

WASHING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a washing machine capable of circulating water with an enough hydraulic pressure even with a low water level.

2. Background Art

The conventional washing machine disclosed in Unexamined Japanese Patent Publication No. 07-255992 (Patent Document 1) is provided with a water circulation path and a filter to efficiently collect a foreign matter, such as lint, which arises during washing.

The washing machine disclosed in the Patent Document 1 is described below referring to Fig. 4.

Fig. 4 is a side cross-sectional view illustrating an overall structure of the conventional washing machine disclosed in the Patent Document 1. As illustrated in Fig. 4, the conventional washing machine has water tub 3 provided in outer tub 2, water circulation path 120 provided in a direction perpendicular to an inner peripheral surface of water tub 3, and discharge opening 140 having lint filter 150 and provided on an upper end of water circulation path 120. An inner surface of a bottom section of water tub 3 is provided with rotary vane 5 having outer vane 502 radially formed on a side facing a bottom section of water tub 3.

When rotary vane 5 is rotated with water tub 3 being filled with

water, a pumping action exerted by outer vane 502 delivers the water on the bottom portion of water tub 3 into lower-end opening 130 of water circulation path 120 through water passage port 200. The water thus delivered into lower-end opening 130 runs upward in water circulation path 120 to be finally discharged into water tub 3 through discharge opening 140. During the delivery of the water, a foreign matter included in the water discharged into water tub 3, such as lint, is collected by lint filter 150.

In the conventional washing machine which automatically selects a water level depending on a volume of laundry, the water level is set to a low position in water tub 3 when a small volume of laundry is washed. Such a low water level weakens a pumping action of outer vane 502 of rotary vane 5, failing to lift the water as high as to reach discharge opening 130 of water circulation path 120. As a result, a volume of water passing through lint filter 150 lessens, resulting in a decrease in the efficiency of collecting the foreign matter.

It is a possible solution for improving the efficiency of collecting the foreign matter to increase the volume of water passing through lint filter 150 by setting the water level to a higher position. This solution, however, requires at least a certain volume of water all the time even with a small amount of laundry to be washed, sacrificing a water-saving effect.

SUMMARY OF THE INVENTION

A washing machine according to the present invention includes a water tub having a rotary vane on a bottom section thereof and an outer tub rotatably encompassing the water tub, wherein a first water circulation path

and a second water circulation path are provided on an inner peripheral surface of the water tub; the first water circulation path has a first opening formed at a position facing an outer peripheral side of the rotary vane, and a first filter having a first discharge section and provided on an upper side of the water tub; the second water circulation path has a second opening formed at a position facing the outer peripheral side of the rotary vane, a second discharge section provided on water tub, and a second filter having a third discharge section and provided between the second opening and the second discharge section; and the second discharge section is provided at a position lower than the first discharge section. The washing machine thus can discharge water through the filter by using the second water circulation path even when a water level for washing is set to a relatively low position, thereby improving an efficiency of collecting any foreign matter such as lint.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 shows a side cross-sectional view illustrating an overall structure of a washing machine according to an exemplary embodiment of the present invention;

Fig. 2 shows a perspective view illustrating a structure of a second water circulation path in the washing machine according to the exemplary embodiment;

Fig. 3 shows a perspective view illustrating an internal structure of the second water circulation path in the washing machine according to the exemplary embodiment; and

Fig. 4 shows a side cross-sectional view illustrating an overall

structure of a conventional washing machine.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, an exemplary embodiment of the present invention is described referring to the drawings. The present invention is not necessarily limited to the exemplary embodiment described below.

Exemplary Embodiment

Fig. 1 is a side cross-sectional view illustrating an overall structure of a washing machine according to an exemplary embodiment of the present invention.

As illustrated in Fig. 1, the washing machine according to the exemplary embodiment has water tub 3 in which multiple water passage holes 16 are circumferentially formed, and outer tub 2 rotatably encompassing water tub 3. Outer tub 2 is supported by a plurality of hanging bars (not illustrated in the drawing) in outer cabinet 1 so that the vibration of outer tub 2 is not transmitted to outer cabinet 1. Balancer 11 is provided on an upper end portion of water tub 3 to control the vibration of water tub 3 during centrifugal dehydration.

Rotary vane 5 is rotatably provided on a bottom portion of water tub 3. Rotary vane 5 has agitator vane 501 formed on the opening side of water tub 3, and outer vane 502 radially formed on the bottom-portion side of water tub 3. A rotational power of motor 6 attached to a lower surface of outer tub 2 is transmitted to water tub 3 and rotary vane 5 by way of motor pulley 7, belt 8, main pulley 9, and power switching unit 10. Power switching unit 10 mechanically couples or decouples driving shafts of water tub 3 and rotary

vane 5 so that water tub 3 and rotary vane 5 are integrally rotated when laundry is centrifugally dehydrated but rotary vane 5 alone is rotated otherwise. A direct drive method may be employed to rotate water tub 3 and rotary vane 5 without using belt 8.

An inner peripheral surface of water tub 3 is provided with first water channel wall member 30. Between the inner peripheral surface of water tub 3 and first water channel wall member 30, first water circulation path 12 having a flat shape in cross section and extending in a substantially perpendicular direction (including perpendicular direction) is formed. First water circulation path 12 has first opening 13 opened at a lower end thereof, and first filter 15 having first discharge section 14 opened at an upper end thereof. To collect a foreign matter such as lint, for example, a mesh lint filter is attached to first discharge section 14 in a detachable manner.

The inner peripheral surface of water tub 30 is further provided with second water channel wall member 31. Between the inner peripheral surface of water tub 3 and second water channel wall member 31, second water circulation path 17 having a flat shape in cross section and extending in a substantially perpendicular direction (including perpendicular direction) is formed. Second water circulation path 17 has second opening 18 opened at a lower end thereof, second discharge section 19 opened at an upper end thereof, and second filter 25 provided on the lower side of second discharge section 19 and protruding inward of water tub 3. Second filter 25 is provided with third discharge section 23. Second discharge section 19 of second water circulation path 17 is provided at a position lower than first discharge section 14 of first water circulation path 12. When a water level

for washing is set to relatively low, the washing machine thus can discharge and circulate the water well by using second discharge section 19 even with a low hydraulic pressure. As a result, such a foreign matter as lint can be collected with a high efficiency, and detergent put in the washing machine can be dissolved for a short period of time so that the laundry can be washed with a high washing performance within a preset running time of the rotary vane.

Hereinafter, second water circulation path 17 is described in detail referring to the drawings.

Fig. 2 is a perspective view illustrating a structure of the second water circulation path in the washing machine according to the exemplary embodiment. Fig. 3 is a perspective view illustrating an internal structure of the second water circulation path in the washing machine according to the exemplary embodiment. Fig. 2 is a perspective illustration of the second water circulation path in the washing machine according to the exemplary embodiment when viewed from the inner peripheral side of the water tub (front side of the second water circulation path). Fig. 3 is a perspective illustration of the second water circulation path in the washing machine according to the exemplary embodiment when viewed from the outer peripheral side of the water tub (back side of the second water circulation path).

As illustrated in Figs. 2 and 3, second water circulation path 17 includes second opening 18 opened at a lower end thereof, second discharge section 19 opened inward of water tub 3, and main member 20 having filter room 21 formed therein in such a substantially box shape (including box

shape) that opens inward of water tub 3 where second filter 25 is attached and detached.

In second water circulation path 17, water channels 22a and 22b continuous from second opening 18 to second discharge section 19 are formed on both sides of filter room 21 as illustrated in Fig. 3. Water passage ports 23a and 23b located on the upper side of lint filter 33 of detachable second filter 25 are formed on the respective sides of water channels 22a and 22b of filter room 21.

Second filter 25 has filter frame 40, and mesh lint filter 33 used to collect, for example, lint. Second filter 25 is provided so that lint filter 33 having a substantially bag shape (including bag shape) protrudes into water tub 3. Such a structure makes it difficult for a lint capturing plane of second filter 25 to directly face the water when the wash or rinse operation is suspended by reversing the rotation of rotary vane 5, or the water after wash is discharged from water tub 3 into second water circulation path to be drained, thereby decreasing a flow rate of the water passing through the filter. This effectively prevents the lint captured by lint filter 33 from returning into water tub 3, consequently reducing the quantity of lint attached to the washed clothing when the wash is completed independent of whether the water level is high or low.

Further, water flowing into second filter 25 to be discharged passes through water passage ports 23a and 23b of filter room 21 of second water circulation path 17 provided at positions higher than lint filter 33 of second filter 25 before flowing into second filter 25. This positional arrangement helps to improve the efficiency of collecting the foreign matter, and prevents

such an event that the captured lint is released from lint filter 33, which is likely to occur when the wash operation is suspended by reversing the rotation of the rotary vane.

Second filter 25 is provided to protrude into water tub 3, which makes it easier to check whether lint filter 33 is clogged with lint. Therefore, the filter can be cleaned whenever suitable to do so. A material of lint filter 33 is made of, for example, antimicrobial-treated polyester resin fiber. Such a material can avoid mold which may be generated by the captured lint, thereby continuously sustaining good hygiene during the.

Filter frame 40 of second filter 25 can be attached to and detached from filter room 21 of main member 20 in second water circulation path 17. Filter frame 40 has a retainer unit 41 equipped with protruding portion 42 formed at a lower end thereof, and claw portions 43 having a substantially U shape (including U shape) to be engaged with mating portions (not illustrated in the drawings) of filter room 21. Using, for example, resin to form retainer unit 41, second filter 25 can be attached to and detached from filter room 21 by elastically deforming retainer unit 41.

More specifically, when attaching filter frame 40 to filter room 21, first, protruding portion 42 formed at the lower end of filter frame 40 is inserted in dented portion 44 formed in filter room 21 of main member 20. Filter frame 40 is pivoted on inserted protruding portion 42 as a pivot point until claw portions 43 formed in retainer unit 41 of filter frame 40 are engaged with engagement holes 45 formed at an upper end portion of filter room 21. Then, claw portions 43 of retainer unit 41 are engaged with engagement holes 45 provided at the upper end portion of filter room 21 so

that filter frame 40 of second filter 25 is securely fitted into filter room 21 by way of claw portions 43 and protruding portion 42 of retainer unit 41.

To remove filter frame 40 from filter room 21, filter frame 40 is pulled forward while pushing an upper section of retainer unit 41. Then, claw portions 43 of second filter 25 and engagement holes 45 of filter room 21 are disengaged from each other, and filter frame 40 with lint filter 33 attached thereto is removed from filter room 21. Lint filter 33 of second filter 25 thus removed can be easily cleaned.

The lint captured by lint filter 33 generally includes the residual of detergent or dirt containing a large volume of moisture. If the lint is left in water tub 3 with poor ventilation, lint filter 33 is likely to be moldy. According to the washing machine equipped with filter frame 40 that can be attached to and detached from filter room 21, second filter 25 can be easily cleaned and used in good condition.

On both ends of filter frame 40, cutout portion 34 is provided to deliver the water into second filter 25 through water passage ports 23a and 23b of filter room 21 when second filter 25 is attached to filter room 21.

Reservoir 32 is provided in a lower section of filter room 21. Water passage ports 23a and 23b of filter room 21 are provided at positions higher than a lowermost portion of lint filter 33 of second filter 25. The water passage ports (water passage ports 23a and 23b) of the filter room 21 is provided in a position higher than a lower end of the second filter 25 when the second filter 25 is attached to the filter room 21, and the water for washing being circulated flows into water tub 3 through lint filter 33 provided in the second discharge section from the upper side of second filter

25.

Therefore, when the wash or rinse operation is suspended by reversing the rotation of rotary vane 5 or the water is drained, the water for washing in water tub 3 coming from second discharge section 19 and flowing back downward from upward in second water circulation path 17 can be guided to flow into lint filter 33 of second filter 25 through water passage ports 23a and 23b by way of water channels 22a and 22b of second water circulation path 17 to collect the foreign matter.

As illustrated in Fig. 3, protruding portions 24a and 24b are provided in second water circulation path 17 at positions facing water passage ports 23a and 23b of filter 21 in water channels 22a and 22b so that a flow path sectional area near water passage ports 23a and 23b is narrowed. As a result of providing these protruding portions, the water discharged from second discharge section 19 can have an enough hydraulic pressure, and an enough volume of water can flow into second filter 25 through water passage ports 23a and 23b of second water circulation path 17.

The operation of the washing machine according to the exemplary embodiment thus structured is described below.

When rotary vane 5 is rotated after outer tub 2 is filled with a given volume of water, agitator vane 501 of Fig. 1 provided on the upper surface of rotary vane 5 causes a water flow rotating in a substantially horizontal direction (including horizontal direction) in water tub 3. A pumping action exerted by outer vane 502 of rotary vane 5 sucks up the water between the bottom surfaces of water tub 3 and outer tub 2 through water passage section 26. The water thus sucked up passes through first opening 13 into

first discharge section 14 by way of first water circulation path 12, and rapidly flows into second discharge section 19 through second opening 18 by way of second water circulation path 17.

The water running upward in first water circulation path 12 passes through the lint filter of first filter 15 to spout into water tub 3. The water running upward in second water circulation path 17 passes through second discharge section 19 to spout into water tub 3. A part of the water running upward in second water circulation path 17 passes through water passage ports 23a and 23b and runs toward filter room 21, and then passes through lint filter 33 provided in the third discharge section 23 of second filter 25 to spout into water tub 3.

When the water level is high with a large volume of laundry to be washed (for example, water level H in Fig. 1), the water running upward in first water circulation path 12 having a high hydraulic pressure rapidly pours into water tub 3 through first filter 15 by way of first discharge section 14. When the water level is low with only a small volume of laundry to be washed (for example, water level L in Fig. 1), less water pours into water tub 3 through first filter 15 because of a low hydraulic pressure of the water running upward in first water circulation path 12.

Second water circulation path 17 is provided at a position lower than first water circulation path 12 so that the opening and the discharge section are less distant from each other than in first water circulation path 12. Therefore, when the water level for washing is low (for example, water level L in Fig. 1), the water can easily run upward in second water circulation path 17 and smoothly pass through second filter 25 to then spout into water

tub 3. Such a water flow enables lint filter 33 of second filter 25 to reliably collect any foreign matter such as lint.

As described so far, the washing machine according to the present exemplary embodiment can effectively remove any foreign matter included in the water in water tub 3 by using first filter 15 and second filter 25 regardless of the water level for washing, whether it is high or low. The washing machine can circulate and discharge the water for washing with an adequately high hydraulic pressure at all of the water levels available in the washing machine. The washing machine can fully dissolve detergent put in the water tub for a short period of time to wash the laundry with a high washing performance within a preset operating time.

Main member 20 of second water circulation path 17 may be provided with a dented portion having a dent on the side of second water circulation path 17 in accordance with the thickness of filter frame 40, so that filter frame 40 can be more securely attached to main member 20. This structural arrangement can prevent second filter 25 from protruding forward, thereby avoiding such an event that the laundry being washed may get caught by second filter 25.

What is claimed is:

1. A washing machine comprising a water tub having a rotary vane on a bottom section thereof and an outer tub rotatably encompassing the water tub, wherein:

a first water circulation path and a second water circulation path are provided on an inner peripheral surface of the water tub;

the first water circulation path has a first opening formed at a position facing an outer peripheral side of the rotary vane, and a first filter having a first discharge section provided on an upper side of the water tub;

the second water circulation path has a second opening formed at a position facing the outer peripheral side of the rotary vane, a second discharge section provided on the water tub, and a second filter having a third discharge section provided between the second opening and the second discharge section; and

the second discharge section is provided at a position lower than the first discharge section.

2. The washing machine as claimed in Claim 1, wherein the second water circulation path includes a filter room provided with a water passage port and water channels formed on both sides of the filter room, and

the water passage port of the filter room is provided in a position higher than a lower end of the second filter when the second filter is attached to the filter room.

3. The washing machine as claimed in Claim 2, wherein the second

filter is provided to protrude into the water tub.

4. The washing machine as claimed in one of Claims 2 and 3, wherein the second water circulation path has a protruding portion protruding toward the water passage port formed inside the water channel in a position facing the water passage port of the filter room.