A washing machine and washing method therefor are provided. In the washing method, in which a drum of a drum type washing machine is rotated in a first direction, the method includes applying a first directional torque to the drum so that laundry in the drum is rotated and lifted; braking the drum so that the laundry is dropped; and then again applying the first directional torque to the drum so that the dropped laundry is rotated and lifted again.
Fig. 4
WASHING MACHINE AND WASHING METHOD THEREFOR

[0001] This application claims the benefit of Korean Patent Application No. 10-2008-0075673, filed on Aug. 1, 2008, and No. 10-2008-0090212, filed on Sep. 12, 2008, which are hereby incorporated by reference for all purposes as if fully set forth herein.

BACKGROUND

[0002] 1. Field
[0003] A washing machine and a washing method therefor are disclosed herein.
[0004] 2. Background
[0005] Washing machines and washing methods are known. However, they suffer from various disadvantages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Embodiments will be described in detail with reference to the following drawings in which like reference numerals refer to like elements, and wherein:
[0007] FIG. 1 is a front perspective view of a washing machine in accordance with an embodiment;
[0008] FIG. 2 is a schematic diagram illustrating a washing method in accordance with an embodiment;
[0009] FIG. 3 is a diagram illustrating negative-phase braking in a washing method in accordance with an embodiment;
[0010] FIG. 4 is a diagram illustrating dynamic braking in a washing method in accordance with an embodiment; and
[0011] FIGS. 5A-5D are diagrams showing various motions created in a washing machine in accordance with an embodiment.

DETAILED DESCRIPTION

[0012] Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings. Throughout the drawings, like elements are indicated using the same or similar reference numerals where possible.

[0013] In general, a washing machine is a machine that removes dirt from items, such as clothing, bedding, etc. (hereafter referred to as “laundry”) through washing, rinsing, and dehydrating cycles using a fluid, such as water, detergent, and mechanical operations. Washing machines are generally classified into an agitator type, a pulsator type, and a drum type washing machine.

[0014] The agitator type washing machine washes laundry by rotating a washing rod protruding from a center of a washing tub in left and right directions. The pulsator type washing machine washes laundry using frictional force generated between a fluid current and laundry by rotating a disk-shaped pulsator formed at a bottom of the washing tub in right and left directions. The drum type washing machine washes laundry by introducing a fluid, such as water, detergent, and laundry into a drum and rotating the drum.

[0015] The drum type washing machine may include a tub that contains wash fluid disposed within a cabinet forming an external appearance of the washing machine, a drum that accommodates laundry disposed within the tub, a motor that rotates the drum disposed at a rear side of the tub, and a drive shaft that extends from the motor to pass through the tub connected to a rear side of the drum. A lifter may be disposed within the drum to lift laundry during rotation of the drum.

[0016] The drum type washing machine washes laundry in such a manner that the laundry is lifted by the lifter disposed within the drum, stuck to the drum during rotation of the drum, and then tumbled. However, a variety of washing methods may be required to improve the washing performance, in addition to the tumbling motion.

[0017] FIG. 1 is a front perspective view of a washing machine in accordance with an embodiment. The washing machine 100 of FIG. 1 may include a cabinet 110 that forms an external appearance of the washing machine, a tub 120 disposed within the cabinet 110 and supported thereby, a drum 130 rotatably disposed within the tub 120 configured to accommodate laundry to be washed, a driving device 140 that rotates the drum 122 by applying torque thereto, and a controller 115 that controls the driving device 140.

[0018] The cabinet 110 may include a cabinet main body 111, a cabinet cover 112 disposed on a front side of the cabinet main body 111 and connected thereto, and a top plate 116 connected to the cabinet main body 111. The cabinet cover 112 may include a laundry inlet/outlet hole 114 formed to receive the laundry therethrough, and a door 113 disposed to rotate so that the laundry inlet/outlet hole 114 may be opened and closed.

[0019] The tub 120 may be disposed within the cabinet 110 so as to be buffered by a spring (not shown) and a damper (not shown). The tub 120 may contain a wash fluid, such as water, during washing. The drum 130 may be rotatably disposed within the tub 120.

[0020] The drum 130 may include a plurality of holes through which the wash fluid may pass. A lifter 135 that lifts laundry to a predetermined height during rotation of the drum 130 may be disposed within the drum 130. The drum 130 may be rotated by the driving device 140.

[0021] The driving device 140 may apply torque to the drum 130. Further, the driving device 140 may apply a forward or reverse torque to the drum 130 to rotate the drum in a first or second direction, respectively. For example, the first direction may be a forward or clockwise (CC) direction and the second direction may be a reverse or counterclockwise (CCW) direction. The driving device 140 may include a motor and a rotation shaft.

[0022] The controller 115 may control the driving device 140 to provide various motions to the drum 130, as will be described later with respect to FIG. 5.

[0023] FIG. 2 is a schematic diagram illustrating a washing method in accordance with an embodiment. When the driving device 140 applies a first directional torque to the drum 130, the drum 130 may be rotated in a first direction, and thus, the laundry may be rotated and lifted, in step S210. The first directional torque may be an axial torque, and the second direction may be a forward or CW direction. When the driving device 140 applies the first directional torque to the drum 130 where laundry is placed at a bottom thereof, the drum 130 may be rotated in the first direction. When the drum 130 is rotated in the first direction, the laundry may be lifted by the lifter 135 and rotated in the first direction. The drum 130 may be rotated at about 60 rpm, which is over 1G, so that the laundry is rotated, sticking to the drum 130 during rotation of the drum 130.

[0024] When the laundry is lifted to a maximum height greater than half a height of the drum 130, the driving device 140 may brake the drum 130 to reduce the rotational speed of
the drum 130, in step S220. When the laundry is lifted above approximately 165° as the drum 130 is rotated in the first direction, the driving device 140 may brake the drum 130. The driving device 140 may brake the drum 130 by negative-phase or dynamic braking. The negative-phase or dynamic braking will be described in detail later with reference to FIGS. 3 and 4.

While the rotational speed of the drum 130 is reduced as the driving device 140 brakes the drum 130, the laundry may be dropped, in step S230. The laundry may be dropped at an angle of about 180° to maximize an amount of impact. Moreover, the rotational speed of the drum 130 may be reduced and then the rotation of the drum 130 may be temporarily stopped while the laundry is dropped. At least a portion of the laundry may be dropped, passing through a center line of the drum 130.

After the drum is dropped, the driving device 140 may again apply the first directional torque to the drum 130 to rotate the drum 130 in the first direction, and thus the dropped laundry may be rotated and lifted again, in step S240. When the laundry is dropped, the driving device 140 may again apply the first directional torque to the drum 130 to rotate the drum 130 again in the first direction. Then, the laundry is lifted by the lifter 135 and rotated in the first direction. The drum 130 may be rotated at about 60 rpm, which is over 1G, so that the laundry may be rotated, sticking to the drum 130 during rotation of the drum 130.

In step S210, step S240 may be performed while the drum 130 rotates in the first direction once. Step S220 may be performed and repeated after step S240, or the first directional torque may be continuously applied.

FIG. 3 is a diagram illustrating negative-phase braking in a washing method in accordance with an embodiment. The negative-phase braking is configured to drive and stop a motor so that torque is generated in a direction opposite to the direction in which the motor rotates.

A power supply device 340 may supply input AC power, for example, AC 220V, rectified by a bridge diode (not shown) and smoothed by a smoothing capacitor (not shown). A DC voltage device 350 may store a DC voltage by charging a capacitor with a voltage supplied from the power supply device 340, and the stored DC voltage may be used to drive a motor 381.

During negative-phase braking, the DC voltage device 350 may apply a voltage having a magnitude corresponding to the speed of the motor 381 to a braking device 360. The braking device 360 may convert the voltage output from the DC voltage device 350 into a reverse voltage having a phase shifted by approximately 180° from that of the voltage being used to drive the motor 381 and supply the same to the motor 381.

FIG. 4 is a diagram illustrating dynamic braking in a washing method in accordance with an embodiment. The dynamic braking is configured to stop a motor by forming a closed circuit in the motor so that an electromotive force generated in the closed circuit is consumed by a resistor.

Referring to FIG. 4, a braking device 460 may include three phases (T1 and T2, T3 and T4, and T5 and T6) connected in parallel, in which each phase may include two switching elements 465, such as a transistor or IGBT, connected in series. During dynamic braking, the braking device 460 may turn on lower switching elements T2, T4, and T6 among the switching elements 465 constituting the braking device 460 and turn off upper switching elements T1, T3, and T5. Thus, a DC voltage device 450 and a motor 481 may be disconnected, and a coil 485, a resistor 487, and the lower switching elements T2, T4, and T6 may form a closed circuit. The motor 481 rotated by an applied voltage may function as an electric generator, and thus, a counter electromotive force may be generated in the coil 485. The generated counter electromotive force may be consumed by the resistor 487 in the motor 481 to brake the motor 481. However, the counter electromotive force may be consumed by a resistor arranged outside the motor 481.

FIGS. 5A-5B are diagrams showing various motions created in a washing machine in accordance with an embodiment.

FIG. 5A represents a first motion which is created when the driving device 140 applies a first directional torque to the drum 130, brakes the drum 130, and then again applies the first directional torque to the drum 130 so that the drum 130 is rotated in the first direction. As set forth above, the first directional torque may be a forward or CW directional torque and the first direction may be a forward or CW direction. The first motion is created in the same manner as the washing method described with respect to FIG. 2 and, therefore, its detailed description will be omitted.

FIG. 5B represents a second motion which is created when the driving device 140 continuously applies a first directional torque to the drum 130 to rotate the drum 130 in the first direction so that the laundry in the drum 130 may be lifted and then dropped. When the driving device 140 applies the first directional torque to the drum 130, the drum 130 may be rotated in the first direction. As the drum 130 is rotated in the first direction, the laundry in the drum 130 may be repeatedly lifted and dropped.

In the case in which the drum 130 is rotated at about 45 rpm, which corresponds to 1G, the laundry in the drum 130 may be lifted to a maximum height greater than half a height of the drum 130 and then dropped. In the case in which the drum 130 is rotated at less than approximately 40 rpm, the laundry in the drum 130 may be lifted to a maximum height less than half the height of the drum 130 and then tumbled.

FIGS. 5C and 5D represent third motions which are created when the driving device 140 reciprocates the drum 130 in first and second directions so that the laundry in the drum 130 is lifted and then dropped. The second direction may be a reverse or counterclockwise (CCW) direction. In FIG. 5C, a motion of the third motions in which the driving device 140 reciprocates the drum 130 in the first and second directions so that the laundry in the drum 130 is lifted to a maximum height greater than half of the height of the drum 130 and then tumbled. The driving device 140 rotates the drum 130 at about 60 rpm, which is over 1G, by applying the first directional torque to the drum 130 so that the laundry in the drum 130 is rotated, sticking to the drum 130, and lifted by the first directional rotation of the drum 130. After being lifted to a maximum height greater than half the height of the drum 130, the laundry is dropped as the drum 130 is braked. Then, the driving device 140 applies a second directional torque to the drum 130 so that the laundry is rotated, sticking to the drum 130, and lifted by the second directional rotation of the drum 130. The second directional torque may be a reverse or counterclockwise (CCW) directional torque. Subsequently, after being lifted to a maximum height greater than half the height of the drum 130, the laundry is dropped as the drum 130 is braked.

FIG. 5E represents a motion which is created when the driving device 140 reciprocates the drum 130 in the first
and second directions so that the laundry in the drum 130 is lifted to a maximum height less than half the height of the drum 130. Motion of FIG. 5D is similar to motion of FIG. 5C; however, in this case, the rotational speed of the drum 130 does not exceed approximately 40 rpm so that the laundry in the drum 130 is lifted to a maximum height less than half the height of the drum 130 and then tumbled.

[0039] In the case in which the amount of the laundry is large, the second motion (FIG. 5B) and the motion of FIG. 5C may be appropriately repeated. In this case, the second motion may be performed at about 45 rpm so that the laundry is lifted to a maximum height greater than half the height of the drum 130 and then dropped. Moreover, a duration of the second motion may be longer than that of the motion of FIG. 5C.

[0040] In the case in which the amount of the laundry is small, the first motion (FIG. 5A) and the motion of FIG. 5C may be appropriately repeated. In this case, the second motion (FIG. 5B) may be performed during that process. Moreover, a duration of the motion of FIG. 5C may be longer than that of the first motion.

[0041] In the case in which the laundry may be easily damaged or the washing process is performed, for example, late at night, the motion of FIG. 5D may be performed.

[0042] Further, the second motion (FIG. 5B) and the motion of FIG. 5C may be appropriately repeated according to an amount of wash fluid in a rinsing process.

[0043] The washing machine and washing method therefor according to embodiments disclosed herein provide at least one of the following advantages:

[0044] First, an amount of impact may be increased or minimized when the laundry is dropped, thus improving washing performance. Second, the washing performance may be improved while minimizing damage to laundry. Third, various motions may be performed according to a type of laundry during washing or rinsing cycles. Finally, it is possible to minimize wear and tear of parts and heat generation by performing effective braking.

[0045] Embodiments disclosed herein provided a washing method, in which a drum of a drum type washing machine is rotated in a forward direction once, that may include applying forward torque to the drum so that laundry in the drum is rotated and lifted; braking the drum so that the laundry is dropped; and applying forward torque to the drum so that the dropped laundry is rotated and lifted again.

[0046] Embodiments disclosed herein provide a washing method, in which a drum of a drum type washing machine is rotated in a forward direction once, that may include applying forward torque to the drum to be rotated; braking the drum to reduce the rotational speed of the drum; and applying forward torque to the drum to be rotated.

[0047] Embodiments disclosed herein further provide a washing method that may include rotating a drum in the forward direction so that laundry in the drum is lifted to a maximum height greater than half the height of the drum; reducing the rotational speed of the drum so that the laundry is dropped; and rotating the drum in the forward direction so that the dropped laundry is lifted again to a maximum height greater than half the height of the drum.

[0048] Embodiments disclosed herein further provide a washing machine that may include a drum accommodating laundry and rotated; a driving unit or device that rotates the drum by applying torque thereto; and a control unit or controller that provides a first motion in which the driving unit rotates the drum in the forward direction once by applying forward torque to the drum, braking the drum, and then applying forward torque to the drum, and a second motion in which the driving unit rotates the drum in the forward direction once by continuously applying forward torque to the drum.

[0049] Embodiments disclosed herein further provide a washing machine that may include a drum accommodating laundry and rotated; a driving unit or device that rotates the drum by applying torque thereto; and a control unit or controller that provides a first motion in which the driving unit rotates the drum in the forward direction once by applying forward torque to the drum, braking the drum, and then applying forward torque to the drum, and a second motion in which the driving unit rotates the drum in the forward direction once by continuously applying forward torque to the drum.

[0050] Any reference in this specification to “one embodiment,” “an embodiment,” “example embodiment,” etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

[0051] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. A washing method, performed during one revolution of a drum of a washing machine in a first direction, the method comprising:
   - applying a first directional torque to the drum so that laundry in the drum is rotated and lifted;
   - braking the drum so that the laundry is dropped; and
   - again applying the first directional torque to the drum so that the dropped laundry is rotated and lifted again.

2. The washing method of claim 1, wherein, in the braking the drum, a maximum height of the laundry exceeds half a height of the drum when the laundry is dropped.

3. The washing method of claim 1, wherein, in the braking the drum, the drum is braked before the laundry is dropped after a maximum height of the laundry exceeds half a height of the drum.

4. The washing method of claim 1, wherein, in the braking the drum, the laundry is dropped when a rotational speed of the drum is reduced.

5. The washing method of claim 1, wherein, in the braking the drum, at least a portion of the laundry is dropped, passing through a central longitudinal axis of the drum.
6. The washing method of claim 1, wherein, in the braking the drum, a second directional torque, which is a reverse of the first directional torque, is applied to the drum.

7. The washing method of claim 1, wherein, in the braking the drum, an electromotive force generated in a closed circuit formed in a motor of a driving device that rotates the drum is consumed by a resistor to brake the drum.

8. The washing method of claim 1, wherein the washing method is performed in a wash cycle of the washing machine.

9. The washing method of claim 1, wherein the washing machine is a front loading washing machine.

10. A washing method, performed during one revolution of a drum of a washing machine in a first direction, the method comprising:

applying a first directional torque to the drum;

braking the drum to reduce a rotational speed of the drum;

and again applying the first directional torque to the drum.

11. The washing method of claim 10, wherein, in the braking the drum, a second directional torque, which is a reverse of the first directional torque, is applied to the drum.

12. The washing method of claim 10, wherein, in the braking the drum, an electromotive force generated in a closed circuit formed in a motor of a driving device that rotates the drum is consumed by a resistor to brake the drum.

13. The washing method of claim 10, wherein the washing method is performed in a wash cycle of the washing machine.

14. The washing method of claim 10, wherein the washing machine is a front loading washing machine.

15. A washing method, performed during one revolution of a drum of a washing machine in a first direction, comprising:

rotating the drum in the first direction so that laundry in the drum is lifted to a maximum height greater than half a height of the drum;

reducing a rotational speed of the drum via a controller of the washing machine so that the laundry is dropped; and

again rotating the drum in the first direction so that the dropped laundry is lifted again to the maximum height greater than half the height of the drum.

16. The washing method of claim 15, wherein, in the reducing the rotational speed of the drum, at least a portion of the laundry is dropped, passing through a central longitudinal axis of the drum.

17. The washing method of claim 15, wherein, in the reducing the rotational speed of the drum, a reverse torque is applied to the drum to reduce the rotational speed of the drum.

18. The washing method of claim 15, wherein, in the reducing the rotational speed of the drum, an electromotive force generated in a closed circuit formed in a motor of a driving device that rotates the drum is consumed by a resistor to reduce the rotational speed of the drum.

19. The washing method of claim 15, wherein the washing method is performed in a wash cycle of the washing machine.

20. The washing method of claim 15, wherein the washing machine is a front loading washing machine.

21. A washing machine, comprising:

a drum configured to accommodate laundry to be washed;

a driving device that rotates the drum by applying torque thereto; and

a controller that controls the driving device to provide a first motion to the drum by applying a first directional torque to the drum to rotate the drum in a first direction so that laundry in the drum is rotated and lifted, braking the drum so that the laundry is dropped, and again applying the first directional torque to the drum so that the dropped laundry is rotated and lifted again, and a second motion in which the driving device rotates the drum in the first direction by continuously applying the first directional torque to the drum.

22. The washing machine of claim 21, wherein the first and second motions are performed at least once during a washing or rinsing cycle.

23. The washing machine of claim 21, wherein the washing machine is a front loading washing machine.

24. A washing machine, comprising:

a drum that accommodates laundry to be washed;

a controller that controls the driving device to provide a first motion to the drum by applying a first directional torque to the drum to rotate the drum in a first direction so that laundry in the drum is rotated and lifted, braking the drum so that the laundry is dropped, and again applying the first directional torque to the drum so that the dropped laundry is rotated and lifted again, and a second motion in which the driving device reciprocatingly rotates the drum in the first direction and a second direction, which is a reverse of the first direction, so that the laundry in the drum is lifted and then dropped.

25. The washing machine of claim 24, wherein a maximum height of the laundry exceeds half a height of the drum while the laundry is dropped in the second motion.

26. The washing machine of claim 24, wherein a maximum height of the laundry does not exceed half a height of the drum while the laundry is dropped in the second motion.

27. The washing machine of claim 24, wherein the first and second motions are performed at least once during a washing or rinsing cycle.

28. The washing machine of claim 24, wherein the washing machine is a front loading washing machine.

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