

DESCRIPTION

WASHING MACHINE

5 TECHNICAL FIELD

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

BACKGROUND ART

10 Conventionally, this type of washing machine has been proposed to have a configuration that improves washing performance by forming a circulation channel in a washing and spin-drying tub, circulating a washing liquid in the washing and spin-drying tub using the circulation channel, and washing while spraying the washing liquid to clothes from an upper part of the
15 washing and spin-drying tub (for example, see PTL 1).

FIG. 7 is a longitudinal sectional view of a conventional washing machine disclosed in PTL 1.

In FIG. 7, a plurality of circulation channel covers 56a, 56b is provided on an inner surface of washing and spin-drying tub 53, and a plurality of
20 circulation channels 57a, 57b is formed between circulation channel covers 56a, 56b and washing and spin-drying tub 53.

Further, blade 58 is provided integrally on a lower surface of agitating blade 52, pump chamber 59 is formed on an outer peripheral side of blade 58, and pump chamber 59 communicates with circulation channels 57a, 57b.
25 Openings 60a, 60b opening toward inside or within washing and spin-drying tub 53 are formed in upper parts of circulation channels 57a, 57b, respectively. Lint filter 62 is attached to opening 60a of circulating channel 57a to remove

lint from the washing liquid circulating in circulation channel 57a. Opening 60b of circulation channel 57b is provided with a sprinkler nozzle 61 to be configured to shoot far away the washing liquid sprinkled into washing and spin-drying tub 53 from opening 60b.

5 Motor 63 drives agitating blade 52 via a V-belt and speed reduction mechanism 65. Water level sensor 66 is connected to a lower part of water receiving tub 51 to detect a water level in washing and spin-drying tub 53 and input the output water level to control device 67.

 With the above configuration, in a washing step, agitating blade 52 is
10 rotated by the rotation of motor 63, and laundry 68 and the washing liquid in washing and spin-drying tub 53 are agitated. Blade 58 rotates together with agitating blade 52, and the washing liquid between agitating blade 52 and washing and spin-drying tub 53 is pushed outward by centrifugal force generated by the rotation of blade 58. The washing liquid pushed outward
15 passes through circulation channels 57a, 57b, and is sprinkled into washing and spin-drying tub 53 through sprinkler nozzle 61 and lint filter 62. As a result, a large amount of washing liquid is sprinkled to the laundry in washing and spin-drying tub 53 from an upside.

 However, the configuration disclosed in PTL 1 has a problem that the
20 washing liquid is sprinkled only to a part of the laundry but not to the entire laundry.

 In this regard, another washing machine has been proposed (for example, see PTL 2).

 FIG. 8 is a cross-sectional view of a main portion of a circulation
25 channel of a conventional washing machine disclosed in PTL 2 as viewed from the front.

 In FIG. 8, T-shaped circulation channel cover 72 is provided on a side

wall of washing and spin-drying tub 71, and circulation channel 73 is formed between washing and spin-drying tub 71 and circulation channel cover 72. Circulation channel 73 is configured by side channel 79 and upper channel 80. Central discharge port 74, left discharge port 75, and right discharge port 76 are formed in upper channel 80. When pulsator 77 at a bottom of washing and spin-drying tub 71 rotates, washing liquid circulates in circulation channel 73, and a washing liquid rises through side channel 79, flows to upper channel 80, and is sprinkled to the laundry in washing and spin-drying tub 71 from central discharge port 74, left discharge port 75, and right discharge port 76.

When a washing step starts, the washing liquid in which detergent is dissolved is pushed out of pump chamber 78 by centrifugal force due to rotation of blade below pulsator 77, and flows to circulation channel 73. The washing liquid rises through side channel 79, flows to upper channel 80, and is sprinkled to the laundry in washing and spin-drying tub 71 from central discharge port 74, left discharge port 75, and right discharge port 76.

Multiple through holes 81 are provided on a side surface of washing and spin-drying tub 71, and fluid balancer 82 is provided on an upper peripheral edge of washing and spin-drying tub 71.

Citation List

Patent Literature

PTL 1: Unexamined Japanese Patent Publication No. H07-31785

PTL 2: Unexamined Japanese Patent Publication No. 2016-097233

SUMMARY OF THE INVENTION

However, in the configuration of PTL 2, although the washing liquid is applied to the entire laundry, when the laundry located above the water surface stays on the water surface, there is a possibility that washing

unevenness may occur. In addition, circulation channel 73 needs to be disposed below fluid balancer 82, which increases a volume of parts, increases costs, and is not suitable for increasing a diameter of washing and spin-drying tub 71.

5 The present invention provides a washing machine that prevents washing unevenness at a low cost and has improved washing performance.

 The washing machine according to the present invention includes a washing and spin-drying tub, a pulsator rotatably disposed at a bottom of the washing and spin-drying tub, a blade provided on a lower surface of the pulsator, a pump chamber on an outer periphery of the blade of the pulsator, a
10 circulation channel that is formed by the washing and spin-drying tub and a circulation channel cover, circulates a washing liquid from the pump chamber with a rotation of the pulsator, and has a discharge port discharging the washing liquid to the washing and spin-drying tub, and a plurality of holes
15 formed in the pulsator and guiding washing liquid to the lower surface of the pulsator, in which a total area of the holes of the pulsator is set to be larger than a minimum cross-sectional area of a channel of the circulation channel.

 With this configuration, the efficiency of agitating the laundry can be improved, the washing unevenness can be improved, and the washing
20 performance can be improved.

BRIEF DESCRIPTION OF DRAWINGS

 FIG. 1 is a longitudinal sectional view of a washing machine according to a first exemplary embodiment of the present invention.

25 FIG. 2 is a perspective view of a pulsator of the washing machine according to the first exemplary embodiment of the present invention.

 FIG. 3 is a plan view showing a surface of a circulation channel cover of

the washing machine according to the first exemplary embodiment of the present invention.

FIG. 4 is a plan view showing a back surface of the circulation channel cover of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 5 is a plan view showing a main portion of the surface of the circulation channel cover of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 6 is a plan view showing a main portion of the back surface of the circulation channel cover of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 7 is a longitudinal sectional view of a conventional washing machine.

FIG. 8 is a sectional view of a main portion of another conventional washing machine.

DESCRIPTION OF EMBODIMENT

Hereinafter, an exemplary embodiment of the present invention will be described with reference to the drawings. Note that the present invention is not limited by the present exemplary embodiment.

(First exemplary embodiment)

Hereinafter, a washing machine according to a first exemplary embodiment of the present invention will be described with reference to the drawings.

FIG. 1 is a longitudinal sectional view of the washing machine according to the present exemplary embodiment. FIG. 2 is a perspective view of a pulsator of the washing machine according to the present exemplary

embodiment. FIG. 3 is a plan view showing a surface of a circulation channel cover of the washing machine according to the present exemplary embodiment. FIG. 4 is a plan view showing a back surface of the circulation channel cover of the washing machine according to the present exemplary embodiment. FIG. 5 is a plan view showing a main portion of the surface of the circulation channel cover of the washing machine according to the present exemplary embodiment. FIG. 6 is a plan view showing a main portion on the back surface of the circulation channel cover of the washing machine according to the present exemplary embodiment.

In FIG. 1, water tub 3 is swingably supported by anti-vibration spring 2 in housing 1. In water tub 3, washing and spin-drying tub 7 that stores laundry is rotatably supported. Washing and spin-drying tub 7 is rotatably supported around washing and spin-drying shaft 4. Pulsator 8 having a plurality of holes 13 is rotatably supported at an inner bottom of washing and spin-drying tub 7. Holes 13 penetrate through pulsator 8 and communicate an upside and a downside of pulsator 8.

Washing and spin-drying tub 7 is provided with a plurality of spin-drying holes 5 on a side wall, and annular fluid balancer 6 for reducing spin-drying vibration is attached to an upper part of washing and spin-drying tub 7. Washing and spin-drying tub 7 is provided with a pair of circulation channel covers 14 at opposing positions on the side wall, and forms circulation channels 10 between a side surface of washing and spin-drying tub 7 and circulation channel covers 14. Two circulation channels 10 are formed by attaching a pair of circulation channel covers 14 to washing and spin-drying tub 7. Circulation channels 10 are preferably formed in an identical shape in order to suppress occurrence of imbalance during a rotation of washing and spin-drying tub 7, but may be formed in a different shape as needed.

Motor 9 is provided at a bottom of water tub 3, and motor 9 incorporates a clutch mechanism and a brake mechanism. During a washing operation, motor 9 brakes a spin-drying shaft of washing and spin-drying shaft 4, drives a washing shaft of washing and spin-drying shaft 4, and drives pulsator 8 to rotate. During a spin-drying operation, motor 9 releases braking of the spin-drying shaft, drives washing and spin-drying tub 7 to rotate, opens drain valve 26, and drains the washing liquid or a rinsing liquid in water tub 3 through drain valve 26 from drain port 25 to the outside of the machine.

Blade 18 is integrally formed on a lower surface of pulsator 8. When pulsator 8 is rotated by motor 9, the washing liquid is pushed to an outer peripheral side by centrifugal force of blade 18, and circulates in circulation channels 10. The washing liquid that has circulated through circulation channels 10 is discharged and sprinkled into washing and spin-drying tub 7 from discharge port 11 of circulation channels 10 located in the upper part of washing and spin-drying tub 7.

Operation display unit 23 is provided on an upper front surface of housing 1, and control device 24 is provided at a position below operation display unit 23 in housing 1. Control device 24 includes a control means (not shown) including a microcomputer, controls a rotation of motor 9, opening and closing of water supply valve 22 and drain valve 26, and the like, and successively controls a series of steps of washing, rinsing, and spin-drying. As shown in FIG. 1, water supply valve 22 that supplies water into washing and spin-drying tub 7 is provided at a rear part of housing 1.

Next, circulation channels 10 and circulation channel covers 14 will be described with reference to FIGS. 3 to 6. As shown in FIGS. 3 and 4, circulation channel covers 14 have discharge ports 11 formed at positions corresponding to the upper part and a middle part of washing and spin-drying

tub 7. Discharge port 11 may be formed only at a position corresponding to the upper part of washing and spin-drying tub 7.

Rib 12 protruding toward washing and spin-drying tub 7 is formed on the back surface of circulation channel covers 14, and rib 12 is brought into
5 contact with an inner surface of washing and spin-drying tub 7 to partition and form circulation channels 10. A flow rate and a flow velocity of circulation channels 10 can be adjusted by changing a width of rib 12 or a width of circulation channel covers 14 in a depth direction.

In each of circulation channels 10, a minimum cross-sectional area of a
10 channel is larger than a cross-sectional area of discharge port 11 located in an upside, and thus a pressure loss can be suppressed, and a discharge range of the washing liquid ejected from discharge port 11 located in the upside can be widened.

As shown in FIG. 6, in the present exemplary embodiment, each of
15 circulation channels 10 has the cross-sectional area of the channel formed to be smaller than the area of discharge port 11 located in the upside at an upstream position immediately before discharge port 11 located in the upside. For example, each of circulation channels 10 is formed such that a width of the channel (width b in FIG. 6) is shorter than a longitudinal length of discharge
20 port 11 (width a in FIG. 6) at the upstream position immediately before discharge port 11 located in the upside, and a position formed to have width b shorter than width a in the longitudinal direction of discharge port 11 is brought close to discharge port 11 (see space h in FIG. 6).

With this configuration, each circulation channel 10 is configured so as
25 to form a channel having a smaller cross-sectional area than the area of discharge port 11 located in the upside at the upstream position immediately before discharge port 11, and spread, at a wide angle, water ejected from

discharge port 11 located in the upside while suppressing the pressure loss.

Difference $(a - b)$ between width a in the longitudinal direction of discharge port 11 and the narrow channel having width b on the upstream side of discharge port 11 is set to be large, and space h from discharge port 11 to the
5 narrow channel having width b is reduced. The washing liquid can be therefore ejected over a wide range.

In order to supply the washing liquid to the laundry efficiently by ejecting the washing liquid from discharge port 11 located in the upside in a wide range, the flow rate of the circulating washing liquid and a channel cross-
10 sectional area of circulation channels 10 need to be optimized.

When difference $(a - b)$ between width a in the longitudinal direction of discharge port 11 and width b of the narrow channel on the upstream side of discharge port 11 is too large, the water ejected from discharge port 11 is parted or a distance discharged from discharge port 11 is reduced.

15 When the difference $(a - b)$ between width a in the longitudinal direction of discharge port 11 and width b of the narrow channel at the upstream position immediately before discharge port 11 is too small, the washing liquid discharged from discharge port 11 does not spread to a sufficient discharge range.

20 When space h from discharge port 11 to the narrow channel having width b is too long, an effect of reducing the channel cross-sectional area cannot be exerted, and the distance discharged from discharge port 11 is reduced.

When space h from discharge port 11 to the narrow channel having
25 width b is too short, the washing liquid discharged from discharge port 11 does not spread to a sufficient discharge range.

Various experiments have revealed that the washing liquid can be

ejected over a wide range by setting width a, width b, and space h so as to satisfy $4 > (a - b)/h > 2$.

In the above formula, when $(a - b)/h$ is set to be larger than 4, the water ejected from discharge port 11 is parted or the distance ejected from discharge port 11 is reduced. Conversely, when $(a - b)/h$ is set to be smaller than 2, the washing liquid discharged from discharge port 11 does not spread to a sufficient discharge range.

In the present exemplary embodiment, the cross-sectional area of the channel is changed by adjusting the width of the channel. However, the cross-sectional area may be changed by adjusting a space between circulation channel covers 14 of the channel and washing and spin-drying tub 7. Alternatively, the cross-sectional area of the channel may be changed by adjusting both the width and the space.

Hereinafter, operations and actions of the washing machine configured as described above will be described.

In the washing step, when the laundry is put into washing and spin-drying tub 7 and washing is started, water supply valve 22 is operated to fill water tub 3 with water to a predetermined height, and pulsator 8 is rotated to start a washing operation.

When the washing operation starts, blade 18 also rotates with the rotation of pulsator 8, and the washing liquid rises in circulation channels 10 from pump chamber 19 by the centrifugal force due to the rotation of the blade 18, and is sprinkled from the discharge port 11 to the laundry in washing and spin-drying tub 7.

At this time, the washing liquid is pushed to the outer peripheral side by the centrifugal force due to the rotation of blade 18 of pulsator 8, and the washing liquid is pumped up to circulation channels 10. The washing liquid in

washing and spin-drying tub 7 is thus drawn into the lower surface of pulsator 8 through holes 13 of pulsator 8.

In the present exemplary embodiment, the total area of holes 13 formed in pulsator 8 is set to be larger than a sum of the minimum cross-sectional areas of the channels in two circulation channels 10. Thus, the water flow flowing from holes 13 of pulsator 8 to the lower surface of pulsator 8 is increased, the water flow drawing the laundry is increased, and an effect of the laundry being drawn under the water surface is increased.

In addition, since convection of the washing liquid in washing and spin-drying tub 7 is increased, convection efficiency of the laundry is improved. The washing liquid can be also continuously sprinkled from discharge port 11 to the laundry newly appearing on the water surface due to the convection of the washing liquid. In particular, a course of performing the washing step with warm water with a function of raising a water temperature can prevent a decrease in the temperature of the laundry on the water surface and reduce washing unevenness.

In the conventional configuration, it is conceivable to increase the rotation speed of the pulsator. However, in this configuration, a vortex water flow due to the rotation of the pulsator is stronger than the water flow drawn into the lower surface of the pulsator. Thus, although the water flow that draws the laundry under the water surface becomes strong, the water flow that pushes up the water surface is weak. This reduces the efficiency of sprinkling the washing liquid to the laundry.

Consequently, the washing machine in the present exemplary embodiment can agitate the laundry in washing and spin-drying tub 7 while sprinkling the washing liquid evenly from the upside, and thus the washing unevenness can be suppressed and washing performance can be enhanced.

As described above, a first invention is provided with the washing and spin-drying tub, the pulsator rotatably disposed at the bottom of the washing and spin-drying tub, the blade provided on the lower surface of the pulsator, the pump chamber formed on an outer periphery of the blade of the pulsator, 5 and the circulation channels that are formed between the washing and spin-drying tub and the circulation channel cover, circulate the washing liquid from the pump chamber with the rotation of the pulsator, and have the discharge port that discharges the washing liquid to the washing and spin-drying tub. In addition, the plurality of holes that is formed in the pulsator and guides the 10 washing liquid to the lower surface of the pulsator is provided. The total area of the holes of the pulsator is set to be larger than the minimum cross-sectional area of the channels of the circulation channels.

This configuration increases the water flow drawing the laundry and increases the efficiency of agitating to draw the laundry below the water 15 surface. Further, the water flow drawing the laundry is drawn into the circulation channel following the water flow that has been pumped into the circulation channel, and thus the washing liquid can be continuously sprayed to the laundry that newly appears on the water surface.

In a second invention, in particular, the minimum cross-sectional area 20 in the channel of the circulation channel according to the first invention is set to be smaller than a cross-sectional area of the discharge port.

With this configuration, the water flow drawing the laundry is drawn into the circulation channel following the water flow that has been pumped into the circulation channel, and thus the washing liquid can be continuously 25 sprayed to the laundry that newly appears on the water surface while limiting the pressure loss on a way of a path.

In a third invention, in particular, the channel of the circulation

channel of the first invention has the cross-sectional area at the upstream position of the discharge port set to be smaller than the area of the discharge port.

5 This configuration allows the washing liquid to be jetted to a wide range of the laundry by decreasing a length in a direction in which the washing liquid is to be spread immediately before the discharge port.

In a fourth invention, in particular, the channel of the circulation channel of the first invention has the cross-sectional area at the upstream position of the discharge port set to be smaller than the area of the discharge
10 port.

This configuration allows the washing liquid to be jetted to a wide range of the laundry by decreasing the length in the direction in which the washing liquid is to be spread immediately before the discharge port.

In a fifth invention according to the third invention, in particular,
15 when the width in the longitudinal direction of the discharge port is a , the width of the channel at the upstream position of the discharge port is b , and the space between the discharge port and the channel having a small cross-sectional area at the upstream position of the discharge port is h , the channel at the upstream position of the discharge port of a circulation channel is set to
20 satisfy $4 > (a - b)/h > 2$.

This configuration allows the washing liquid to be ejected over a wide range. When $(a - b)/h$ is larger than 4, there is a problem that the ejected water is parted or the distance is reduced.

In a sixth invention according to the forth invention, in particular,
25 when the width in the longitudinal direction of the discharge port is a , the width of the channel at the upstream position of the discharge port is b , and the space between the discharge port and the channel having a small cross-

sectional area at the upstream position of the discharge port is h , the channel at the upstream position of the discharge port of a circulation channel according to the fourth invention is set to satisfy $4 > (a - b)/h > 2$.

5 This configuration allows the washing liquid to be ejected over a wide range. When $(a - b)/h$ is larger than 4, there is a problem that the ejected water is parted or the distance is reduced.

INDUSTRIAL APPLICABILITY

10 As described above, the washing machine according to the present invention can suppress the washing unevenness and improve the washing performance. Thus, the washing machine can be applied to washing and drying machines, and can be applied not only to domestic washing machines but also to commercial washing machines.

15 REFERENCE MARKS IN THE DRAWINGS

	1	housing
	3	water tub
	7	washing and spin-drying tub
	8	pulsator
20	9	motor
	10	circulation channel
	11	discharge port
	12	rib
	14	circulation channel cover
25	18	blade
	19	pump chamber

CLAIMS

1. A washing machine comprising:

a washing and spin-drying tub;

5 a pulsator rotatably disposed at a bottom of the washing and spin-drying tub;

a blade provided on a lower surface of the pulsator;

a pump chamber on an outer periphery of the blade of the pulsator;

a circulation channel that is formed between the washing and spin-
10 drying tub and a circulation channel cover, circulates a washing liquid from the pump chamber with a rotation of the pulsator, and has a discharge port discharging the washing liquid to the washing and spin-drying tub; and

a plurality of holes formed in the pulsator and guiding washing liquid to the lower surface of the pulsator,

15 wherein a total area of the holes of the pulsator is set to be larger than a minimum cross-sectional area of a channel of the circulation channel.

2. The washing machine according to claim 1, wherein the minimum cross-sectional area in the channel of the circulation channel is set to be
20 smaller than a cross-sectional area of the discharge port.

3. The washing machine according to claim 1, wherein the channel of the circulation channel has a cross-sectional area at an upstream position reaching the discharge port set to be smaller than a cross-sectional area of the
25 discharge port.

4. The washing machine according to claim 2, wherein the channel of

the circulation channel has a cross-sectional area at an upstream position reaching the discharge port set to be smaller than a cross-sectional area of the discharge port.

5 5. The washing machine according to claim 3, wherein
the channel at the upstream position of the discharge port of the
circulation channel is set to satisfy $4 > (a - b)/h > 2$

wherein a is a width in a longitudinal direction of the discharge port,

b is a width of the channel having a small cross-sectional area at the
10 upstream position reaching the discharge port, and

h is a space between the discharge port and the channel having a small
cross-sectional area at the upstream position reaching the discharge port.

6. The washing machine according to claim 4, wherein
15 the channel at the upstream position of the discharge port of the
circulation channel is set to satisfy $4 > (a - b)/h > 2$

wherein a is a width in a longitudinal direction of the discharge port,

b is a width of the channel having a small cross-sectional area at the
upstream position reaching the discharge port, and

20 h is a space between the discharge port and the channel having a small
cross-sectional area at the upstream position reaching the discharge port.