28. Further, by performing a water-extraction cycle for rotating rotary drum 5 at a high speed, the washing water remaining in the laundry articles is discharged into water tub 3 through drum perforations 20 to be discharged to the outside. After the water-extraction cycle is completed, water is supplied into water tub 3 by opening first and second water supply valves 29 and 30. By repeating a rinse cycle and the water-extraction cycle for specific number of times, the washing water remaining in the laundry articles is removed. By performing the water-extraction cycle at the end, the laundry articles become almost free of water and washing is completed. Finally, after opening door 8, the laundry articles are unloaded.

As in the aforementioned configuration, if rotary drum 5 is inclined, it is easy to load and unload the laundry articles into and from rotary drum 5. Further, water supplied into rotary drum 5 is collected on a rear portion thereof, allowing water to be effectively utilized, making it possible to effectively wash a relatively large laundry article load with an amount of water which is less than the amount required in a washing machine having a rotary drum

not inclined. On the other hand, since the laundry articles accommodated in rotary drum 5 are collected on the lowest bottom portion thereof, the rotation of rotary drum 5 forces the laundry articles to be collected on the bottom portion thereof. However, drum type washing machine 1 in accordance with the preferred embodiment is configured to change positions of the laundry articles in rotary drum 5 by controlling a rotation operation of rotary drum 5 with drum driving motor 4. Moreover, the shape of agitation blades 21 is configured to change the positions of the laundry articles forwardly and backwardly with the rotation of rotary drum 5. With such configuration, the laundry articles are forced to undergo positional changes continuously while being washed, allowing the washing water including the detergent to thoroughly penetrate the laundry articles, increasing the cleaning efficiency.

Although the aforementioned preferred embodiment illustrates an example drum type washing machine 1 having inclined rotary drum 5, the present invention can be applied to a general configuration in which rotary drum 5 is disposed in a horizontal direction.

In accordance with the present invention, in a drum type washing machine having a function for heating washing water to a target temperature, since steam generated in a water tub is condensed and then returned to the water tub, the pressure inside the water tube is not increased thereby.

Moreover, since the steam is not discharged to the outside, the steam does not get condensed on a surface of the washing machine, making it possible to avoid various detrimental effects caused thereby.

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

What is claimed is:

1. A drum type washing machine comprising:

a cylindrical rotary drum having a closed bottom;

a cylindrical water tub having a closed bottom and accommodating therein the rotary drum;

a detergent dispenser for loading therein a detergent, wherein a detergent-mixed water obtained by supplying water into the detergent dispenser is supplied into the water tub; and

a heater for heating the detergent-mixed water up to a target temperature, the heater being installed in a washing water heating bath provided at a lower portion of the water tub,

wherein near a path of the water supplied into the detergent dispenser, the detergent dispenser is provided with a condensing unit for condensing water from moist air drawn therethrough, and an opening of an air flow path communicating with the water tub is provided at an upstream side of the condensing unit, and

wherein the condensing unit has a bent passageway through which the moist air flows, and the moist air is cooled and the water is condensed therefrom while the moist air flows along the bent passageway.

2. The drum type washing machine of claim 1, wherein the path of the water supplied into the detergent dispenser is formed in a cover of the detergent dispenser.

3. The drum type washing machine of claim 1 or 2, wherein a trap is formed in a water supply pipe extending from the detergent dispenser to the water tub.

4. The drum type washing machine of claim 2, wherein the condensing unit is formed in the cover of the detergent dispenser.

5. The drum type washing machine of any one of claims 1 to 4, wherein the moist air flowing through the condensing unit is not in direct contact with the water supplied into the detergent dispenser.

6. The drum type washing machine of any one of claims 1 to 5, wherein the bent passageway is cooled by the water supplied into the detergent dispenser and the moist air is cooled to condense the water therefrom while flowing through the cooled bent passageway without being in direct contact with the water supplied into the detergent dispenser.