DESCRIPTION

Title of Invention: WASHING MACHINE

TECHNICAL FIELD

The present invention relates to a washing machine, and particularly relates to a washing machine including a hot water generating device that heats washing water.

BACKGROUND ART

Conventionally, this type of washing machine includes a hot water generating device, and by heating washing water, detergent is activated to increase detergency (for example, see PTL 1).

FIG. 18 is a perspective view of a water tub in a conventional washing machine. FIG. 19 is a perspective view of a bottom surface of the water tub in a state in which a heater of the conventional washing machine is detached. FIG. 20 is a configuration diagram of a main portion of a heater assembly showing a state in which the heater of the conventional washing machine is attached to a bottom of the water tub.

In FIG. 18, water tub 200 is suspended, vibration-controlled, and supported by a suspension (not shown) inside a washing machine body (not shown). Inside water tub 200, a washing machine and spin-drying tub (not shown) is disposed rotatably.

An inner bottom of water tub 200 has bulging part 210 that bulges downward, and heater 220 including a sheath heater or the like is housed inside bulging part 210. Further, a lower part of bulging part 210 includes drain port 213. Note that heater assembly 211 constituting a hot water

generating device at least includes bulging part 210 formed on an outer bottom surface of water tub 200, heater 220 disposed within bulging part 210, and support member 240 disposed between bulging part 210 and heater 220.

In the above configuration, motion in a presoaking process of the conventional washing machine will be described.

Laundry is put into the washing and spin-drying tub with necessary detergent, and an operation switch (not shown) is operated to start operation. When the operation is started, a predetermined amount of water is supplied into water tub 200 by a water supply device.

Subsequently, in order to dissolve the detergent, agitation with supplied water in which the washing and spin-drying tub rotates at low speed is performed.

After that, the presoaking process of heating the washing water for a long time is performed by heating of heater 220.

By this presoaking process, the detergent is activated by a rise in a water temperature of the washing water, and washing can be effectively performed.

As shown in FIG. 20, the bottom surface of water tub 200 of the conventional washing machine is configured with support member 240 for supporting heating part 221 of heater 220. Support member 240 is folded so as to match with a shape of heating part 221 folded many times, and supports heating part 221 so that heating part 221 does not move. Further, tip 241 of support member 240 is fastened to boss 250 by fastening member 243.

Hereinafter, a method for mounting heater 220 of heater assembly 211 of the above-described conventional washing machine on water tub 200 and a method for separating heater 220 from water tub 200 will be described.

When heater 220 is mounted on water tub 200, heating part 221 of

heater 220 is inserted into bulging part 210 from outside of water tub 200 through opening 230 at a lower part of water tub 200. Since heater 220 is inserted into support member 240 within bulging part 210, heater 220 is stably supported without being moved. When insertion of heater 220 is completed, by tightening a nut that fixes heater 220 and the washing and spin-drying tub, heater 220 is firmly supported and fixed inside bulging part 210.

Meanwhile, when maintenance of heater assembly 211 is performed, heater 220 can be separated from water tub 200 by a method opposite to the above-described mounting operation method. In other words, by loosening the nut and pulling heater 220 out of bulging part 210, heater 220 can be extracted from bulging part 210 and separated from water tub 200.

Citation List

Patent Literature

PTL 1: Japanese Translation of PCT Publication No. 2005-512742

SUMMARY

In the conventional configuration, when maintenance of heater assembly 211 is performed, it is necessary to extract heater 220 from bulging part 210. However, since the washing and spin-drying tub is disposed inside water tub 200, when heater 220 is inserted from the outside of water tub 200, an inside of water tub 200 cannot be visually recognized. Accordingly, whether heater 220 is certainly attached to support member 240 on an inner bottom surface of water tub 200 cannot be recognized. Further, since heater 220 needs to be inserted into water tub 200 in a state in which a position of support member 240 inside water tub 200 cannot be recognized, there is a possibility that heater 220 is collided with support member 240 and damaged.

Thus, the washing machine having the conventional configuration has

a problem in convenience when maintenance of the hot water generating device (the heater assembly in the above-described conventional technique) is performed.

A washing machine according to the present invention includes a washing machine body, a water tub supported in an inside of the washing machine body and having a bottom with a drain port, and a drain cock unit coupled with the drain port of the water tub. Further, the drain cock unit is connected with a heater unit communicating with an inner bottom of the water tub. The heater unit incorporates a heater for heating washing water and includes a water passage communicating with the inner bottom of the water tub. The water passage and the drain cock unit are opened to the heater unit at positions where water temperatures of the washing water are different.

With this configuration, since the heater unit is provided separately from the water tub, state confirmation of an inside of the heater unit and maintenance of the heater unit can be easily performed.

Further, a washing machine relating to the present invention includes a washing machine body, a water tub supported in an inside of the washing machine body and having a bottom with a drain port, a drain cock unit coupled with the drain port of the water tub, and a heater unit coupled with the drain cock unit and communicating with an inner bottom of the water tub. Furthermore, the heater unit has a heater container that houses a heater for heating washing water inside, and an inner wall bottom surface of the heater container is gradually inclined downward toward the drain cock unit.

With this configuration, maintenance of the heater unit can be easily performed, and since washing water within the heater container flows to the drain cock unit during drainage, accumulation of the washing water within the heater container or foreign matter during the drainage can be suppressed.

Further, a washing machine relating to the present invention includes a washing machine body having an openable inspection opening for inspecting an inside, a water tub supported in an inside of the washing machine body and having a bottom with a drain port, a drain cock unit coupled with the drain port of the water tub, and a heater unit coupled with the drain cock unit and communicating with an inner bottom of the water tub. Further, the heater unit has a heater container having an opening at one end, a heater mounted within the heater container for heating washing water, and a lid body for openably mounting the opening of the heater container. Furthermore, the heater unit is mounted on the bottom of the water tub in a state in which the opening of the heater container is directed to the inspection opening.

With this configuration, by removing the lid body from the heater container, even when the heater container is mounted on an outer bottom of the water tub, a state of an inside of the heater container can be easily recognized, and a state of an inside of a hot water generating device can be easily recognized.

Further, in the arrangement configuration of heater 220 of the conventional washing machine, since support member 240 for reducing radiant heat of heater 220 is fixed to water tub 200 by screw fastening, expansion of water leakage damage from perforation from a screw part caused by melting of water tub 200 may occur.

A washing machine relating to the present invention includes a washing machine body, a water tub supported in an inside of the washing machine body and having a bottom with a drain port, a drain cock unit coupled with the drain port of the water tub, and a heater unit coupled with the drain cock unit and communicating with an inner bottom of the water tub. Further, the heater unit has a heater container having an opening at a first end, a

heater mounted within the heater container for heating washing water, and a substantially U-shaped sheet metal member located between the heater container and the heater. Further, a fixed gap is formed on a side surface of the sheet metal member, the sheet metal member is inserted into the heater container from the opening on the first end side of the heater container, and in the heater container, a belt-shaped rib is extended in an insertion direction of the sheet metal member so as to correspond to the gap of the sheet metal member. Furthermore, an end on the first end side of the belt-shaped rib is formed narrower than the gap on the side surface of the sheet metal member, and a second end opposite to the first end of the belt-shaped rib is formed wider than the gap on the side surface of the sheet metal member.

With this configuration, since the sheet metal member can be fixed within the heater container without screw fastening or welding, occurrence of water leakage damage from a screw caused by melting of the heater container can be suppressed.

Further, a washing machine relating to the present invention includes a washing machine body, a water tub supported in an inside of the washing machine body and having a bottom with a drain port, and a drain cock unit coupled with the drain port of the water tub. Further, a heater unit coupled with the drain cock unit and communicating with an inner bottom of the water tub and a heater incorporated in the heater unit for heating washing water are included, and the drain port is formed in a substantially elliptical shape.

With this configuration, maintenance of the heater unit can be easily performed, and an area of the drain port can be increased without making large investment on mold. Accordingly, the washing water within the water tub and the heater container can be efficiently circulated at low cost.

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.

FIG. 2 is an exploded perspective view of a heater unit disposed on a back surface of a water tub of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 3 is a perspective view of the heater unit of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 4 is a perspective view of the heater unit of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 5A is a top view of the heater unit of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 5B is a sectional view taken along line 5B-5B in FIG. 5A.

FIG. 6 is a sectional view of the heater unit of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 7 is a sectional view of a bottom surface of the water tub and the heater unit of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 8 is an enlarged sectional view of a main portion of the heater unit of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 9 is a sectional view taken along line 9-9 in FIG. 5A.

FIG. 10 is an enlarged sectional view of a main portion of the heater unit of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 11 is a partial sectional perspective view showing flow of washing water within the heater unit of the washing machine according to the first

exemplary embodiment of the present invention.

FIG. 12 is a graph of a water temperature within a heater container and a water temperature within the water tub of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 13 is an exploded perspective view of a heater unit of a washing machine according to a second exemplary embodiment of the present invention.

FIG. 14 is a sectional view of a bottom surface of a water tub, a drain cock unit, and the heater unit of the washing machine according to the second exemplary embodiment of the present invention.

FIG. 15 is a perspective view of the heater unit of the washing machine according to the second exemplary embodiment of the present invention.

FIG. 16 is a perspective view of the heater unit of the washing machine according to the second exemplary embodiment of the present invention.

FIG. 17 is a sectional view showing flow of washing water within the heater unit of the washing machine according to the second exemplary embodiment of the present invention.

FIG. 18 is a perspective view of a water tub in a conventional washing machine.

FIG. 19 is a perspective view of a back surface of the water tub in a state in which a heater of the conventional washing machine is detached.

FIG. 20 is a side view of a main portion showing a heater assembly in a state in which the heater of the conventional washing machine is attached to a bottom of the water tub.

DESCRIPTION OF EMBODIMENTS

Hereinafter, exemplary embodiments will be described in detail with reference to the drawings as appropriate. However, descriptions in more detail

than necessary may be omitted. For example, the detailed description of already well-known matters and the overlap description of substantially identical configurations may be omitted. This is intended to prevent the following description from becoming unnecessarily redundant and to facilitate understanding by those skilled in the art.

Note that the attached drawings and the following description are provided for those skilled in the art to fully understand the present disclosure, and are not intended to limit the subject matter as described in the appended claims.

[Contents]

1. First exemplary embodiment

1-1. Configuration

1-1-1. Configuration of washing machine

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1-2. Operational motion of washing machine

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1-4. State confirmation of heater unit, and maintenance method

1-5. Method for detecting water temperature within water tub

2. Second exemplary embodiment

2-1. Configuration of heater unit

2-2. Flow of washing water within heater unit

3. Other exemplary embodiments

[1. First exemplary embodiment]

A washing machine according to the first exemplary embodiment of the present invention will be described below with reference to FIGS. 1 to 12.

[1-1. Configuration]

[1-1-1. Configuration of washing machine]

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

In FIG. 1, water tub 13 is suspended, vibration-controlled, and supported by suspension 12 inside washing machine body 11. Washing and spin-drying tub 15 serving both as a washing tub and a spin-drying tub is rotatably provided inside water tub 13. Pulsator 18 is rotatably disposed at a bottom of washing and spin-drying tub 15.

An outer bottom of water tub 13 is provided with transmission mechanism 20. Transmission mechanism 20 incorporates a gear (not shown) to reduce speed during washing, a changeover clutch (not shown) of washing/spin-drying shaft 14, and a brake (not shown) to stop washing and spin-drying tub 15.

Motor 21 is mounted on the outer bottom of water tub 13, and motor-side pulley 22 is mounted on motor 21. Mechanism-side pulley 23 is coupled to washing/spin-drying shaft 14, and motor-side pulley 22 and mechanism-side pulley 23 are coupled to each other by belt 24. With this configuration, power of motor 21 is transmitted to washing/spin-drying shaft 14 via belt 24. Further, by controlling the changeover clutch, a state of rotating only pulsator 18 and a state of simultaneously rotating pulsator 18 and washing and spin-drying tub 15 can be realized by using motor 21.

Upper frame body 25 is disposed on an upper part of washing machine body 11. A substantially central part of upper frame body 25 includes laundry loading/unloading port 26 for communicating washing and spin-drying tub 15 and an outside, and laundry loading/unloading port 26 is openably covered with door body 27. A rear side of upper frame body 25 is disposed with operation display 29 in which various input settings are made and which displays the set contents. Water supply valve 30 that can be opened by

electromagnetic force and water pouring case 31 are disposed inside the rear side of upper frame body 25.

A control device (not shown) having control means (not shown) that controls motor 21 or the like to sequentially control a series of washing, rinsing, and spin-drying processes or to control a water temperature of washing water is disposed inside washing machine body 11.

Fluid balancer 16 is disposed at an upper part of washing and spin-drying tub 15. Backboard 17 is detachably disposed on a back surface of washing machine body 11 so as to cover back surface opening (inspection opening) 11a.

FIG. 2 is a perspective view of a bottom surface of the water tub and an exploded perspective view of a heater unit of the washing machine according to the present exemplary embodiment. As shown in FIG. 2, a bottom of water tub 13 has first drain port 33a and second drain port 33b.

[1-1-2. Configuration of heater unit]

FIGS. 3 and 4 are perspective views of the heater unit of the washing machine according to the present exemplary embodiment. FIG. 5A is a top view of the heater unit of the washing machine according to the present exemplary embodiment. FIG. 5B is a sectional view taken along line 5B-5B in FIG. 5A. FIG. 6 is a sectional view of the heater unit of the washing machine according to the present exemplary embodiment. FIG. 7 is a sectional view of the bottom surface of the water tub and the heater unit of the washing machine according to the present exemplary embodiment. FIG. 8 is an enlarged sectional view of a main portion of the heater unit in FIG. 7. FIG. 9 is a sectional view of the bottom surface of the water tub of the washing machine according to the present exemplary embodiment and taken along line 9-9 in FIG. 5A. FIG. 10 is an enlarged sectional view of a main portion of the

heater unit in FIG. 9 of the washing machine according to the present exemplary embodiment.

Heater unit 32 of the washing machine according to the present exemplary embodiment will be described below.

As shown in FIG. 1, heater unit 32 is fixed to the outer bottom on the back surface side of water tub 13 at a position where maintenance can be performed by detaching backboard 17.

As shown in FIG. 2, heater unit 32 includes substantially rectangular parallelepiped heater container 37 with both ends in a longitudinal direction opened, heater 38 inserted through a first opening of heater container 37, sheet metal member 36 inserted through a second opening of heater container 37 and covering heater 38, and lid body 51 covering the second opening, through which sheet metal member 36 is inserted.

The parts will be described below.

[A. Heater container 37]

Heater container 37 is formed of heat-resistant resin, and has the substantially rectangular parallelepiped shape with both the ends in the longitudinal direction opened. Of the openings in the longitudinal direction of heater container 37, the first opening is heater inserting opening 37b for inserting heater 38, and the second opening is sheet metal inserting opening 37c for inserting sheet metal member 36 and covered with lid body 51.

On an upper surface of heater container 37 and near heater inserting opening 37b, tubular outflow passage 37g communicating with second drain port 33b at the bottom of water tub 13 is formed.

On a side surface adjacent to a surface having outflow passage 37g and near sheet metal member inserting opening 37c, drain cock connecting opening 37a communicating with drain cock unit 34 is formed. Drain cock unit 34 and

heater container 37 are detachably mounted by screw fastening (not shown) or the like.

As shown in FIG. 2, drain cock unit 34 is welded and fixed by welding bosses 45 at a position where inflow port 34a and first drain port 33a at the bottom of water tub 13 communicate. Water tub 13 and heater container 37 are communicated and connected via drain cock unit 34. As shown in FIGS. 2, 3, 4, and 5B, drain cock unit 34 has drain passage side opening 34c. Drain passage side opening 34c is connected and communicated with drain passage 41 (see FIG. 1). By opening a drain valve (not shown) of drain cock unit 34, washing water within water tub 13 and heater container 37 is drained to the outside of washing machine body 11 through drain passage 41.

In the present exemplary embodiment, as shown in FIGS. 6 and 9, inner wall upper surface 39b and inner wall lower surface 39a of heater container 37 are formed so that an inclination angle of inner wall upper surface 39b and an inclination angle of inner wall lower surface 39a of heater container 37 are substantially identical. With this configuration, as shown in FIGS. 3 and 4, even when heater container 37 is turned upside down, heater container 37 can be inserted into the bottom of water tub 13 via drain cock unit 34 and used. As a result, heater unit 32 can be disposed considering a gravity center of vibration, arrangement of parts, and the like for each type of the washing machine.

Note that in the present exemplary embodiment, water tub 13 and drain cock unit 34 are welded and fixed, but the present invention is not limited to this. Drain cock unit 34 and water tub 13 may be detachably mounted by screw fastening or the like.

[B. Sheet metal member 36]

As shown in FIG. 2, sheet metal member 36 surrounding heater 38 has

a substantially rectangular parallelepiped shape with both ends in the longitudinal direction opened. Sheet metal member 36 is inserted forward into heater container 37 through sheet metal member inserting opening 37c.

Since radiant heat generated from heater 38 is conducted to sheet metal member 36 and diffused, a risk of melting a part of heater container 37 by heat concentration to cause perforation can be reduced.

Sheet metal member 36 includes two sheet metal parts. As shown in FIGS. 2 and 7, one end of sheet metal member 36 is spot-welded along spot welding part 42 in the longitudinal direction. As shown in FIGS. 7 and 8, another end of sheet metal member 36 has separation part 36a that is not welded and has a fixed gap. As a result, sheet metal member 36 is substantially U-shaped. Sheet metal member 36 includes support piece 40 recessed inward by bending. This support piece 40 fixes heater 38 housed in heater container 37 so that heater 38 is not moved.

With reference to FIGS. 6, 7, and 8, a method for fixing sheet metal member 36 and heater container 37 will be described.

As shown in FIG. 6, on the inner wall of heater container 37, belt-shaped rib 37d is extended so as to correspond to a position of separation part 36a in a state in which sheet metal member 36 is inserted into heater container 37. When sheet metal member 36 is inserted forward into heater container 37 through sheet metal member inserting opening 37c, belt-shaped rib 37d is located at separation part 36a.

As shown in FIGS. 7 and 8, in the state in which sheet metal member 36 is inserted into heater container 37, width dimension W of belt-shaped rib 37d at a position abutting on sheet metal member 36 is made larger from a rear side to a front side.

Width dimension W1 of an end on sheet metal member inserting

opening 37c side (rear side) of belt-shaped rib 37d in FIG. 8 is formed smaller than a separation width of separation part 36a in a state in which sheet metal member 36 is housed within heater container 37. Width dimension W2 of an end on heater inserting opening 37b side (front side) of belt-shaped rib 37d in FIG. 8 is formed larger than the separation width of separation part 36a in the state in which sheet metal member 36 is housed within heater container 37. Further, as shown in FIG. 9, inner wall lower surface 39a of heater container 37 is gradually inclined upward and inner wall upper surface 39b is gradually inclined downward from sheet metal member inserting opening 37c side (rear side) to heater inserting opening 37b side (front side). As a result, as sheet metal member 36 is inserted from sheet metal member inserting opening 37c side (rear side) to heater inserting opening 37b side (front side), the separation width of separation part 36a becomes smaller.

With this configuration, when sheet metal member 36 is inserted into heater container 37 from sheet metal member inserting opening 37c side (rear side) to heater inserting opening 37b side (front side), width W of belt-shaped rib 37d is larger than the separation width of separation part 36a of sheet metal member 36 from the middle of insertion. Accordingly, when sheet metal member 36 is press-fitted into heater container 37 by pushing, an end of separation part 36a of sheet metal member 36 is sunk into belt-shaped rib 37d. Thus, sheet metal member 36 can be supported and fixed within heater container 37, and looseness of sheet metal member 36 can be prevented during spin-drying rotation of washing and spin-drying tub 15.

In the present exemplary embodiment, sheet metal member 36 is formed by spot-welding two sheet metals. However, sheet metal member 36 may be configured by molding one sheet metal, for example.

[C. Heater 38]

Heater 38 will be described with reference to FIG. 2.

Heater 38 is inserted through heater inserting opening 37b of heater container 37.

Heater 38 includes heating part 38a, terminal 38b, and connecting part 38c.

Heating part 38a is located inside heater container 37, and generates heat for heating washing water within heater container 37. Further, as shown in FIG. 2, heating part 38a is folded many times on an identical plane. With this configuration, since a surface area of heating part 38a is increased, the washing water can be heated efficiently.

Terminal 38b is electrically connected with heating part 38a. Further, terminal 38b is electrically connected with an external power source (not shown) located on the outside of heater container 37 and a control device (not shown). Power from the external power source is supplied to heating part 38a via terminal 38b.

Connecting part 38c is interposed between heating part 38a and terminal 38b. Connecting part 38c is provided with flexible member 38d with a size corresponding to a size of heater inserting opening 37b of heater container 37. In FIG. 9, by tightening nut 43 in a state in which heating part 38a is inserted through heater inserting opening 37b, heater 38 can be fixed within heater container 37. In other words, forward force is applied to bolt 44 and pressure welding plate 47 welded by bolt 44 by tightening nut 43, and flexible member 38d is expanded in a circumferential direction by being compressed in a front and rear direction, thereby enabling sealing of heater inserting opening 37b. With this configuration, the washing water within heater container 37 can be prevented from being leaked from heater inserting opening 37b. Flexible member 38d is formed of packing which is elastically

deformed, such as rubber.

Further, as shown in FIG. 2, connecting part 38c is disposed with temperature detector 56 for measuring a water temperature within heater container 37. Temperature detector 56 includes a thermistor or the like.

[D. Lid body 51]

As shown in FIGS. 9 and 10, lid body 51 detachably covers sheet metal member inserting opening 37c of heater container 37 by screw fastening (not shown).

In order to detach lid body 51 to confirm the inside of heater container 37 and to perform maintenance of heater unit 32, sheet metal member inserting opening 37c covered with lid body 51 is provided on the back surface side, in which back surface opening 11a of washing machine body 11 is disposed.

Sheet metal member inserting opening 37c covered with lid body 51 is mounted to a position facing heater 38 inserted into heater container 37. With this configuration, a state of heater 38 can be easily visually recognized by detaching lid body 51 from heater container 37.

Lid body 51 includes inclined rib 51a (projected rib) for pressing sheet metal member 36 inserted into heater container 37 against an inner wall surface side of heater container 37. Inclined rib 51a (projected rib) has an inclined surface facing sheet metal member 36 housed in heater container 37, and the inclined surface is inclined so as to approach the inner wall surface of heater container 37 from the front side to the rear side in FIG. 9. With this configuration, an end on sheet metal member inserting opening 37c side (rear side) of sheet metal member 36 inserted into heater container 37 is expanded toward inner wall lower surface 39a and inner wall upper surface 39b by inclined rib 51a (projected rib). The end on sheet metal member inserting

opening 37c side (rear side) of sheet metal member 36 inserted into heater container 37 is expanded toward inner wall lower surface 39a and inner wall upper surface 39b by inclined rib 51a.

Further, in a state in which heater container 37 is mounted on the bottom of water tub 13, rib 37e (see FIG. 7) for supporting sheet metal member 36 is extended on inner wall lower surface 39a and inner wall upper surface 39b of heater container 37. Rib 37e suppresses direct transmission of heat of sheet metal member 36 heated by heater 38 to inner wall lower surface 39a and inner wall upper surface 39b.

With this configuration, by covering sheet metal member inserting opening 37c with lid body 51 in a state in which sheet metal member 36 is inserted into heater container 37, sheet metal member 36 is supported and fixed by inclined rib 51a and rib 37e. As a result, oscillation of sheet metal member 36 within heater container 37 is suppressed.

In this way, heater unit 32 is configured.

[1-2. Operational motion of washing machine]

Next, operational motion of the washing machine in the present exemplary embodiment will be described.

A user opens door body 27, loads clothes into washing and spin-drying tub 15 through laundry loading/unloading port 26, closes door body 27, and starts a hot water washing course by operating operation display 29.

When a washing process is started, water supply valve 30 is opened, and water is poured into water tub 13 from water pouring case 31. The poured water flows into heater container 37 through first drain port 33a and second drain port 33b at the bottom of water tub 13.

Here, in the hot water washing course, after the washing process in water heated by heater 38 is completed, rinsing and spin-drying processes are

performed.

In the hot water washing course, when the water in water tub 13 reaches a predetermined water level by pouring water into water tub 13, heater 38 of heater unit 32 is turned ON. Based on a water temperature of the washing water within the water tub, the control device performs ON-OFF control of heater 38 to control the temperature of the washing water. A method for detecting the water temperature within the water tub will be described in [1-5. Method for detecting water temperature within water tub].

When the water temperature within water tub 13 reaches predetermined temperature M1 (for example, 55°C), heater 38 is turned OFF. Further, when the measured water temperature within water tub 13 is lowered to less than or equal to predetermined temperature M2 (for example, less than or equal to 53°C), heater 38 is turned ON. According to this method, the washing water within water tub 13 can be controlled to have a predetermined water temperature.

Note that predetermined temperatures M1, M2 may be set for each operation course (for example, a sterile filtration course or a mud stain washing course). When predetermined temperatures M1, M2 are changed according to the operation course, the washing water can be controlled to have water temperature suitable for a purpose of each operation course.

By opening a drain cock of drain cock unit 34, the washing water is drained to the outside of washing machine body 11. Here, since the washing water in water tub 13 flows out to the outside of washing machine body 11 via drain cock unit 34, outflow passage 37g, and heater container 37, accumulation of washing water in heater container 37 or foreign matter during drainage can be suppressed.

Further, after the hot water washing, motion in which water is added

into washing and spin-drying tub 15 and agitated by pulsator 18 may be repeated until the water temperature within water tub 13 is less than or equal to a predetermined temperature (for example, less than or equal to 50°C). When the water temperature within water tub 13 is less than or equal to 50°C, the drain valve of drain cock unit 34 is opened, and the washing water is discharged to the outside of washing machine body 11. When the water temperature within water tub 13 is more than or equal to a predetermined temperature (for example, more than or equal to 50°C) and the water level of water tub 13 reaches a limited level, temporary drainage is performed for a predetermined time.

With this configuration, even in an environment where drainage water is drained to a road surface, the washing water can be drained in a state in which the water temperature is lowered. Accordingly, safety is improved.

On the other hand, when outflow passage 37g of heater container 37 is blocked by yarn waste of clothes or the like, there is a possibility that water flow between heater container 37 and water tub 13 is disturbed. When the water flow between heater container 37 and water tub 13 is disturbed, even though the water temperature within the water tub is less than or equal to predetermined temperature M1, it is assumed that the inside of heater unit 32 is overheated. In this case, when measured water temperature of temperature detector 56 for detecting the water temperature within heater container 37 reaches heater overheating set temperature (for example, 95°C), control is performed so as to turn heater 38 OFF. Accordingly, overheating within heater unit 32 can be prevented, and occurrence of scale or degradation of heater container 37 can be suppressed.

[1-3. Flow of washing water within heater unit]

FIG. 11 is a partial sectional perspective view showing flow of washing

water within the heater unit of the washing machine according to the present exemplary embodiment.

With reference to FIG. 11, flow of washing water within heater unit 32 when heater 38 is turned ON in the hot water washing course will be described.

Outflow passage 37g communicating with an inner bottom of water tub 13 is formed on a root side of heating part 38a on the upper surface of heater container 37, and drain cock unit 34 communicating with the inner bottom of water tub 13 is coupled to a tip lateral side of heating part 38a on the side surface of heater container 37.

The washing water heated within heater container 37 and raised in water temperature moves up within heater container 37.

Herein, since a distance from heater 38 to outflow passage 37g is shorter than a distance from heater 38 to drain cock connecting opening 37a, in a state in which a power source of heater 38 is turned on, the water temperature in outflow passage 37g is higher than the water temperature in drain cock connecting opening 37a within heater container 37. As a result, as shown in arrow D in FIG. 11, the washing water moved up within heater container 37 is discharged to water tub 13 through outflow passage 37g.

In order to supplement the high temperature washing water discharged from heater container 37 to water tub 13, as shown in arrow C in FIG. 11, washing water having a low temperature and a heavy specific gravity within water tub 13 flows from inflow port 34a into the inner bottom of heater container 37 through drain cock front passage 34b on an upstream side of the drain cock of drain cock unit 34. The washing water flowed into heater container 37 is heated by effectively utilizing the radiant heat of heater 38, while flowing from the vicinity of the tip to the vicinity of the root of heating part 38a of heater 38. Accordingly, the washing water can be heated efficiently.

As shown in FIG. 11, since outflow passage 37g is located above drain cock connecting opening 37a, the hot water can be circulated efficiently by using a difference in specific gravity between the low temperature washing water flowing from water tub 13 into heater container 37 and the high temperature washing water flowing out from heater container 37 to water tub 13.

As shown in FIG. 11, an upper end of outflow passage 37g is located above inflow port 34a of drain cock unit 34. With this configuration, since a pressure difference between the upper end and a lower end of outflow passage 37g is larger than a pressure difference between an upper end and a lower end of drain cock front passage 34b, the high temperature washing water within heater container 37 easily flows out from outflow passage 37g to water tub 13. As a result, the hot water can be circulated more efficiently.

Thus, since two passages (inflow port 34a, outflow passage 37g) coupling water tub 13 and heater container 37 are provided at the positions having different distances from heater 38, the washing water within water tub 13 and the washing water within heater container 37 can be circulated by natural convection, utilizing the difference in water temperature of the washing water within the passages. As a result, a number of parts can be reduced without requiring an external force, such as a pump, and cost can be cut.

Further, since a capacity of heater container 37 is smaller than a capacity of water tub 13, a temperature rising speed by heater 38 and a water temperature of the washing water within heater container 37 are higher than the temperature rising speed and the water temperature of the washing water within water tub 13. As a result, bacteria included in the washing water flowing into heater container 37 can be effectively sterilized.

Furthermore, by rotating pulsator 18 every fixed time, the washing water within water tub 13 can be agitated, and the water temperature within water tub 13 can be made uniform.

In the present exemplary embodiment, when first drain port 33a and second drain port 33b have larger opening areas, circulation of the washing water in heater unit 32 and water tub 13 can be activated. However, when the opening areas of first drain port 33a and second drain port 33b are increased in perfect circular shapes, first drain port 33a and second drain port 33b interfere with welding boss 45, female screw 46, and the like around first drain port 33a and second drain port 33b. Therefore, it is necessary to greatly modify the bottom of water tub 13.

Therefore, by forming first drain port 33a in a substantially elliptical shape as shown in FIG. 2, the opening area of first drain port 33a can be increased without changing positions of welding boss 45 and female screw 46. Hence, the washing water within water tub 13 and heater container 37 can be efficiently circulated at low cost without making large investment on mold.

Further, a sectional area of outflow passage 37g may be made larger than a sectional area of drain cock front passage 34b. Since a volume of the high temperature washing water within heater container 37 is larger than a volume of the low temperature washing water within water tub 13, by increasing the sectional area of outflow passage 37g through which the high temperature washing water flows, the washing water within heater container 37 and the washing water within water tub 13 can be efficiently circulated.

Further, as shown in FIG. 9, inner wall lower surface 39a on the bottom side of heater container 37 is gradually inclined downward from heater inserting opening 37b to drain cock connecting opening 37a. With this configuration, during drainage, the washing water within heater container 37

flows toward drain cock connecting opening 37a and flows out to the outside of washing machine body 11 through drain cock unit 34, drain passage 41 (see FIG. 1). Hence, accumulation of the washing water within heater container 37 or foreign matter during drainage can be prevented.

[1-4. State confirmation of heater unit, and maintenance method]

Since relatively large foreign matter, such as yarn waste, generated from clothes is attached to heater 38 or blocks outflow passage 37g, there is a possibility that the hot water within heater container 37 cannot flow out to water tub 13. Further, malfunction may occur to a part of heater unit 32. As a result, it is necessary to confirm a state of the inside of heater unit 32 or repair heater unit 32, as needed.

State confirmation of the inside of heater unit 32 and a maintenance method will be described below.

In order to confirm the state of heater unit 32, backboard 17 covering back surface opening 11a on a rear side of washing machine body 11 shown in FIG. 1 is detached, and lid body 51 of heater container 37 mounted on the bottom surface of water tub 13 is detached from back surface opening 11a. Since heater container 37 and lid body 51 are fixed by screw fastening, lid body 51 can be detached by removing the screw.

According to this method, the state of heater 38 within heater container 37 can be confirmed from back surface opening 11a of washing machine body 11, and yarn waste attached to a surface of heater 38 can be removed as needed. Accordingly, since detachment of a lead wire connector connected to heater 38 is not required, confirmation and maintenance of heater 38 can be easily performed.

Further, when sheet metal member 36 is desired to be repaired or replaced, sheet metal member 36 can be detached by pulling out sheet metal

member 36 from heater container 37, thereby enabling repair or replacement.

Further, heater unit 32 and water tub 13, and heater unit 32 and drain cock unit 34 are fastened by a screw or the like (not shown) and detachably mounted. With this configuration, when removal of foreign matter entered into heater unit 32 is required, or when replacement of heater unit 32 is required, washing machine body 11 can be laid on a side, and at the bottom of washing machine body 11, heater unit 32 can be detached from water tub 13 and drain cock unit 34, thereby enabling maintenance of heater unit 32 alone. Further, since only a broken part of heater unit 32 can be maintained, time and cost required for the repair can be reduced.

[1-5. Method for detecting water temperature within water tub]

FIG. 12 is a graph of a water temperature within heater container 37 and a water temperature within water tub 13 of the washing machine according to the present exemplary embodiment.

When heater 38 is turned ON at time Ta0, water within heater container 37 is heated by heater 38. Since a volume of heater container 37 is smaller than a volume of the water tub, the water temperature within heater container 37 is normally 10°C to 40°C higher than the water temperature within water tub 13. When a predetermined period of time elapses after heater 38 is turned OFF at time Ta1, the water temperature within water tub 13 and the water temperature within heater container 37 are gradually equalized and become substantially equal at time Ta2.

A method for estimating the water temperature within water tub 13 using temperature detector 56 disposed in heater 38 will be described below.

In the hot water washing course, when the water in water tub 13 reaches a predetermined water level by pouring water into water tub 13, heater unit 32 is turned ON. Time at this point is set to Ta0. Next, after a

predetermined period of time elapses after heater 38 is turned ON (time at this point is set to Ta1), heater 38 is turned OFF. After a predetermined period of time elapses after heater 38 is turned OFF and then the water temperature within heater container 37 and the water temperature within water tub 13 become substantially equal (time at this point is set to Ta2), temperature detector 56 measures the water temperature within heater container 37. Accordingly, the water temperature within water tub 13 can be estimated.

It is desirable that ON time (Ta0 to Ta1) of heater 38 be calculated from an output of heater 38, an amount of water, an amount of clothes within water tub 13, and the like. For example, when the output of the heater is 1500 W, the amount of water within water tub 13 is 66 L, the amount of clothes is 5 kg, and heating is performed from an initial water temperature of 20°C to a predetermined temperature of 55°C, the ON time is about 130 minutes.

It is desirable that a predetermined period of time (Ta1 to Ta2) that heater 38 is turned OFF be 1 to 5 minutes, for example.

After heater 38 is turned OFF for the predetermined period of time, by rotating pulsator 18 for a predetermined period of time, the washing water within water tub 13 is agitated, and a difference in water temperature between water tub 13 and heater container 37 can be balanced. As a result, the difference in water temperature between heater container 37 and water tub 13 can be reduced in a short time, and the water temperature within water tub 13 can be accurately detected.

Next, a control method for controlling the washing water within water tub 13 to have a predetermined set target water temperature (for example, 53°C) by using temperature detector 56 will be described.

After completion of water supply to water tub 13, first energizing time of heater 38 is calculated from an amount of water supply, a water

temperature, or the like within water tub 13, and heater 38 is turned ON for the first energizing time. Herein, heater 38 may be turned ON continuously or operated intermittently during the first energizing time.

In the first energizing time, temperature rising speed Vt of the washing water within water tub 13 is calculated from a water temperature of the washing water within water tub 13 estimated by temperature detector 56. From temperature rising speed Vt and water temperature T1 within water tub 13 after the end of the first energizing time (time at this point is set to Tb1), second energizing time of heater 38 until the washing water within the water tub reaches the set target water temperature is calculated. Herein, heater 38 may be turned ON continuously or operated intermittently during the second energizing time.

After heater 38 is turned ON continuously for the second energizing time, water temperature T2 within water tub 13 is estimated by temperature detector 56 and compared with the set target water temperature. When water temperature T2 is lower than the set target water temperature, heater 38 is turned ON for a predetermined period of time, and the water temperature within water tub 13 is estimated again by temperature detector 56. When water temperature T2 is higher than the set target water temperature, heater 38 is turned OFF for a predetermined period of time, and the water temperature within water tub 13 is estimated again by temperature detector 56.

According to this method, temperature control of the washing water within water tub 13 can be performed by using temperature detector 56 that measures the water temperature within heater container 37. As a result, a low cost and highly reliable washing machine which does not require arrangement of a water temperature detector within a water tub can be

provided.

In the present exemplary embodiment, a coupling passage between water tub 13 and heater container 37 is configured by drain cock unit 34 and outflow passage 37g formed in heater container 37. However, the present invention is not limited to this configuration. For example, an inflow passage and an outflow passage may be formed in heater container 37, and water tub 13 and heater container 37 may be directly communicated without passing through drain cock unit 34. At this time, drain cock unit 34 may be connected to the bottom surface or the side surface of heater container 37 in a state in which heater container 37 is mounted on the bottom of water tub 13.

In the present exemplary embodiment, the configuration in which the water temperature within water tub 13 is detected by temperature detector 56 disposed within heater container 37 has been described. However, the present invention is not limited to this configuration. For example, a water tub temperature detector including a thermistor or the like may be disposed within water tub 13 or drain cock unit 34 to measure the water temperature within water tub 13.

In the present exemplary embodiment, the two coupling passages between water tub 13 and heater container 37, that is, drain cock unit 34 and outflow passage 37g, are provided. However, the present invention is not limited to this number. A number of coupling passages between water tub 13 and heater container 37 may be three or more.

In the present exemplary embodiment, sheet metal member 36 is configured by molding two sheet metals. However, sheet metal member 36 may be configured by one sheet metal, for example.

In the present exemplary embodiment, the configuration in which lid body 51 is provided at the opening of heater container 37 on the back surface

side of washing machine body 11 in the state in which heater unit 32 is attached to the outer bottom surface of water tub 13 has been described. Lid body 51 may be provided in heater container 37 in a direction in which the openable opening of washing machine body 11 is located. Therefore, the opening of heater container 37 opened and closed by lid body 51 may be formed on a front surface side of washing machine body 11, or may be formed on a side surface side of washing machine body 11.

In the present exemplary embodiment, first drain port 33a is formed in the substantially elliptical shape. However, the second drain port may be formed in the substantially elliptical shape, or first drain port 33a and second drain port 33b may be formed in the substantially elliptical shapes.

In the present exemplary embodiment, the configuration in which the hot water is circulated by natural convection by communicating the inner bottom of water tub 13 and heater container 37 has been described. However, the present invention is not limited to this configuration. For example, heater container 37 and washing and spin-drying tub 15 may be communicated via a circulation pump, and the circulation pump may flow out the washing water heated within heater container 37 into washing and spin-drying tub 15 to circulate the hot water.

In the present exemplary embodiment, a guide body for flowing the washing water within water tub 13 may be provided at inflow port 34a of drain cock unit 34. With this configuration, by utilizing centrifugal force by driving of pulsator 18, the washing water can be allowed to flow into heater container 37 from water tub 13 efficiently.

In the present exemplary embodiment, a top-loading-type washing machine has been described as an example of washing machine. However, the present invention is not limited to this type of washing machine, and may be

applied to a drum type washing machine.

The present exemplary embodiment has been described above as an example of the technique disclosed in the present application. The technique in the present disclosure, however, can be applied to any exemplary embodiment to which modification, replacement, addition, omission, or the like are made, other than the foregoing exemplary embodiment. In addition, new exemplary embodiments can be made by combining components described in the present exemplary embodiment.

[2. Second exemplary embodiment]

In the washing machine according to the first exemplary embodiment, heater container 37 and the inner bottom surface of water tub 13 are coupled by the two passages, and the washing water heated within heater container 37 and the washing water within water tub 13 are circulated. However, in the first exemplary embodiment, it is necessary to provide the plurality of drain ports in water tub 13. Therefore, in a washing machine according to a second exemplary embodiment, a heater container and an inner bottom surface of a water tub are coupled by one passage.

The second exemplary embodiment will be described below with reference to FIGS. 13 to 17. Note that regarding a longitudinal sectional view of the washing machine, see FIG. 1.

The bottom of water tub 13 of the washing machine according to the first exemplary embodiment has first drain port 33a and second drain port 33b. A bottom of water tub 113 of the washing machine according to the present exemplary embodiment has drain port 133 shown in FIG. 14. Since the other configuration of the washing machine according to the present exemplary embodiment is identical to the configuration of the washing machine according to the first exemplary embodiment, description thereof is omitted.

[2-1. Configuration of heater unit]

FIG. 13 is an exploded perspective view of heater unit 132 of the washing machine according to the present exemplary embodiment. FIG. 14 is a sectional view of the bottom surface of the water tub, a drain cock unit, and the heater unit of the washing machine according to the present exemplary embodiment. FIGS. 15 and 16 are both perspective views of the heater unit of the washing machine according to the present exemplary embodiment.

Heater unit 132 of the washing machine according to the present exemplary embodiment will be described below.

As shown in FIG. 14, heater unit 132 is fixed to an outer bottom on a back surface side of water tub 113 at a position where maintenance can be performed after detaching backboard 17.

As shown, heater unit 132 includes substantially rectangular parallelepiped heater container 137 with both ends in a longitudinal direction opened, heater 138 inserted through a first opening of heater container 137, sheet metal member 136 inserted through a second opening of heater container 137 and covering heater 138, and lid body 151 covering the second opening, through which sheet metal member 136 is inserted.

The parts will be described below. Note that since heater 138 according to the present exemplary embodiment has a configuration identical to the configuration of heater 38 according to the first exemplary embodiment, description thereof is omitted.

[A. Heater container 137]

As shown in FIG. 13, heater container 137 is formed of heat-resistant resin, and has the substantially rectangular parallelepiped shape with both the ends in the longitudinal direction opened.

On a side surface on the longitudinal direction side of heater container

137 and near sheet metal member inserting opening 137c, drain cock connecting opening 137a communicating with drain cock unit 134 is formed. In the washing machine according to the first exemplary embodiment, tubular outflow passage 37g communicating with second drain port 33b at the bottom of water tub 13 is formed on the upper surface of heater container 37. However, such a passage is not formed in heater container 137 according to the present exemplary embodiment. The other configuration of heater container 137 is identical to the configuration of heater container 37 according to the first exemplary embodiment.

As shown in FIG. 14, drain cock unit 134 is detachably mounted to drain port 133 at the bottom of water tub 113 by a screw or the like. As shown in FIG. 15, a part of drain cock unit 134 is formed substantially in an L shape that extends toward heater container 137, and water tub 113 and heater container 137 are connected in communication via drain cock unit 134. As shown in FIG. 14, drain cock unit 134 is provided with partition wall 146 for separating a passage that communicates from water tub 113 to heater container 137 within drain cock unit 134. Partition wall 146 includes vertical part 146a and horizontal part 146b extending from a lower end of vertical part 146a toward heater 138, and is formed in an L shape in a cross section. By partition wall 146, a water passage within drain cock unit 134 is separated into inflow passage 135a located on a left side of vertical part 146a and below horizontal part 146b and outflow passage 135b located above horizontal part 146b and on a right side of vertical part 146a in FIG. 14.

In the present exemplary embodiment, as shown in FIG. 14, inner wall upper surface 139b and inner wall lower surface 139a of heater container 137 are formed so that an inclination angle of inner wall upper surface 139b and an inclination angle of inner wall lower surface 139a of heater container 137

are substantially identical. With this configuration, as shown in FIGS. 15 and 16, even when heater container 137 is turned upside down, heater container 137 can be inserted into the bottom of water tub 113 via drain cock unit 134 and used. As a result, heater unit 132 can be disposed considering a gravity center of vibration, arrangement of parts, and the like for each type of the washing machine.

[B. Sheet metal member 136]

As shown in FIG. 13, sheet metal member 136 surrounding heater 138 has a substantially rectangular parallelepiped shape with one end in the longitudinal direction opened. Sheet metal member 136 is configured by molding one sheet metal part into a substantially rectangular parallelepiped shape. As shown in FIG. 14, the one end in the longitudinal direction of sheet metal member 136 has separation part 136a that is not welded and has a fixed gap. Fixing metal fittings 140 for supporting and fixing heater 138 are welded to an inner surface of sheet metal member 136. Fixing metal fittings 140 fix heater 138 housed in heater container 137 so that heater 138 is not moved.

Note that sheet metal member 136 may be configured by welding two sheet metals by spot welding or the like, for example.

A method for fixing sheet metal member 136 and heater container 137 is identical to the method in the first exemplary embodiment.

[C. Lid body 151]

As shown in FIG. 13, lid body 151 detachably covers sheet metal member inserting opening 137c of heater container 137 by fastening with a screw (not shown) or the like.

Lid body 51 of the washing machine according to the first exemplary embodiment includes inclined rib 51a (projected rib) (see FIG. 6). However, lid body 151 of the washing machine according to the present exemplary

embodiment does not include such a rib. The other configuration of lid body 151 according to the present exemplary embodiment is identical to the configuration of lid body 51 according to the first exemplary embodiment.

In this way, heater unit 132 is configured.

[2-2. Flow of washing water within heater unit]

FIG. 17 is a sectional view showing flow of washing water within the heater unit of the washing machine according to the present exemplary embodiment. With reference to FIG. 17, flow of washing water within heater unit 132 in a state in which heater 138 is turned ON in a hot water washing course will be described.

As shown in FIG. 13, drain cock unit 134 communicating with an inner bottom of water tub 113 is coupled to a side surface in the longitudinal direction of heater container 137. As shown in FIG. 14, partition wall 146 is provided inside drain cock unit 134. Partition wall 146 is formed substantially in the L shape extending downward toward heater 138. Partition wall 146 prevents low temperature washing water within inflow passage 135a flowing from water tub 113 to heater container 137 and high temperature washing water within outflow passage 135b flowing from heater container 137 to water tub 113 from being mixed within drain cock unit 134, and the washing water can be efficiently circulated.

When heater 138 is turned ON in a state in which the washing water is filled within heater container 137, the washing water within heater container 137 is heated by heater 138, moves up within heater container 137, and is discharged from outflow passage 135b to water tub 113 as shown in arrow B in FIG. 17.

On the other hand, in order to supplement the high temperature washing water discharged from heater container 137 to water tub 113,

washing water having a low temperature and a heavy specific gravity within water tub 113 flows into heater container 137 through inflow passage 135a as shown in arrow A in FIG. 17. Since the washing water heated within heater container 137 moves upward, the low temperature washing water within water tub 113 easily flows into the bottom side of heater container 137 from inflow passage 135a.

The washing water flowed into heater container 137 is heated by heater 138, moves up within heater container 137, and is discharged from outflow passage 135b to water tub 113.

Thus, by communicating heater container 137 and the inner bottom of water tub 113 by the one passage and circulating the washing water by natural convection caused by a difference in temperature of the washing water, a common metal mold for water tub 113 can be used for a type of washing machine having heater unit 132 and a type of washing machine having no heater unit 132. As a result, manufacturing cost when a washing machine is developed to realize a hot water specification function can be suppressed low. Furthermore, heater unit 132 can be externally provided as needed.

Further, as shown in FIGS. 14 and 17, an upper end of vertical part 146a of partition wall 146 is located above inflow port 134a. With this configuration, entering of the high temperature washing water discharged from outflow passage 135b to water tub 113 into inflow passage 135a can be suppressed. Accordingly, the washing water within the water tub can be heated efficiently.

Furthermore, by rotating pulsator 18 every fixed time, the washing water within water tub 113 can be agitated, and the water temperature within water tub 113 and the water temperature within the heater container can be made uniform in a short time.

Further, as shown in FIG. 17, inner wall upper surface 139b on water tub 113 side (upper side) of heater container 137 is gradually inclined to the water tub side (upper side) from heater inserting opening 137b (see FIG. 13) toward drain cock connecting opening 137a. With this configuration, when the washing water is supplied into heater container 137, air accumulated within heater container 137 is easily discharged from heater container 137 toward water tub 113. As a result, air accumulation within heater container 137 can be prevented, and a risk of no-water burning can be reduced.

[3. Other exemplary embodiments]

The first exemplary embodiment and the second exemplary embodiment have been described above as an example of the technique disclosed in the present application. The technique in the present disclosure, however, can be applied to any exemplary embodiment to which modification, replacement, addition, omission, or the like are made, other than the foregoing exemplary embodiments. In addition, new exemplary embodiments can be made by combining components described in the first exemplary embodiment and the second exemplary embodiment.

Therefore, other exemplary embodiments will be described below.

In the first exemplary embodiment, the coupling passage between water tub 13 and heater container 37 is configured by drain cock unit 34 and outflow passage 37g formed in heater container 37. However, the present invention is not limited to this configuration. For example, an inflow passage and an outflow passage may be formed in heater container 37, and water tub 13 and heater container 37 may be directly communicated without passing through drain cock unit 34. At this time, drain cock unit 34 may be connected to the bottom surface or the side surface of heater container 37 in a state in which heater container 37 is mounted on the bottom of water tub 13. Further,

three or more coupling passages may be provided between water tub 13 and heater container 37.

In the first exemplary embodiment, first drain port 33a is formed in the substantially elliptical shape. However, second drain port 33b may be formed in the substantially elliptical shape, or first drain port 33a and second drain port 33b may be formed in the substantially elliptical shapes.

In the first exemplary embodiment, the configuration in which the water temperature within water tub 13 is detected by temperature detector 56 disposed within the heater container has been described. However, the present invention is not limited to this configuration. For example, a water tub temperature detector including a thermistor or the like may be disposed within water tub 13 to measure the water temperature within water tub 13.

In the second exemplary embodiment, the coupling passage is configured by drain cock unit 134 between water tub 113 and heater container 137. However, the present invention is not limited to this configuration. For example, by forming a passage communicating with the drain port at the inner bottom of water tub 113 in heater container 137, water tub 113 and heater container 137 may be directly communicated without passing through drain cock unit 134. At this time, a partition wall may be disposed inside the passage. Further, by forming the passage of heater container 137 in a substantially L shape and communicating the side surface of heater container 137 and the inner bottom surface of water tub 113, the low temperature washing water within water tub 113 easily flows into the bottom side of heater container 137 through inflow passage 135a. Further, drain cock unit 134 may be connected to the bottom surface or the side surface of heater container 137 in a state in which heater container 137 is mounted on the bottom of water tub 113.

In the second exemplary embodiment, the configuration in which the upper end of vertical part 146a of partition wall 146 is located above inflow port 134a has been described. However, the present invention is not limited to this configuration. The upper end of vertical part 146a may be located below inflow port 134a.

In the first exemplary embodiment and the second exemplary embodiment, the configuration in which lid body 51, 151 is provided in heater container 37 at back surface opening 11a of washing machine body 11 in the state in which heater unit 32, 132 is attached to the outer bottom surface of water tub 13, 113 has been described. Lid body 51 may be provided in heater container 37 in a direction in which the openable opening of washing machine body 11 is located. Therefore, the opening of heater container 37, 137 opened and closed by lid body 51, 151 may be formed on the front surface side of washing machine body 11, or may be formed on the side surface side of washing machine body 11.

In the first exemplary embodiment and the second exemplary embodiment, the top-loading-type washing machine has been described as an example of washing machine. However, the present invention is not limited to this type of washing machine, and may be applied to a drum type washing machine.

The present exemplary embodiments are illustrations of the technique of the present disclosure. Therefore, various changes, replacements, additions, or omissions may be made to the exemplary embodiments within the scope of claims or their equivalents.

As described above, a washing machine according to a first disclosure includes a washing machine body, a water tub supported in an inside of the washing machine body and having a bottom with a drain port, and a drain

cock unit coupled with the drain port of the water tub. Further, the drain cock unit is connected with a heater unit communicating with an inner bottom of the water tub. The heater unit incorporates a heater for heating washing water and includes a water passage communicating with the inner bottom of the water tub. The water passage and the drain cock unit are opened to the heater unit at positions where water temperatures of the washing water are different.

With this configuration, state confirmation of an inside of the heater unit and maintenance of the heater unit can be easily performed.

Further, in a washing machine according to a second disclosure, the water passage and the drain cock unit of the washing machine according to the first disclosure are near both ends of the heater incorporated in the heater unit.

With this configuration, the washing water flowed into a heater container can be efficiently heated while effectively utilizing radiant heat of the heater.

Further, a washing machine according to a third disclosure includes a washing machine body, a water tub supported in an inside of the washing machine body and having a bottom with a drain port, and a heater unit communicating with an inner bottom of the water tub and incorporating a heater for heating washing water inside. Further, the heater unit communicates with the inner bottom of the water tub through a plurality of water passages, and the plurality of water passages is opened to the heater unit at positions where water temperatures of the washing water are different.

With this configuration, state confirmation of an inside of the heater unit and maintenance of the heater unit can be easily performed.

Further, in a washing machine according to a fourth disclosure, the plurality of water passages of the washing machine according to the third

disclosure is at least near both ends of the heater incorporated in the heater unit.

With this configuration, the washing water flowed into a heater container can be efficiently heated while effectively utilizing radiant heat of the heater.

(Notes regarding solution to problem, part 1)

[Note 1] A washing machine includes: a washing machine body; a water tub supported in an inside of the washing machine body and having a bottom with a drain port; a drain cock unit coupled with the drain port of the water tub; and a heater unit coupled with the drain cock unit and communicating with an inner bottom of the water tub, wherein the heater unit has a heater container that houses a heater for heating washing water inside, and an inner wall bottom surface of the heater container is gradually inclined downward toward the drain cock unit.

[Note 2] The washing machine according to Note 1, wherein an inner wall upper surface of the heater container is gradually inclined upward toward the drain cock unit.

[Note 3] The washing machine according to Note 2, wherein the inner wall upper surface and the inner wall bottom surface of the heater container are formed so that an inclination angle of the inner wall upper surface and an inclination angle of the inner wall bottom surface of the heater container are substantially identical.

According to the configuration in [Note 1], since washing water within the heater container flows to the drain cock unit during drainage, accumulation of the washing water within the heater container or foreign matter during the drainage can be suppressed.

According to the configuration in [Note 2], when the washing water is

supplied into the heater container, air accumulated within the heater container is easily discharged toward the water tub. As a result, air accumulation within the heater container can be prevented, and a risk of no-water burning can be reduced.

According to the configuration in [Note 3], even when the heater container is turned upside down, the heater container can be mounted on the bottom of the water tub and used. As a result, the heater unit can be disposed considering a gravity center of vibration, arrangement of parts, and the like.

(Notes regarding solution to problem, part 2)

[Note 1] A washing machine includes: a washing machine body having an openable inspection opening for inspecting an inside; a water tub supported in an inside of the washing machine body and having a bottom with a drain port; a drain cock unit coupled with the drain port of the water tub; and a heater unit coupled with the drain cock unit and communicating with an inner bottom of the water tub, wherein the heater unit has a heater container having an opening at one end, a heater mounted within the heater container for heating washing water, and a lid body for openably mounting the opening of the heater container, and the heater unit is mounted on the bottom of the water tub in a state in which the opening of the heater container is directed to the inspection opening.

[Note 2] The washing machine according to Note 1, wherein in the heater unit, the opening of the heater container is formed at a position facing the heater incorporated in the heater container.

According to the configuration in [Note 1], a state of the heater can be easily visually recognized by removing the lid body from the heater container.

According to the configuration in [Note 2], the state of the heater can be visually recognized, and maintenance of the heater can be easily performed.

(Notes regarding solution to problem, part 3)

[Note 1] A washing machine includes: a washing machine body; a water tub supported in an inside of the washing machine body and having a bottom with a drain port; a drain cock unit coupled with the drain port of the water tub; and a heater unit coupled with the drain cock unit and communicating with an inner bottom of the water tub, wherein the heater unit has a heater container having an opening at a first end, a heater mounted within the heater container for heating washing water, and a substantially U-shaped sheet metal member located between the heater container and the heater, and a fixed gap is formed on a side surface of the sheet metal member, the sheet metal member is inserted into the heater container from the opening on the first end side of the heater container, in the heater container, a belt-shaped rib is extended in an insertion direction of the sheet metal member so as to correspond to the gap of the sheet metal member, an end on the first end side of the belt-shaped rib is formed narrower than the gap on the side surface of the sheet metal member, and a second end opposite to the first end of the belt-shaped rib is formed wider than the gap on the side surface of the sheet metal member.

[Note 2] The washing machine according to Note 1, wherein as the sheet metal member is inserted into the heater container from the opening on the first end side of the heater container, an end on a periphery of the gap of the sheet metal member is sunk into the belt-shaped rib.

[Note 3] The washing machine according to any one of Notes 1 and 2, wherein an extension rib is provided on an inner wall upper surface and an inner wall lower surface of the heater container.

[Note 4] The washing machine according to any one of Notes 1 to 3, wherein a lid body for openably mounting the opening of the heater container is provided, the lid body is provided with a projected rib located inside of the

heater container in a state in which the opening of the heater container is covered, the projected rib has an inclined surface facing the sheet metal member housed in the heater container, and the inclined surface is inclined so as to approach an inner wall surface of the heater container from a tip of the projected rib toward the opening.

According to the configuration in [Note 1], the sheet metal member can be fixed within the heater container without screw fastening or welding. As a result, occurrence of water leakage damage from a screw caused by melting of the heater container can be suppressed, and a highly reliable washing machine can be provided.

According to the configuration in [Note 2], the heater container and the sheet metal member can be fixed firmly.

According to the configuration in [Note 3], the sheet metal member inserted into the heater container can be supported, and direct transmission of heat of the sheet metal member heated by the heater to the inner wall lower surface and the inner wall upper surface of the heater container can be suppressed.

According to the configuration in [Note 4], the sheet metal member inserted into the heater container can be supported and fixed by the lid body.

(Notes regarding solution to problem, part 4)

[Note 1] A washing machine includes: a washing machine body having an openable inspection opening for inspecting an inside; a water tub supported in an inside of the washing machine body and having a bottom with a drain port; a drain cock unit coupled with the drain port of the water tub; and a heater unit coupled with the drain cock unit and communicating with an inner bottom of the water tub, wherein the heater unit has a heater container having an opening at one end, a heater mounted within the heater container for

heating washing water, and a lid body for openably mounting the opening of the heater container, and the heater unit is mounted on the bottom of the water tub in a state in which the opening of the heater container is directed toward the inspection opening.

[Note 2] The washing machine according to Note 1, wherein in the heater unit, the opening of the heater container is formed at a position facing the heater incorporated in the heater container.

According to the configuration in [Note 1], a state of the heater can be easily visually recognized by removing the lid body from the heater container.

According to the configuration in [Note 2], the state of the heater can be visually recognized, and maintenance of the heater can be easily performed.

INDUSTRIAL APPLICABILITY

As described above, a washing machine according to the present invention is applicable not only to a washing machine for home use but also a washing machine for business use.

REFERENCE MARKS IN THE DRAWINGS

11: washing machine body

11a: back surface opening (inspection opening)

12: suspension

13, 113, 200: water tub

14: washing/spin-drying shaft

15: washing and spin-drying tub

16: fluid balancer

17: backboard

18: pulsator

20: transmission mechanism

21: motor

22: motor-side pulley

23: mechanism-side pulley

24: belt

25: upper frame body

26: laundry loading/unloading port

27: door body

29: operation display

30: water supply valve

31: water pouring case

32, 132: heater unit

33a: first drain port

33b: second drain port

34, 134: drain cock unit

34a, 134a: inflow port

34b: drain cock front passage

34c: drain passage side opening

36, 136: sheet metal member

36a, 136a: separation part

37, 137: heater container

37a, 137a: drain cock connecting opening

37b, 137b: heater inserting opening

37c, 137c: sheet metal member inserting opening

37d: belt-shaped rib

37e: rib

37g: outflow passage

38, 138, 220: heater

38a, 221: heating part

38b: terminal

38c: connecting part

38d: flexible member

39a, 139a: inner wall lower surface

39b, 139b: inner wall upper surface

40: support piece

41: drain passage

42: spot welding part

43: nut

44: bolt

45: welding boss

46: female screw

51, 151: lid body

51a: inclined rib

56: temperature detector

CLAIMS

1. A washing machine comprising:

a washing machine body;

a water tub supported in an inside of the washing machine body and having a bottom with a drain port; and

a drain cock unit coupled with the drain port of the water tub,

wherein

the drain cock unit is connected with a heater unit communicating with an inner bottom of the water tub,

the heater unit incorporates a heater for heating washing water and includes a water passage communicating with the inner bottom of the water tub, and

the water passage and the drain cock unit are opened to the heater unit at positions where water temperatures of the washing water are different.

2. The washing machine according to claim 1, wherein the water passage and the drain cock unit are near both ends of the heater incorporated in the heater unit.

3. A washing machine comprising:

a washing machine body;

a water tub supported in an inside of the washing machine body and having a bottom with a drain port; and

a heater unit communicating with an inner bottom of the water tub and incorporating a heater for heating washing water inside,

wherein the heater unit communicates with the inner bottom of the

water tub through a plurality of water passages, and the plurality of water passages is opened to the heater unit at positions where water temperatures of the washing water are different.

4. The washing machine according to claim 3, wherein the plurality of water passages is at least near both ends of the heater incorporated in the heater unit.