US 20050268669A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2005/0268669 A1

Ko et al. (43) Pub. Date: Dec. 8, 2005

(54) DRUM-TYPE WASHING MACHINE

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(21) Appl. No.: **11/092,628**

(22) Filed: **Mar. 30, 2005**

(30) **Foreign Application Priority Data**

Jun. 2, 2004 (KR) 2004-40000

Publication Classification

(51) **Int. Cl.**[7] **D06F 33/02**

(52) **U.S. Cl.** **68/12.05**; 68/24; 68/58; 68/140; 68/12.19; 68/12.21; 68/142; 68/207

(57) **ABSTRACT**

A drum-type washing machine including at least one lifter for supplying wash water from the outside of a drum to the inside of the drum, and a controller for controlling water supply operations and washing operations based on the angle of rotation of the drum sensed by an angle sensing device. The controller positions the lifter under a water supply pipe so that the wash water is directly supplied from the outside of the drum to the inside of the drum through the lifter. Thus, laundry loaded in the drum is uniformly and rapidly wetted with the wash water. The controller also causes the laundry carried by the lifter to fall from the top position of the drum to maximize dropping power in a wash mode.

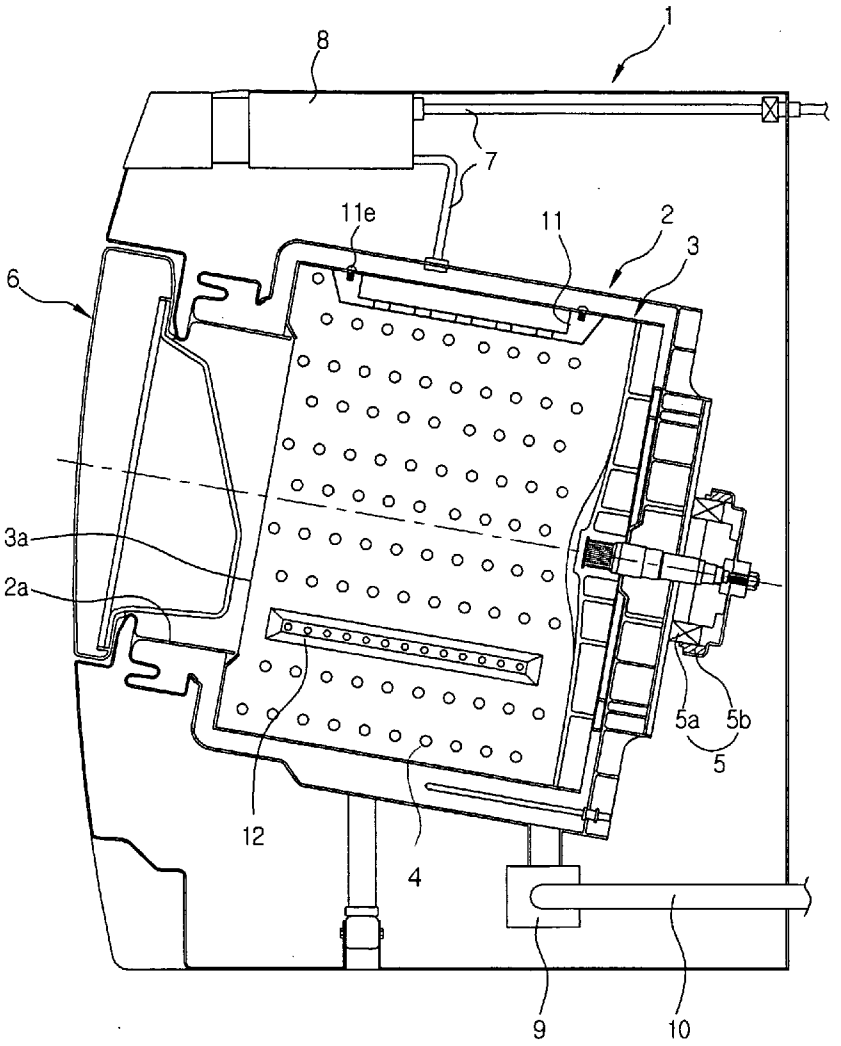


FIG 1

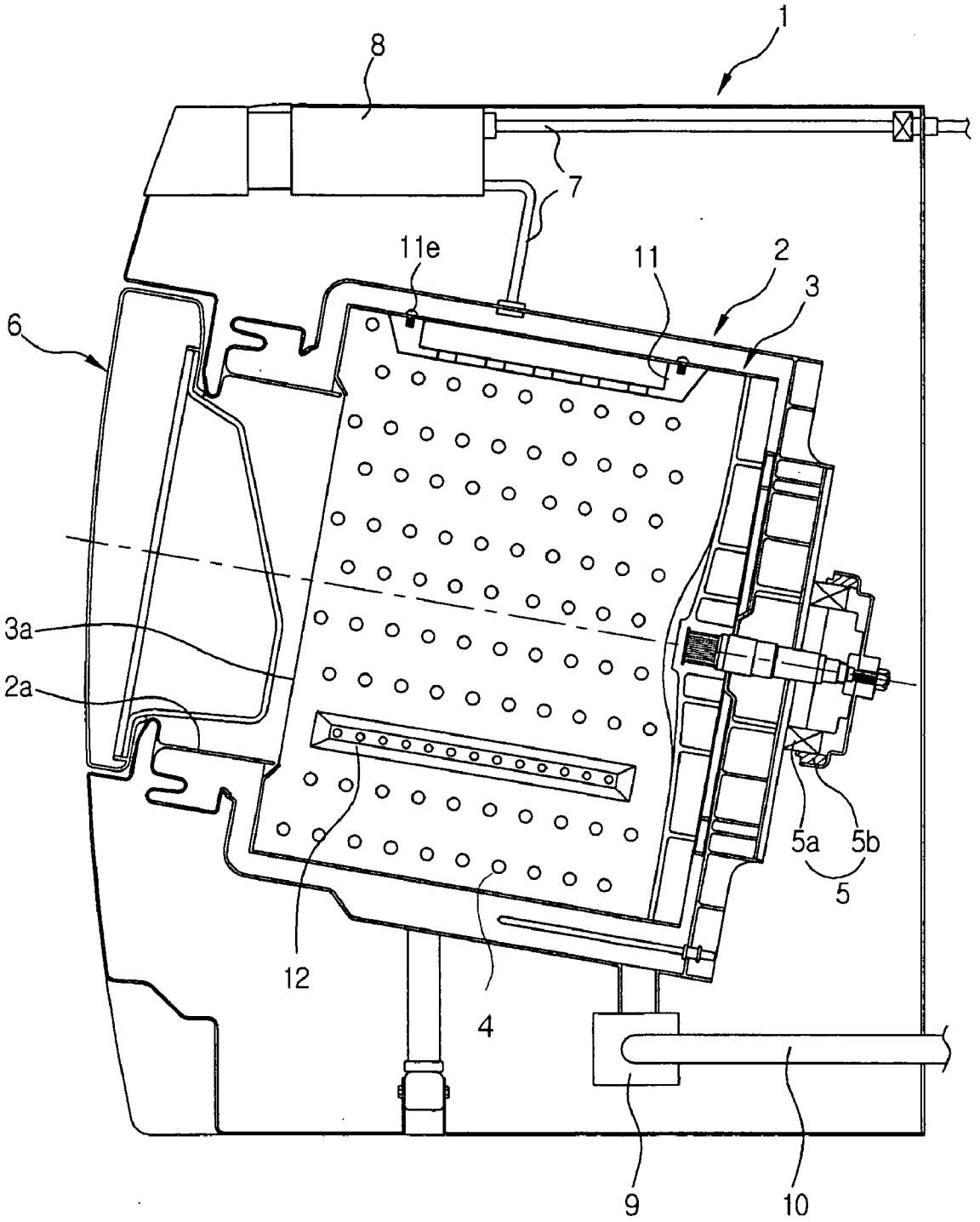


FIG 2

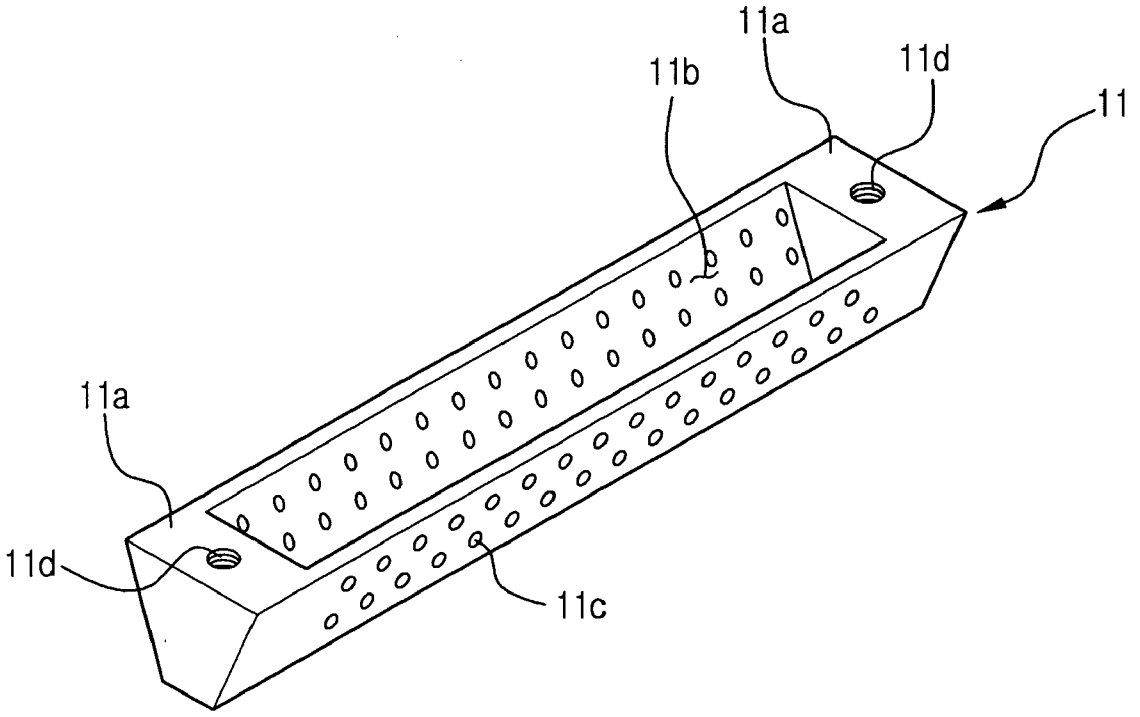


FIG 3

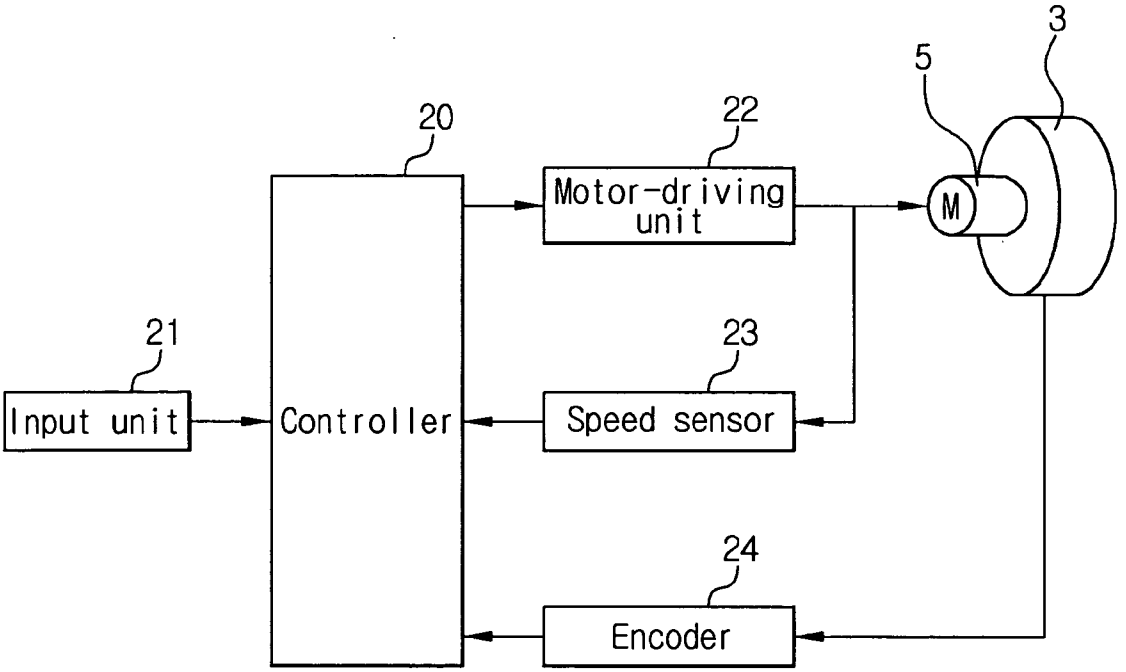

3
5
20
22
Motor-driving unit
M
21
23
Input unit
Controller
Speed sensor
24
Encoder

FIG 4

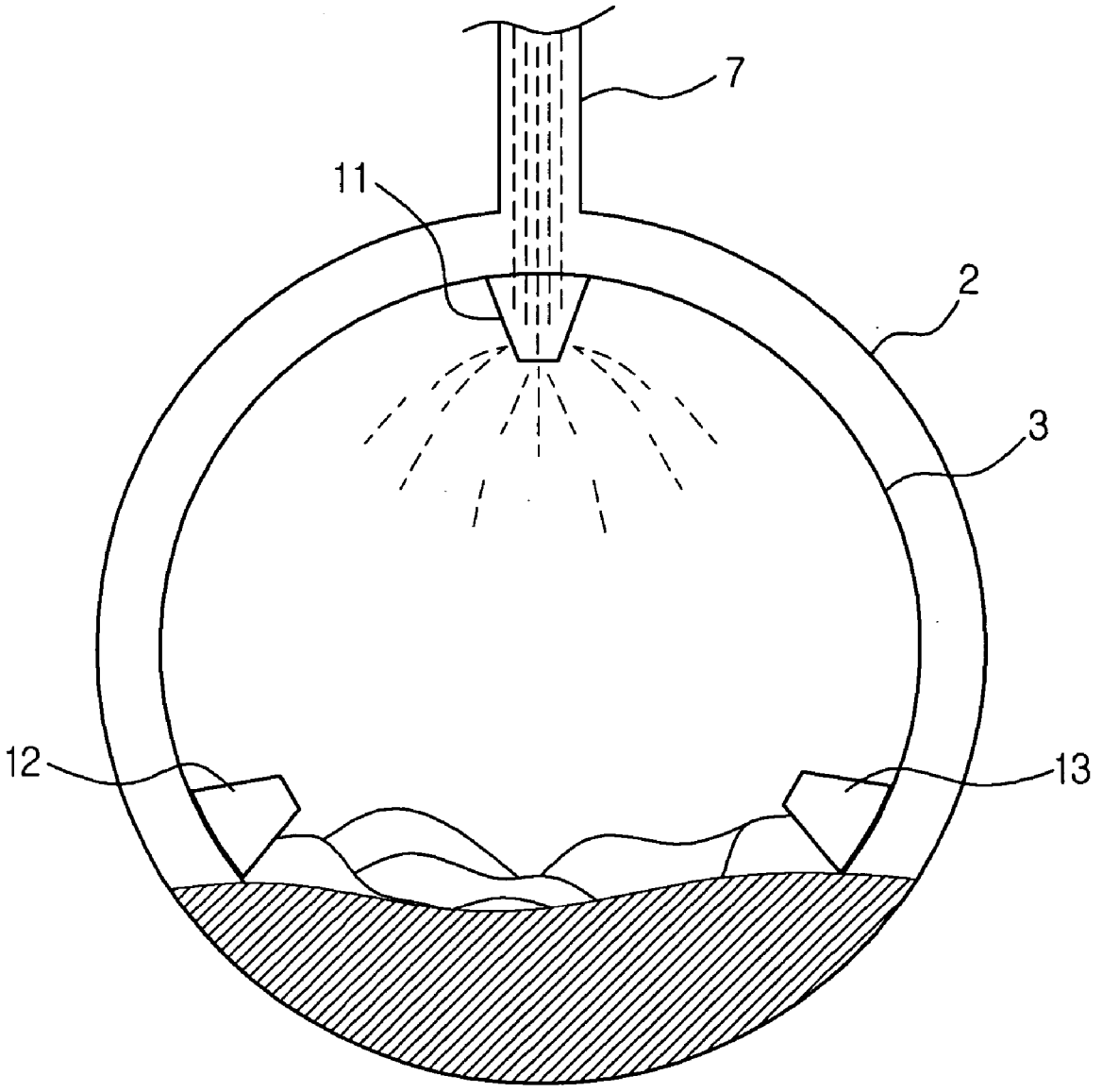


FIG 5

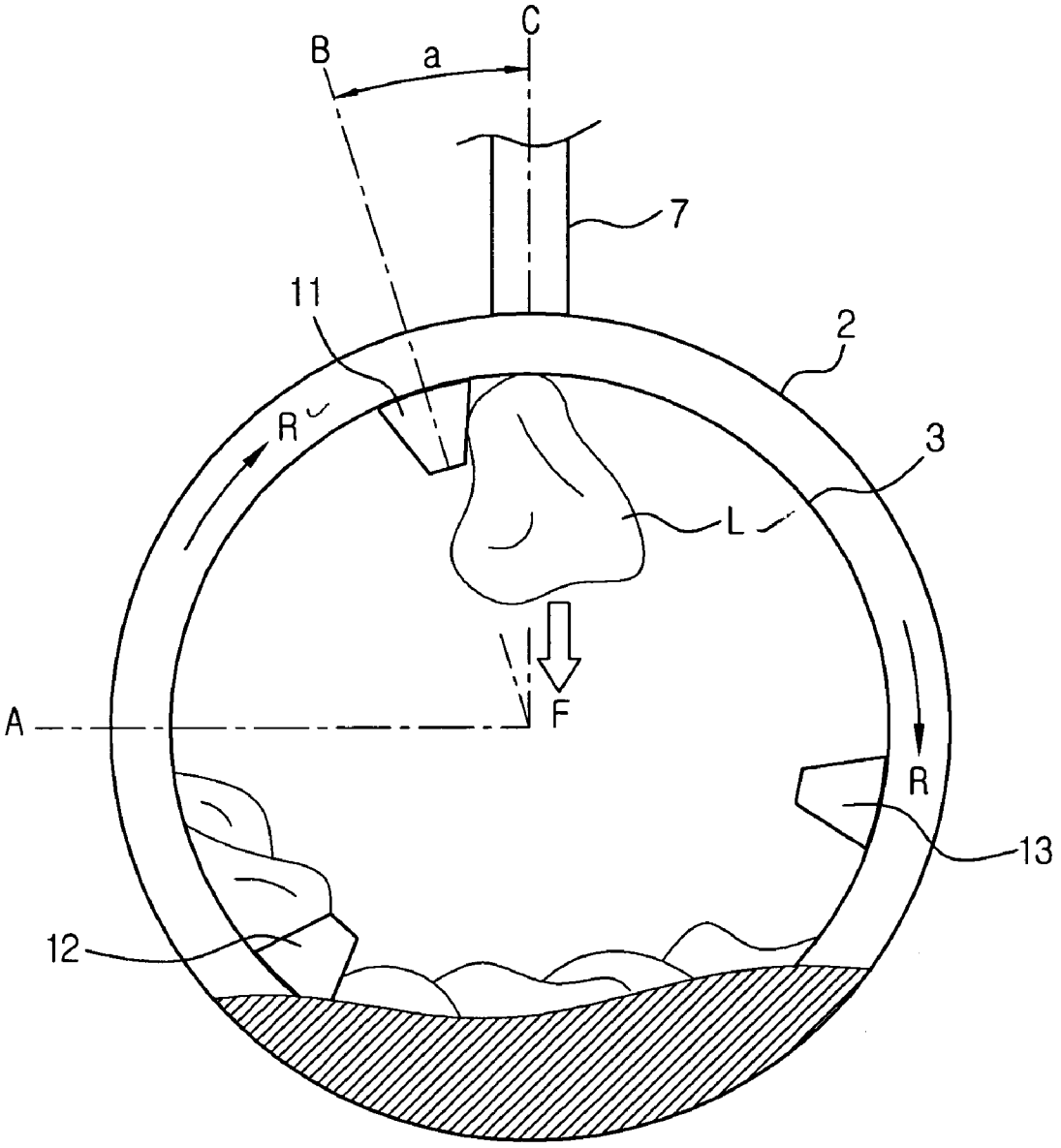


FIG 6

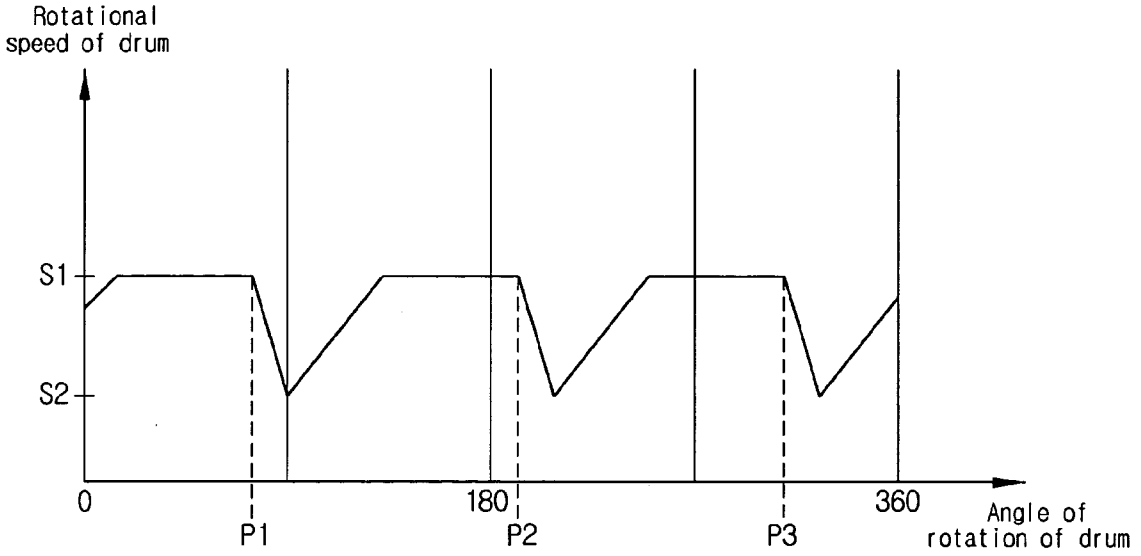
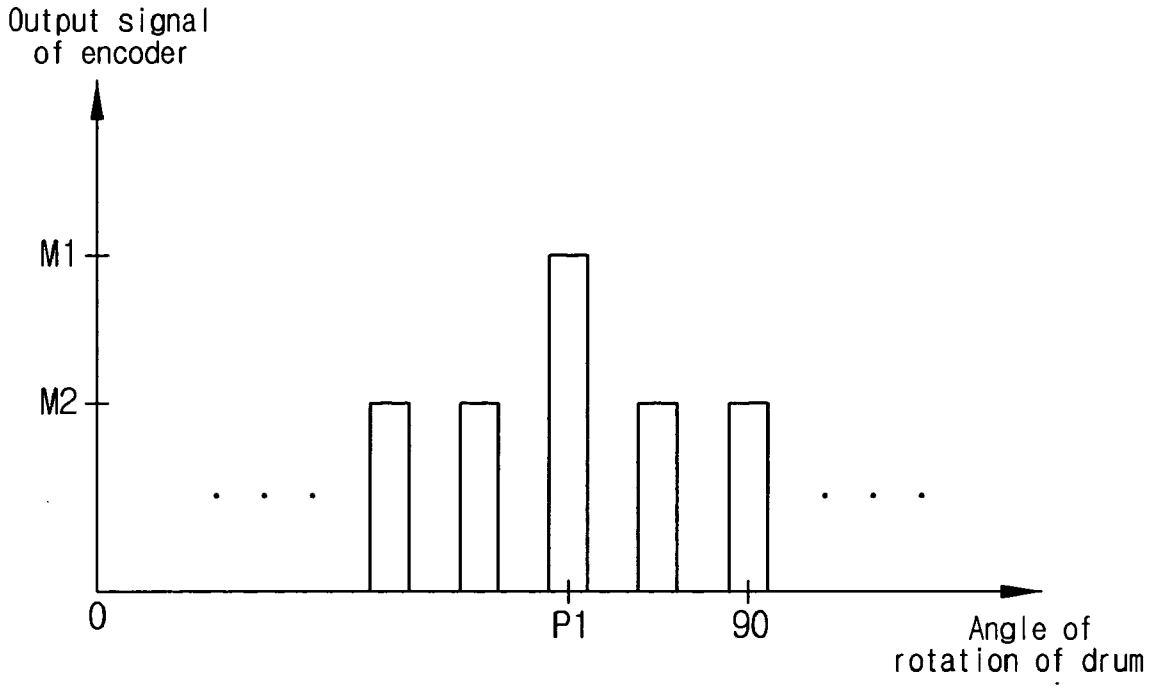

Rotational
speed of drum
S1
S2
0
180
360
P1
P2
P3
Angle of
rotation of drum

FIG 7


Output signal
of encoder
M1
M2
0
P1
90
Angle of
rotation of drum

DRUM-TYPE WASHING MACHINE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 2004-40000, filed Jun. 2, 2004, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a drum-type washing machine and, more particularly, to a drum-type washing machine having an improved water supply structure, in which laundry drops from a top position in a drum.

[0004] 2. Description of the Related Art

[0005] A drum-type washing machine washes laundry using the frictional force between a drum and the laundry by operating a drum motor to rotate the drum containing detergent, wash water and the laundry.

[0006] The drum-type washing machine is constructed such that the wash water filling a tub is supplied to the laundry in the drum through holes located in the drum. Since the wash water first fills a gap between the inner circumference of the tub and the outer circumference of the drum before the wash water wets the laundry in the drum, it takes a long time to uniformly wet the laundry in the drum.

[0007] Lifters formed in a longitudinal direction of a rotary shaft are installed on the inner circumference of the drum. The lifters lift the laundry in a rotational direction of the drum during the rotation of the drum. The laundry is allowed to drop by force of gravity when the laundry reaches the upper part of the drum, thereby achieving the washing of the laundry.

[0008] Since the conventional drum-type washing machine sets the rotational speed of the drum based on the weight of the laundry and then operates the drum based on the set rotational speed, the laundry carried by the lifters drops either before or after the laundry reaches the top position of the drum. Accordingly, when compared to the case in which the laundry drops from the top position of the drum, the conventional drum-type washing machine has a low dropping power, thereby reducing the washing effect and requiring a long time to wash the laundry.

SUMMARY OF THE INVENTION

[0009] Therefore, an aspect of the invention is to provide a drum-type washing machine having an improved water supply structure, in which laundry put into a drum is uniformly and rapidly wetted with wash water, and a rotational speed of the drum is controlled so that the laundry drops from the top position of the drum.

[0010] In accordance with one aspect, the present invention provides a drum-type washing machine comprising: a drum containing laundry; angle sensing means for sensing the angle of rotation of the drum; a drum motor for rotating the drum; a motor-driving unit for driving the drum motor; and a controller for controlling the water supply operations and washing operations based on the angle of rotation of the drum sensed by the angle sensing means.

[0011] At least one lifter for supplying wash water, for washing the laundry, from the outside of the drum to the inside of the drum may be installed in the drum, and the controller may recognize the position of the lifter using the angle sensing means and thereby control the rotational position of the drum such that the drum can receive the wash water from the lifter.

[0012] The lifter may include a main body, incoming holes formed through the main body for receiving the supplied wash water, and spray holes formed through the main body for spraying the wash water into the drum.

[0013] At least one lifter for carrying the laundry may be installed in the drum, and the controller may recognize the position of the laundry carried by the lifter using the angle sensing means and thereby control the rotational speed of the drum.

[0014] The controller may decrease the rotational speed of the drum before the laundry reaches the top position of the drum so that the laundry drops from the top position of the drum.

[0015] The angle sensing means may be an encoder outputting different pulse signals based on the rotational position of the drum, and the encoder may output a standard pulse signal when the drum is in a predetermined standard position and output another pulse signal when the drum is not in the predetermined standard position.

[0016] The standard pulse signal may have a higher intensity than that of another pulse signal.

[0017] In accordance with another aspect, the present invention provides a drum-type washing machine comprising: a rotary drum; a motor for rotating the rotary drum; a motor-driving unit for driving the motor; at least one lifter, for lifting laundry and supplying wash water from the outside of the drum to the inside of the drum, installed in the rotary drum; sensing means for detecting the position of the lifter; and a controller for placing the lifter at a first predetermined position in a stopped state, in a water supply mode, to supply the wash water to the inside of the drum and for reducing the rotational speed of the drum when the lifter, rotated along the rotational direction of the drum, reaches a second predetermined position in a wash mode.

[0018] The lifter may include a main body, incoming holes formed through the main body for receiving the supplied wash water, and spray holes formed through the main body for spraying the wash water into the drum.

[0019] The angle sensing means may be an encoder outputting different pulse signals based on the rotational position of the drum corresponding to the position of the lifter, and the encoder may output a standard pulse signal when the drum is in a predetermined standard position and output another pulse signal having a lower intensity than that of the standard pulse signal when the drum is not in the predetermined standard position.

[0020] The first determined position may be the top position having the highest level in the drum, and the second determined position may be a position of a level lower than that of the top position.

[0021] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] These and/or other aspects and advantages of the invention will be readily apparent and appreciated from the following description of exemplary embodiments, taken in conjunction with the accompanying drawings, of which:

[0023] **FIG. 1** is a longitudinal-sectional view of a drum-type washing machine in accordance with the present invention;

[0024] **FIG. 2** is a perspective view of a lifter of the drum-type washing machine in accordance with the present invention;

[0025] **FIG. 3** is a block diagram of the drum-type washing machine in accordance with the present invention;

[0026] **FIG. 4** is a schematic view illustrating a water supplying operation of the drum-type washing machine in accordance with the present invention;

[0027] **FIG. 5** is a schematic view illustrating a washing operation of the drum-type washing machine in accordance with the present invention;

[0028] **FIG. 6** is a graph illustrating the relation between angle of rotation a drum and rotational speed of the drum of the drum-type washing machine in accordance with the present invention; and

[0029] **FIG. 7** is a graph illustrating the relation between output signal of an encoder and rotational speed of the drum of the drum-type washing machine in accordance with the present invention.

DETAILED DESCRIPTION OF NON-LIMITING, ILLUSTRATIVE EMBODIMENTS OF THE INVENTION

[0030] Reference will now be made in detail to an embodiment of the present invention, an example of which is illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The exemplary embodiment is described below to explain the present invention by referring to the figures.

[0031] As shown in **FIGS. 1 and 2**, a drum-type washing machine in accordance with the present invention comprises a housing **1** having a nearly cubic shape defining an external appearance, a tub **2** for containing wash water, a drum **3** rotatably installed in the tub **2** and provided with a plurality of through holes **4** formed therethrough, and a drum motor **5** for rotating the drum **3** to wash laundry. The drum motor **5** includes a stator **5***a* and a rotor **5***b*.

[0032] Openings **2***a* and **3***a* are respectively formed through the front surfaces of the tub **2** and the drum **3**, and a door **6** for opening and closing the openings **2***a* and **3***a* is hinged to a front surface of the housing **1**.

[0033] A water supply pipe **7**, for supplying wash water from the outside to the washing machine, and a detergent container **8**, for mixing a detergent with the wash water supplied through the water supply pipe **7**, are installed in an upper part of the housing **1**, and a drain pump **9** and a drain hose **10**, for discharging the wash water to the outside of the housing **1** after the washing operation is completed, are installed on a lower part of the housing **1**.

[0034] The drum **3** is upwardly inclined at a designated angle toward the front surface of the housing **1**, and the tub **2** is also upwardly inclined at the same angle as that of the drum **3**.

[0035] A plurality of lifters **11**, **12** and **13** (**FIG. 5**) are installed on the inner circumference of the drum **3** such that the lifters **11**, **12** and **13** are spaced from each other by designated intervals. The lifters serve to lift the laundry loaded in the drum **3** together with the wash water to a designated height. The laundry then drops due to the rotation of the drum **3**, thereby allowing the laundry to be washed.

[0036] **FIG. 2** is a perspective view of a lifter of the drum-type washing machine in accordance with the present invention.

[0037] The lifter **11** includes a main body **11***a* having a trapezoidal shape for defining an external appearance, incoming holes **11***b* formed through the upper surface of the main body **11***a* in a longitudinal direction for receiving the supplied wash water, a plurality of spray holes **11***c* formed through the lower and side surfaces of the main body **11***a* for spraying the wash water into the drum **3** to wet the laundry, and connection holes **11***d* formed through the upper surface of the main body **11***a* for connecting the lifter **11** to the drum **3** using screws **11***e*.

[0038] When the incoming holes **11***b* are disposed under the water supply pipe **7**, the majority of the wash water supplied through the water supply pipe **7** falls into the incoming holes **11***b* and is supplied to the inside of the drum **3** through the spray holes **11***c*. The remainder of the wash water, which does not fall into the incoming holes **11***b*, falls along the outer circumference of the drum **3** and fills the drum **3** from the bottom. As described above, the drum-type washing machine consistent with the present invention sprays the wash water directly from the upper part of the drum **3**, thereby allowing the laundry contained in the drum **3** to be uniformly and rapidly wetted by the wash water.

[0039] As shown in **FIG. 3**, the drum-type washing machine consistent with the present invention further comprises a controller **20** for controlling the overall operation including the water supply mode and the wash mode.

[0040] The controller **20** controls a motor-driving unit **22** to drive the drum motor **5** based on input instructions from a user through an input unit **21**, thereby transmitting the driving force of the drum motor **5** to the drum **3** and then rotating the drum **3** at a designated speed.

[0041] A speed sensor **23** senses the rotational speed of the drum motor **5** and supplies the sensed speed to the controller **20**.

[0042] An encoder **24** senses the angle of rotation of the drum **3** and supplies the sensed angle to the controller **20**. The encoder **24** is installed in the tub **2** such that the encoder **24** generates a designated pulse signal by means of a magnetic force generated from magnets (not shown) installed on the outside the drum **3** when the drum **3** is rotated. A magnet having a comparatively large magnetic force, as compared to the other magnets installed on the

drum **3**, is installed at a predetermined standard position. Thus, the intensity of a standard pulse signal outputted from the encoder **24** by means of the comparatively large magnetic force of the above magnet is higher than the intensities of the pulse signals outputted from the encoder **24** by means of the magnetic force of the other magnets. Although, in this embodiment, the encoder outputs a plurality of standard pulse signals, based on the standard position, to respectively correspond to the plurality of lifters during one revolution of the drum, the encoder may output only one standard pulse signal, based on the standard position, to correspond to any one lifter of the plurality of lifters per one revolution of the drum.

[**0043**] Hereinafter, the operation of the drum-type washing machine consistent with the present invention will be described in detail.

[**0044**] When a user inputs washing instructions through the input unit **21**, as shown in **FIG. 4**, the controller **20** controls the motor-driving unit **22** to drive the drum motor **5** so that the incoming holes **11***b* of the lifter **11** are disposed under the water supply pipe **7**. That is, the controller **20** controls the angle of rotation of the drum **3** based on the standard pulse signal outputted from the encoder **24**. When the wash water is supplied to the inside of the drum under the condition that the incoming holes **11***b* of the lifter **11** is aligned with the water supply pipe **7** in a straight line, the wash water supplied through the water supply pipe **7** falls into the incoming holes **11***b* of the lifter **1** and is sprayed into the drum **3** through the spray holes **11***c*.

[**0045**] When the washing machine is operated in the wash mode, as shown in **FIG. 5**, the drum **3** is rotated in the clockwise direction (R) and the lifter reaches a predetermined position (B). Then, the rotational speed of the drum **3** is suddenly decreased.

[**0046**] As shown in **FIGS. 6 and 7**, when the rotation of the drum **3** is started from the condition that the lifter **11** is disposed at a start position (A), the controller **20** operates the drum **3** at a first rotational speed (S1). Here, the encoder **24** outputs a pulse signal having a low intensity (M2). When the lifter **11** reaches the predetermined position (B), i.e., the angle of rotation of the drum **3** is a first predetermined angle (P1), the encoder **24** outputs a standard pulse signal having a high intensity (M1) and then the controller **20** reduces the rotational speed of the drum **3**. When the drum **3** is rotated so that the lifter **11** reaches a top position (C), the rotational speed of the drum **3** has reduced from the first rotational speed (S1) to a second rotational speed (S2), which is lower than the first rotational speed (S1). The rotational speed of Laundry (L) carried by the lifter **11** is now reduced, and Laundry (L) drops in the gravitational direction (F) from the top position (C), which deviates from the predetermined position (B) by a designated angle (a). Then, while the lifter **11** passes through the top position (C), the controller **20** increases the rotational speed of the drum **3** to the first rotational speed (S1) and maintains the first rotational speed (S1) of the drum **3**.

[**0047**] Whenever the subsequent lifter **12** or **13** reaches the predetermined position (B), that is, the angle of rotation of the drum **3** reaches a second predetermined angle (P2) or a third predetermined angle (P3), the rotational speed of the drum **3** is decreased to the second rotational speed (S2). When the lifter **12** or **13** passes through the top position (C), the rotational speed of the drum **3** is increased to the first rotational speed (S1) and maintained at the first rotational speed (S1). Whenever the drum **3** turns one revolution, the above-described process is repeated.

[**0048**] Similarly, when the drum **3** is rotated in the counterclockwise direction and the lifter **11** reaches a predetermined position before the top position (C) by a designated angle, the controller **20** decreases the rotational speed of the drum **3** and allows the laundry carried by the lifter **11** to drop from the top position (C).

[**0049**] As described above, the drum of the washing machine consistent with the present invention is rotated alternately in the clockwise and counterclockwise directions during the wash mode, and whenever a lifter reaches the top position, the laundry carried by the lifter is allowed to fall by the force of gravity, thereby maximizing falling power.

[**0050**] As apparent from the above description, the present invention provides a drum-type washing machine having an improved water supply structure, in which a lifter is placed under a water supply pipe so that wash water is directly supplied from the outside of the drum to the inside of the drum to allow laundry loaded in the drum to be uniformly and rapidly wetted with the wash water, thereby shortening wash time. Further, the drum-type washing machine of the present invention controls the rotational speed of the drum based on the position of the laundry so that the laundry carried by the lifters can fall from the top position of the drum to maximize the falling power, thereby improving the washing effect.

[**0051**] Although an exemplary embodiment of the invention has been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. A drum-type washing machine comprising:

a drum;

an angle sensing device which senses the angle of rotation of the drum;

a drum motor rotating the drum;

a motor-driving unit driving the drum motor; and

a controller controlling water supply operations and washing operations based on the angle of rotation of the drum sensed by the angle sensing device.

2. The drum-type washing machine according to claim 1, comprising:

at least one lifter,

wherein the at least one lifter supplies wash water to the inside of the drum, and

wherein the controller recognizes the position of the at least one lifter using the angle sensing device and thereby controls the rotational position of the drum such that the drum can receive the wash water from the at least one lifter.

3. The drum-type washing machine according to claim 2, wherein the at least one lifter includes a main body, incoming holes formed through the main body for receiving the

supplied wash water, and spray holes formed through the main body for spraying the wash water into the drum.

4. The drum-type washing machine according to claim 1, comprising:

at least one lifter,

wherein the at least one lifter carries laundry loaded in the drum, and

wherein the controller recognizes the position of the laundry carried by the at least one lifter using the angle sensing device and thereby controls the rotational speed of the drum.

5. The drum-type washing machine according to claim 4, wherein the controller decreases the rotational speed of the drum before the laundry reaches a top position so that the laundry falls from the top position.

6. The drum-type washing machine according to claim 2, wherein the angle sensing device is an encoder outputting different pulse signals based on the rotational position of the drum, and the encoder outputs a standard pulse signal when the drum is in a predetermined standard position and outputs another pulse signal when the drum is not in the predetermined standard position.

7. The drum-type washing machine according to claim 6, wherein the standard pulse signal has a higher intensity than that of another pulse signal.

8. The drum-type washing machine according to claim 4, wherein the angle sensing device is an encoder outputting different pulse signals based on the rotational position of the drum, and the encoder outputs a standard pulse signal when the drum is in a predetermined standard position and outputs another pulse signal when the drum is not in the predetermined standard position.

9. The drum-type washing machine according to claim 8, wherein the standard pulse signal has a higher intensity than that of another pulse signal.

10. A drum-type washing machine comprising:

a rotary drum;

a motor rotating the rotary drum;

a motor-driving unit driving the motor;

at least one lifter lifting laundry and supplying wash water to the inside of the drum;

a sensing device which detects the position of the lifter; and

a controller that places the lifter at a first predetermined position to supply the wash water to the inside of the drum, and reduces the rotational speed of the drum when the lifter rotated along the rotational direction of the drum reaches a second predetermined position.

11. The drum-type washing machine according to claim 10, wherein the lifter includes a main body, incoming holes formed through the main body for receiving the supplied wash water, and spray holes formed through the main body for spraying the wash water into the drum.

12. The drum-type washing machine according to claim 10, wherein the sensing device is an encoder outputting different pulse signals based on the rotational position of the drum corresponding to the position of the lifter, and the encoder outputs a standard pulse signal when the drum is in a predetermined standard position and outputs another pulse signal having a lower intensity than that of the standard pulse signal when the drum is not in the predetermined standard position.

13. The drum-type washing machine according to claim 12, wherein the first determined position is a top position of the drum having the highest level in the drum, and the second determined position is a position of a level lower than that of the top position.

14. A drum-type washing machine comprising:

a drum;

means for sensing the angle of rotation of the drum;

a drum motor for rotating the drum;

means for driving the drum motor; and

means for controlling water supply operations and washing operations based on the angle of rotation of the drum sensed by the angle sensing means.

* * * * *