

DESCRIPTION

WASHING MACHINE

5 TECHNICAL FIELD

[0001]

The present invention relates to a washing machine which performs a washing step, a rinsing step, and a spin-drying step.

10 BACKGROUND ART

[0002]

A conventional washing machine known as of this type is structured as illustrated in FIG. 12, and controlled as illustrated in FIG. 13. A conventional washing machine is hereinafter described with reference to FIGS.

15 12 and 13.

[0003]

As illustrated in FIG. 12, pulsator 46 is rotatably provided on the bottom surface of washing and spin-drying tub 45. Water receiving tub 47 is provided outside washing and spin-drying tub 45. Motor 48 drives washing and spin-drying tub 45 or pulsator 46 via V-belt 49 and speed reduction mechanism also serving as clutch 50. Drain valve 51 drains washing water from washing and spin-drying tub 45, while water supply valve 52 supplies water into washing and spin-drying tub 45. Water receiving tub 47 is supported by housing 53 via suspensions 54 in an anti-vibration state. Annular fluid balancer 55 is disposed at an upper part of washing and spin-drying tub 45 to reduce vibration generated during spin-drying.

[0004]

Controller 56 controls motor 48, drain valve 51, water supply valve 52 and the like to sequentially control a series of steps of washing, rinsing, and spin-drying.

[0005]

5 On an inner surface of washing and spin-drying tub 45, circulation lint channel 58 is defined by circulation lint cover 57 and washing and spin-drying tub 45. Lint filter 59 is detachably attached to an upper end of circulation lint channel 58. Detergent supply cover 60 is provided in a freely openable and closable state on circulation lint cover 57 at a position below lint filter 59.

10 When detergent supply cover 60 is opened and detergent is put in from detergent supply cover 60, the detergent passes through circulation lint channel 58 and falls into pump chamber 62 formed below pulsator 46 (for example, see PTL 1).

[0006]

15 Next, an operation of the washing machine thus structured is described. After throwing laundry into washing and spin-drying tub 45, a user opens detergent supply cover 60 and supplies the detergent. The detergent passes through circulation lint channel 58, and falls into pump chamber 62. When washing is started, controller 56 causes water supply

20 valve 52 to supply a predetermined amount of water, corresponding to a volume of the laundry, into washing and spin-drying tub 45. Thereafter, controller 56 drives motor 48 to rotate pulsator 46 and lower blade 61 provided on a lower surface of pulsator 46. This rotation agitates the laundry and cleaning liquid in washing and spin-drying tub 45 to clean the laundry.

25 [0007]

FIG. 13 is a graph for explaining a control during a washing step performed by the conventional washing machine. In this washing step, the

fact that the number of inertial rotation of pulsator 46 caused after rotation is varied in accordance with the volume of laundry is utilized. More specifically, a variation of the number of inertial rotation is detected, and then a predetermined water level is determined in accordance with the volume of the laundry based on a table showing a correlation of volumes of laundry and water levels. Subsequently, water is continuously supplied from water supply valve 52 into washing and spin-drying tub 45 to reach the predetermined water level. At the predetermined water level, controller 56 rotates pulsator 46 so as to clean the laundry by a water flow due to rotation of pulsator 46.

10 [0008]

With the configuration of the conventional washing machine described above, the detergent supplied into pump chamber 62 is pushed outward by an effect of rotation of lower blade 61, and rises through circulation lint channel 58 from pump chamber 62, so that the detergent is supplied into washing and spin-drying tub 45 via discharge ports. However, the detergent may be supplied into washing and spin-drying tub 45 together with the cleaning solution before the detergent is completely dissolved. When the undissolved detergent adheres to the laundry, the adhering detergent may remain in an undissolved state. Moreover, since the cleaning solution that contains a small amount of bubbles is supplied to the laundry, there arises a problem that the cleaning performance is low.

Citation List

Patent Literature

[0009]

25 PTL 1: Unexamined Japanese Patent Publication No. 63-117798

SUMMARY

[0010]

Embodiments have been developed to solve the aforementioned conventional problems. The present invention aims to provide a washing machine capable of prevent remaining of undissolved detergent and improving
5 cleaning performance.

[0011]

A washing machine according to one aspect includes a main body, a water tub supported inside the main body in an anti-vibration state, a washing and spin-drying tub rotatably accommodated in the water tub, and a pulsator
10 rotatably disposed on a central inner bottom portion of the washing and spin-drying tub. The washing machine further includes a pump chamber formed at a position below the pulsator in the water tub, a blade formed integrally with the pulsator and disposed in the pump chamber, a motor for rotating the pulsator and the washing and spin-drying tub. The washing
15 machine further includes a water supply valve for supplying water into the water tub, a circulation channel provided in the washing and spin-drying tub and for circulating washing liquid in the pump chamber to the washing and spin-drying tub, an upper discharge port formed in an upper portion of the circulation channel and for supplying the washing liquid into the washing and
20 spin-drying tub, and a lower discharge port formed at a position below the upper discharge port in the circulation channel. The washing machine further includes a controller for controlling operations of the motor, the water supply valve and others to control respective steps of washing, rinsing, and spin-drying. The controller performs a first step of supplying water to a first
25 predetermined water level, and rotating the pulsator and the blade to dissolve detergent and generate bubbles of the washing liquid within the pump chamber. The controller further performs a second step of supplying water to

a second predetermined water level higher than the first predetermined water level, and rotating the pulsator and the blade to supply the bubbles and the washing liquid within the pump chamber into the washing and spin-drying tub from the lower discharge port through the circulation channel. The controller
5 further performs a third step of supplying water to a third predetermined water level higher than the second predetermined water level, and rotating the pulsator and the blade to supply the bubbles and the washing liquid within the pump chamber into the washing and spin-drying tub from the lower discharge port and the upper discharge port through the circulation channel, wherein a
10 water amount at the first predetermined water level in the first step is set to such a water amount as not to allow supply of the washing liquid into the washing and spin-drying tub from the lower discharge port.

[0012]

Accordingly, the first step can prevent undissolved residue of detergent
15 by agitating the washing liquid containing the detergent at a place spaced from the laundry. Moreover, bubbles can be favorably generated by agitation with a small amount of water. In the second step, high-concentration cleaning liquid containing bubbles is discharged toward the laundry from the lower discharge port. Accordingly, this step can promote a permeation effect
20 of the bubbles and the high-concentration cleaning liquid into the laundry, thereby improving the cleaning performance and shortening the cleaning time. In the third step, cleaning liquid containing bubbles is discharged toward the laundry from the upper discharge port. Accordingly, this step can improve the cleaning performance for an upper part of the laundry, for which
25 conventional cleaning performance has been limited, and enhance uniform cleaning performance.

[0013]

A washing machine according to various embodiments is capable of improving cleaning performance, and preventing uneven washing.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

FIG. 1 is a vertical cross-sectional view of a washing machine according
5 to a first exemplary embodiment of the present invention.

FIG. 2 is a cross-sectional view of a washing and spin-drying tub of the
washing machine.

FIG. 3 is a cross-sectional view of the washing and spin-drying tub of
the washing machine as viewed in a different direction.

10 FIG. 4 is a graph showing a relationship between a water level and
first to third steps of a washing step of the washing machine.

FIG. 5 is a perspective view illustrating a main part of a detergent
supply state of the washing machine.

15 FIG. 6 is a schematic cross-sectional view illustrating a first step of the
washing machine.

FIG. 7 is a perspective view illustrating a main part of a second step of
the washing machine.

FIG. 8 is a schematic cross-sectional view illustrating the second step
of the washing machine.

20 FIG. 9 is a perspective view illustrating a main part of a third step of
the washing machine.

FIG. 10 is a schematic cross-sectional view illustrating the third step of
the washing machine.

25 FIG. 11 is a top view illustrating a relationship between laundry and a
discharge range of washing liquid from a circulation channel of the washing
machine.

FIG. 12 is a vertical cross-sectional view of a conventional washing

machine.

FIG. 13 is a graph showing a washing step of the conventional washing machine.

5 DESCRIPTION OF EMBODIMENT

[0015]

(First Exemplary Embodiment)

FIG. 1 is a vertical cross-sectional view of a washing machine according to a first exemplary embodiment of the present invention. FIG. 2 is a cross-sectional view of a washing and spin-drying tub of the washing machine. FIG. 3 is a cross-sectional view of the washing and spin-drying tub of the washing machine as viewed in a different direction. FIG. 5 is a perspective view illustrating a main part of a detergent supply state of the washing machine. FIG. 6 is a cross-sectional view illustrating a first step of the washing machine. FIG. 7 is a perspective view illustrating a main part of a second step of the washing machine. FIG. 8 is a cross-sectional view illustrating the second step of the washing machine. FIG. 9 is a perspective view illustrating a main part of a third step of the washing machine. FIG. 10 is a cross-sectional view of the third step of the washing machine.

20 [0016]

As illustrated in FIG. 1, main body 1 includes water tub 3 supported by a plurality of suspensions 2 in an anti-vibration state. Vibration generated in water tub 3 during spin-drying is absorbed by suspensions 2. Drain port 25 and drain valve 26 are disposed in a bottom portion of water tub 3. Inner lid 29 is provided on an upper open portion side of water tub 3.

[0017]

Washing and spin-drying tub 7 configured to accommodate laundry is

rotatably disposed inside water tub 3. Washing and spin-drying tub 7 includes a plurality of drain holes 5 in a side wall of washing and spin-drying tub 7, and annular fluid balancer 6 for reducing spin-drying vibration is attached to an upper part of washing and spin-drying tub 7.

5 [0018]

Washing and spin-drying tub 7 is provided rotatably around washing and spin-drying shaft 4 that is hollow and dual-structured. Pulsator 8 configured to agitate laundry (clothes) is rotatably provided on an inner bottom portion of washing and spin-drying tub 7.

10 [0019]

Motor 9 is attached to the bottom portion of water tub 3. Motor 9 contains a clutch mechanism and a brake mechanism. Motor 9 brakes a spin-drying shaft of washing and spin-drying shaft 4, and drives a washing shaft of washing and spin-drying 4 to rotate pulsator 8 during washing. On the other hand, motor 9 cancels braking of the spin-drying shaft of washing and spin-drying shaft 4, and drives washing and spin drying shaft 4 to rotate washing and spin-drying tub 7 during spin-drying. During spin-drying, drain valve 26 is opened to discharge washing liquid or rinsing liquid within water tub 3 to the outside of the machine from drain port 25 via drain valve 26.

20 [0020]

Upper frame 21 that covers an upper portion of main body 1 includes opening and closing lid 28 which is freely openable and closable and which covers laundry inlet port 27 formed substantially at a central portion of upper frame 21. Upper frame 21 includes controller 24 inside operation display unit 23 provided in a front surface part of upper frame 21, and further includes water supply valve 22 inside a rear part of upper frame 21 as a valve through which water is supplied into washing and spin-drying tub 7.

[0021]

Controller 24 includes a control means (not shown) constituted by a microcomputer. Controller 24 is configured to control motor 9, water supply valve 22, drain valve 26 and the like, and sequentially control a series of steps
5 of washing, rinsing, and spin-drying.

[0022]

As illustrated in FIG. 2, bottom member 31 is attached to a lower portion of washing and spin-drying tub 7. Bottom member 31 is made of synthetic resin, and constitutes a bottom portion of washing and spin-drying
10 tub 7. A clearance is formed between an inner bottom surface of bottom member 31 and a rear surface of pulsator 8. Pump chamber 19 is formed between the rear surface of pulsator 8 and the inner bottom surface of bottom member 31. Blade 18 integrated with pulsator 8 is disposed in pump chamber 19. An opening (not shown) is formed in a bottom surface of bottom
15 member 31 to connect washing and spin-drying tub 7 and water tub 3 via the opening.

[0023]

As illustrated in FIGS. 2 and 3, a pair of channel covers 14 is provided on an inner wall of washing and spin-drying tub 7 at such positions as to face
20 each other. Lint filter 32 is disposed at one of positions rotated by 90 degrees from channel covers 14 in a circumferential direction. In addition, cover 33 is provided at the other position rotated by 90 degrees from channel covers 14 at such a position as to face lint filter 32 (see FIG. 3). As illustrated in FIG. 5, detergent supply port 35 is formed in an upper portion of cover 33. Detergent
25 supply port 35 is openably closed by lid 36. Detergent supplied from detergent supply port 35 reaches an inside of water tub 3 through an opening (not shown) formed in washing and spin-drying tub 7. As described later,

cover 33 is provided with lower discharge port 34 at a position below detergent supply port 35 (see FIG. 7). Lower discharge port 34 is formed substantially at a middle position (including middle position) of the height of washing and spin-drying tub 7 (see FIGS. 3 and 7).

5 [0024]

Each of channel covers 14 and cover 33 at bottom member 31 has a circular-arc shape having substantially the same diameter as the diameter of washing and spin-drying tub 7. In a state of attachment of channel covers 14 and cover 33, an inner surface of bottom member 31 and inner surfaces of
10 channel covers 14 and cover 33 form substantially a flat shape with substantially no steps between the inner surfaces.

[0025]

As illustrated in FIG. 3, each of channel covers 14 has a substantially T shape constituted by side cover portion 15 and upper cover portion 16. Side
15 cover portion 15 extends in a direction of a rotation axis of washing and spin-drying tub 7 along a side surface of an inner wall portion of washing and spin-drying tub 7. Upper cover portion 16 extends in a circumferential direction of washing and spin-drying tub 7 at a position below fluid balancer 6 in an upper portion of washing and spin-drying tub 7. Side cover portion 15 is
20 attached water-tightly to the side surface of washing and spin-drying tub 7 and a rear cover portion (not shown) is attached to upper cover portion 16, so that the channel covers 14 define circulation channel 10.

[0026]

With rotation of pulsator 8 and blade 18, washing liquid within pump
25 chamber 19 is sent toward circulation channel 10 of channel covers 14 and circulation channel 10 of cover 33. Washing liquid is also sent into lint filter 32.

[0027]

Center discharge port 11 is formed in a central portion of upper cover portion 16 at a position above side cover portion 15. Left discharge port 12 is formed at a left end portion of upper cover portion 16 (as viewed from rotation center of washing and spin-drying tub 7), and right discharge port 13 is formed at a right end portion of upper cover portion 16 (as viewed from rotation center of washing and spin-drying tub 7). Center discharge port 11, left discharge port 12, and right discharge port 13 are provided substantially at the same height in the circumferential direction of washing and spin-drying tub 7. Center discharge port 11, left discharge port 12, and right discharge port 13 constitute upper discharge ports 111.

[0028]

In this exemplary embodiment, as upper discharge ports 111, three discharge ports of center discharge port 11, left discharge port 12, and right discharge port 13 are provided. However, one port, or four or more ports may be provided. The number, shape, or other conditions of the discharge ports may be appropriately selected.

[0029]

The operations and effects of the washing machine thus constructed are described below.

[0030]

As illustrated in FIG. 4, a washing step includes a bubble generation step corresponding to a first step, a high-concentration bubble discharge step corresponding to a second step, and a bubble upper part discharge step corresponding to a third step. In each of the steps, controller 24 detects a water level in water tub 3 by using a water level sensor, and controls the water level in water tub 3 by controlling water supply valve 22.

[0031]

When a user throws laundry into washing and spin-drying tub 7 and starts operation by pressing a start button (not shown) provided on operation display unit 23, a cloth volume detection means (not shown) detects the volume of laundry and displays a detergent amount corresponding to the detected cloth volume on operation display unit 23. When lid 36 is opened as illustrated in FIG. 5 and detergent of the displayed amount is supplied through detergent supply port 35, the detergent is contained in water tub 3.

[0032]

With a start of operation, controller 24 allows water supply valve 22 to supply water to a first predetermined water level in water tub 3. When water reaches the first predetermined water level, the bubble generation step starts. Controller 24 stops supply of water, and drives motor 9 to rotate pulsator 8 and blade 18.

[0033]

In the bubble generation step, the water in water tub 3 is agitated within pump chamber 19 and through openings formed in the bottom of washing and spin-drying tub 7 by an agitation effect produced by rotation of pulsator 8 and blade 18 as illustrated in FIG. 6. This agitation of water dissolves the detergent in water, produces washing liquid, and generates bubbles in the washing liquid. The water amount at the first predetermined water level is set to such an amount as not to allow supply of the washing liquid or bubbles agitated by the effect of blade 18 into washing and spin-drying tub 7 via lower discharge port 34.

[0034]

In this embodiment, the first predetermined water level is set to a level of a water amount in the range from 0.1 to 0.4 relative to a water amount of a

rated water level corresponding to a third predetermined water level in the bubble upper part discharge step. When the water amount at the first predetermined water level is set to the water amount in the range from 0.1 to 0.4 of the third predetermined water level, remaining of undissolved detergent
5 can be avoided. Accordingly, bubbles can be efficiently generated.

[0035]

The first predetermined water level is a level corresponding to a small water amount, and thus an intensive flow of water can be generated by the agitation effect of blade 18 at low power consumption. Therefore, undissolved
10 detergent after supplied into pump chamber 19 can be prevented. Accordingly, bubbles can be efficiently generated from the washing liquid. A period of the bubble generation step is set to a period allowing substantially complete dissolution of the detergent, and generation of sufficient bubbles from the washing liquid. The set period of the bubble generation step is
15 appropriately determined in accordance with an agitating ability of blade 18, a shape of pump chamber 19 and the like.

[0036]

After completion of the bubble generation step, controller 24 stops motor 9, and allows water supply valve 22 to supply water to a second
20 predetermined water level within water tub 3. When water reaches the second predetermined water level, the high-concentration bubble discharge step starts.

[0037]

As illustrated in FIG. 8, controller 24 in the high-concentration bubble
25 discharge step stops supply of water, and drives motor 9 to rotate pulsator 8 and blade 18. In this step, the washing liquid and the bubbles generated in the bubble generation step are supplied from lower discharge port 34 to an

upper part of the laundry within washing and spin-drying tub 7 by the agitation effect of blade 18 as illustrated in FIG. 7 (supplied bubbles and washing liquid are indicated by arrow in FIG. 7). Thereafter, the bubbles and the washing liquid permeate the laundry. The second predetermined water
5 level is set to a level below lower discharge port 34. In addition, a water amount at the second predetermined water level is set to such a water amount as to allow supply of the washing liquid and bubbles agitated by the effect of blade 18 into washing and spin-drying tub 7 from lower discharge port 34. On the other hand, the water amount at the second predetermined water level
10 is set to such a water amount as not to allow supply into washing and spin-drying tub 7 from center discharge port 11, left discharge port 12, and right discharge port 13 located above lower discharge port 34.

[0038]

When detergent to be used is of a type easily generating bubbles,
15 bubbles may enter washing and spin-drying tub 7 through center discharge port 11, left discharge port 12, and right discharge port 13. Even in this case, there is a possibility that bubbles are supplied into washing and spin-drying tub 7 through center discharge port 11, left discharge port 12, and right discharge port 13.

20 [0039]

An amount of the bubbles and the washing liquid supplied into water tub 3 in the high-concentration bubble discharge step is set to a smaller amount than a water amount of the rated water level corresponding to the third predetermined water level in the bubble upper part discharge step. The
25 bubbles and washing liquid in the high-concentration bubble discharge step contain the dissolved high-concentration detergent. Supply of the high-concentration bubbles and washing liquid into washing and spin-drying

tub 7 can promote a permeation effect into the laundry. Further, the cleaning performance can be improved and the washing time can be shortened. Since the high-concentration bubbles and washing liquid are supplied to the upper part of the laundry along with agitation of the laundry by pulsator 8, the
5 bubble and washing liquid efficiently permeate the laundry, the cleaning performance can be improved and the washing time can be shortened.

[0040]

A period of the high-concentration bubble discharge step is set to such a period as to produce a sufficient permeation effect of the high-concentration
10 bubbles and washing liquid into the laundry. The setting period is appropriately determined in consideration of a balance between a volume of laundry, an ability for supplying bubbles and washing liquid to washing and spin-drying tub 7, an overall period of the washing step, and other conditions.

[0041]

15 After completion of the high-concentration bubble discharge step, controller 24 stops motor 9, and allows water supply valve 22 to supply water to the rated water level corresponding to the third predetermined water level in water tub 3. The rated water level in this embodiment is a water level set depending on the volume of laundry. When water reaches the third
20 predetermined water level, the upper part bubble discharge step starts.

[0042]

In the upper part bubble discharge step, controller 24 stops supply of water, and drives motor 9 to rotate pulsator 8 and blade 18.

[0043]

25 As illustrated in FIGS. 9 and 10, the laundry is agitated by convecting the washing liquid produced by rotation of pulsator 8, while the bubbles and the washing liquid within pump chamber 19 are supplied into washing and

spin-drying tub 7 through lower discharge port 34, center discharge port 11, left discharge port 12, and right discharge port 13 by the agitation effect of blade 18. By agitation of the laundry within the washing liquid containing bubbles along with supply of the bubbles and the washing liquid from above
5 the laundry, the bubbles and the washing liquid can be efficiently permeate the laundry. Particularly, in a case where a large volume of laundry is not immersed in washing liquid, the cleaning performance for an upper part of laundry, for which a cleaning effect has been limited, can be improved. Accordingly, uneven washing can be prevented. Note that, in the upper part
10 bubble discharge step, the bubbles and the washing liquid within pump chamber 19 are supplied into washing and spin-drying tub 7 also from lower discharge port.

[0044]

FIG. 11 is a view illustrating a relationship between laundry and a
15 discharge range from circulation channels of the washing machine according to the embodiment of the present invention.

[0045]

As illustrated in FIG. 11, watering from center discharge port 11, left discharge port 12, and right discharge port 13 of circulation channel 10 on one
20 side occupies substantially a half area of the inside of washing and spin-drying tub 7. In this embodiment, circulation channel 10 on one side and the circulation channel on the other side are opposite to each other. Water supplied from the pair of circulation channels 10 reaches substantially the whole laundry within washing and spin-drying tub 7 from above, and allows
25 permeation of the washing liquid into the laundry. Accordingly, the cleaning performance can be improved, while uneven washing can be prevented.

[0046]

As results of experiments, it is preferable that each of an angle formed by a center position of center discharge port 11 and a center position of left discharge port 12 and an angle formed by the center position of center discharge port 11 and a center position of right discharge port 13 is set within the range from 35° to 45°. In other words, it is preferable that the plurality of upper discharge ports 111 are formed at intervals in the range from 35 degrees to 45 degrees (inclusive) in the circumferential direction. This configuration allows uniform watering of washing liquid to the whole of washing and spin-drying tub 7. While a difference may be produced depending on a flow speed of washing liquid in the circulation channel, shapes of the discharge ports or the like, watering at the angles set within the foregoing range can cover the whole of washing and spin-drying tub 7.

[0047]

As described above, a washing machine according to a first aspect of the present invention includes main body 1, water tub 3 supported inside the main body in an anti-vibration state, washing and spin-drying tub 7 rotatably accommodated in water tub 3, pulsator 8 rotatably disposed on a central inner bottom portion of washing and spin-drying tub 7, and pump chamber 19 provided within water tub 3 and located below pulsator 8. The washing machine further includes blade 18 formed integrally with pulsator 8 and disposed in pump chamber 19, motor 9 that rotates pulsator 8 and washing and spin-drying tub 7, water supply valve 22 that supplies water into the water tub, and circulation channel 10 provided in washing and spin-drying tub 7 and circulating washing liquid within pump chamber 19 to washing and spin-drying tub 7. The washing machine further includes upper discharge ports 111 formed in an upper portion of circulation channel 10 and for supplying the washing liquid into washing and spin-drying tub 7, lower

discharge port 34 formed in circulation channel 10 and located below the upper discharge ports 111, and controller 24 that controls operations of motor 9, water supply valve 22 and the like to control respective steps of washing, rinsing, and spin-drying. Controller 24 performs a first step to supply water
5 to a first predetermined water level, and rotate pulsator 8 and blade 18 so as to dissolve detergent and generate bubbles of washing liquid within pump chamber 19. Controller 24 then performs a second step to supply water to a second predetermined water level higher than the first predetermined water level, and rotate pulsator 8 and blade 18 so as to supply the bubbles and the
10 washing liquid within pump chamber 19 to washing and spin-drying tub 7 via lower discharge port 34 from circulation channel 10. Controller 24 further performs a third step to supply water to a third predetermined water level higher than the second predetermined water level, and rotate pulsator 8 and blade 18 so as to supply the bubbles and the washing liquid within pump
15 chamber 19 to washing and spin-drying tub 7 via lower discharge port 34 and upper discharge ports 111 from circulation channel 10.

[0048]

Accordingly, the first step can prevent undissolved residue of detergent by agitating the washing liquid containing the detergent at a place spaced
20 from the laundry. Moreover, bubbles can be favorably generated by agitation with a small amount of water. In the second step, high-concentration cleaning liquid containing bubbles is discharged toward the laundry via the lower discharge port. Accordingly, this step can promote a permeation effect of the bubbles and the high-concentration cleaning liquid into the laundry,
25 thereby improving the cleaning performance and shortening the cleaning time. In the third step, cleaning liquid containing bubbles is discharged toward the laundry via the upper discharge port. Accordingly, this step can improve the

cleaning performance for an upper part of laundry, for which the cleaning performance has been conventionally limited, and enhance uniform cleaning performance.

[0049]

5 According to a second aspect of the present invention, particularly in the washing machine according to the first aspect, a water amount at the first predetermined water level is set to a water amount in the range from 0.1 to 0.4 relative to a water amount at the third predetermined water level.

[0050]

10 Therefore, undissolved residue of the detergent can be prevented, and the bubble can be efficiently generated.

[0051]

 According to a third aspect of the present invention, particularly in the washing machine according to the first aspect, a water amount at the first
15 predetermined water level in the first step is set to such an amount as not to allow supply of the washing liquid to washing and spin-drying tub 7 via lower discharge port 34.

[0052]

 This prevents undissolved detergent from being supplied to the
20 laundry. Accordingly, undissolved residue of the detergent can be prevented.

[0053]

 According to a fourth aspect of the present invention, particularly in the washing machine according to the first aspect, the second predetermined water level is set to a level below lower discharge port 34.

25 [0054]

 Therefore, the high-concentration bubbles and washing liquid containing high-concentration detergent can be supplied from the lower

discharge port into the washing and spin-drying tub. Thus, the high-concentration bubbles and washing liquid permeate the laundry, so that the cleaning performance can be improved.

[0055]

5 According to a fifth aspect of the present invention, particularly in the washing machine according to the first aspect, a plurality of upper discharge ports 111 are formed in a circumferential direction of washing and spin-drying tub 7.

[0056]

10 Therefore, washing liquid can be efficiently supplied to the whole laundry. Accordingly, the washing performance can be improved, and uneven washing can be prevented.

[0057]

 According to a sixth aspect of the present invention, particularly in the
15 washing machine according to the fifth aspect, the plurality of upper discharge ports 111 are formed at intervals in the range from 35 degrees to 45 degrees (inclusive) in the circumferential direction.

[0058]

 Therefore, uniform watering of the washing liquid toward the whole
20 washing and spin-drying tub is possible.

[0059]

 According to a seventh aspect of the present invention, particularly in the washing machine according to the first aspect, a water amount at the second predetermined water level in the second step is set to such a water
25 amount as not to allow supply of water to washing and spin-drying tub 7 via upper discharge ports 111.

INDUSTRIAL APPLICABILITY

[0060]

As described above, a washing machine according to the present invention can improve the cleaning performance for laundry loaded into a washing and spin-drying tub while preventing uneven washing. Accordingly, the washing machine according to the present invention is applicable to a drum-type or other types of washing machines.

REFERENCE MARKS IN THE DRAWINGS

10 [0061]

- | | | |
|----|----|-----------------------------|
| | 1 | main body |
| | 3 | water tub |
| | 7 | washing and spin-drying tub |
| | 8 | pulsator |
| 15 | 9 | motor |
| | 10 | circulation channel |
| | 11 | center discharge port |
| | 12 | left discharge port |
| | 13 | right discharge port |
| 20 | 14 | channel cover |
| | 15 | side cover portion |
| | 16 | upper cover portion |
| | 18 | blade |
| | 19 | pump chamber |
| 25 | 22 | water supply valve |
| | 24 | controller |
| | 33 | cover |

34	lower discharge port
35	detergent supply port
111	upper discharge port

CLAIMS

1. A washing machine comprising:
 - a main body;
 - 5 a water tub supported inside the main body in an anti-vibration state;
 - a washing and spin-drying tub rotatably accommodated in the water tub;
 - a pulsator rotatably disposed on a central inner bottom portion of the washing and spin-drying tub;
 - 10 a pump chamber formed at a position below the pulsator in the water tub;
 - a blade formed integrally with the pulsator and disposed in the pump chamber;
 - a motor for rotating the pulsator and the washing and spin-drying tub;
 - 15 a water supply valve for supplying water into the water tub;
 - a circulation channel provided in the washing and spin-drying tub and for circulating washing liquid in the pump chamber to the washing and spin-drying tub;
 - an upper discharge port formed in an upper portion of the circulation
 - 20 channel and for supplying the washing liquid into the washing and spin-drying tub;
 - a lower discharge port formed at a position below the upper discharge port in the circulation channel; and
 - a controller for controlling operations of the motor, the water supply
 - 25 valve and others to control respective steps of washing, rinsing, and spin-drying, wherein
 - the controller performs

a first step of supplying water to a first predetermined water level, and rotating the pulsator and the blade to dissolve detergent and generate bubbles of the washing liquid within the pump chamber,

5 a second step of supplying water to a second predetermined water level higher than the first predetermined water level, and rotating the pulsator and the blade to supply the bubbles and the washing liquid within the pump chamber into the washing and spin-drying tub from the lower discharge port through the circulation channel, and

a third step of supplying water to a third predetermined water level higher than the second predetermined water level, and rotating the pulsator and the blade to supply
10 the bubbles and the washing liquid within the pump chamber into the washing and spin-drying tub from the lower discharge port and the upper discharge port through the circulation channel, wherein a water amount at the first predetermined water level in the first step is set to such a water amount as not to allow supply of the washing liquid into the washing and spin-drying tub from the lower discharge port.

15

2. The washing machine according to claim 1, wherein the water amount at the first predetermined water level is a water amount in a range from 0.1 to 0.4 relative to a water amount at the third predetermined water level.

20

3. The washing machine according to claim 1, wherein the second predetermined water level is set to be below the lower discharge port.

4. The washing machine according to claim 1, wherein a plurality of the upper discharge ports are formed in a circumferential direction of the washing and spin-drying tub.

5

5. The washing machine according to claim 4, wherein the plurality of upper discharge ports are formed at intervals in a range from 35 degrees to 45 degrees inclusive in the circumferential direction.

10

6. The washing machine according to claim 1, wherein a water amount at the second predetermined water level in the second step is set to such a water amount as not to allow supply of the washing liquid into the washing and spin-drying tub from the upper discharge port.