

## DESCRIPTION

### TOP-LOADING-TYPE WASHING MACHINE

#### 5 TECHNICAL FIELD

[0001]

The present disclosure relates to a washing machine including a control device.

#### 10 BACKGROUND ART

[0002]

FIG. 6 shows electronic circuit board device 200 provided in a conventional washing machine disclosed in PTL 1.

[0003]

15 As shown in FIG. 6, the conventional washing machine includes electronic circuit board device 200 that controls power supply and an operation of an electric member such as a motor. Electronic circuit board device 200 includes mounting board 100 provided with power module 102 and electronic component 103, heat sink 104 attached to power module 102, and circuit case  
20 106 housing mounting board 100 and heat sink 104.

Citation List

Patent Literature

[0004]

PTL 1: Unexamined Japanese Patent Publication No. 2000-252663

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SUMMARY

[0005]

However, in the conventional configuration, when power module 102 mounted on mounting board 100 generates heat, air heated by the heat generation of power module 102 stays in circuit case 106. This increases a temperature of mounting board 100. Thus, there is a possibility that power module 102, electronic component 103, or the like may fail or malfunction.

[0006]

The present disclosure provides a washing machine that suppresses a failure and a malfunction of the control device by releasing heat generated in the control device to the outside.

10 [0007]

In an aspect, a top-loading-type washing machine of the present disclosure includes a housing, a container provided above and at a rear side of the housing, and a control device disposed in the container and configured to perform a laundry operation including washing, rinsing, and spin-drying. The control device has a board on which the electrical component is disposed, a heat dissipater provided in contact with the electrical component, and a cover disposed to cover the board. The cover is provided with a surface facing the board and covering the board from the bottom side, and an opening opened on the surface. The heat dissipater extends from the electrical component to penetrate the cover through the opening, and the container includes a container opening located at a rear side, the container opening communicating the inside of the container to the outside of the housing.

[0008]

The washing machine of the present disclosure can release heat generated in the control device to the outside. It is therefore possible to prevent a failure and a malfunction of the control device caused by the heated air retention.

25 BRIEF DESCRIPTION OF DRAWINGS

[0009]

and heat sink 73, and the air inside or within and outside metal cover 76 is mixed.

[0046]

Second opening 61d provided in operation display panel 61 according to  
5 the present exemplary embodiment is located below first opening 61c provided in second rib 61a. Consequently, water intrusion from the outside of housing 11 is suppressed. This improves safety.

[0047]

As described above, in the present exemplary embodiment, the washing  
10 machine includes housing 11, container 24b provided in housing 11, and controller 70 disposed in container 24b and configured to perform the laundry operation including washing, rinsing, and spin-drying. Controller 70 has power supply board 71 on which electrical component 72 is disposed, heat sink 73 provided in contact with electrical component 72, and metal cover 76  
15 disposed to cover heat sink 73. Metal cover 76 is provided with opening 76a on a surface facing heat sink 73. Heat sink 73 extends from electrical component 72 to at least partially penetrate metal cover 76 via opening 76a.

[0048]

Thus, heat sink 73 is exposed to the outside of metal cover 76, and the  
20 heat generated in control device 50 is efficiently released to the outside of metal cover 76. It is therefore possible to suppress a failure and a malfunction of control device 50 caused by the heated air staying in metal cover 76.

[0049]

Further, metal cover 76 may include metal.

25 [0050]

Then, the heat dissipation effect via metal cover 76 is expected due to thermal conductivity of the metal. This improves the heat dissipation

[0012]

Further, each drawing is a schematic diagram and is not necessarily precisely illustrated. In each drawing, substantially the same constituent elements are denoted by the same reference marks, and description thereof  
5 may be omitted or simplified.

[0013]

(Exemplary embodiment)

In a first exemplary embodiment, a top-loading-type washing machine will be described as an example of a washing machine.

10 [0014]

FIG. 1 is a longitudinal sectional view of the washing machine according to the present exemplary embodiment. FIG. 2 is an exploded perspective view of a main portion of a control device of the washing machine according to the present exemplary embodiment. FIG. 3 is a sectional view of  
15 a main portion of a rear part of an upper frame of the washing machine according to the present exemplary embodiment. FIG. 4 is an external view of a rear surface of a controller of the washing machine according to the present exemplary embodiment. FIG. 5 is a schematic diagram showing airflow warmed by exhaust heat of the controller of the washing machine according to  
20 the present exemplary embodiment.

[0015]

As shown in FIG. 1, washing machine 10 has water tub 13 inside or within (in) housing 11. Water tub 13 has a bottomed cylindrical shape. Water tub 13 is supported by suspension 12 on housing 11 in a vibration-proof  
25 manner.

[0016]

Washing tub 15 has a bottomed cylindrical shape. Washing tub 15 is

rotatably disposed inside or within water tub 13. Washing tub 15 has multiple water passage holes 16 on its side wall, and is used not only as a washing tub but also as a spin-drying tub. Fluid balancer 17 is disposed at an upper part of washing tub 15. Fluid balancer 17 suppresses abnormal vibration of water tub 13 caused by uneven distribution of clothes in washing tub 15.

[0017]

Pulsator 18 is rotatably disposed at a central bottom of washing tub 15.

[0018]

Axis 14 of rotation is disposed to penetrate a bottom surface of washing tub 15. Pulsator 18 is attached to an upper end of axis 14 of rotation. Transmission mechanism 19 is attached to a lower end of axis 14 of rotation. Axis 14 of rotation is hollow and has a biaxial structure. Axis 14 of rotation can rotate washing tub 15 and pulsator 18, or pulsator 18 alone. A deceleration gear (not shown), a clutch (not shown), and a brake (not shown) are incorporated inside or within transmission mechanism 19.

[0019]

Motor 20 is attached to a bottom of water tub 13.

[0020]

Motor 20 has motor-side pulley 21. Transmission mechanism 19 has mechanism-side pulley 22. Belt 23 is stretched between motor-side pulley 21 and mechanism-side pulley 22. As a result, rotational driving force of motor 20 is transmitted in order of motor-side pulley 21, belt 23, mechanism-side pulley 22, and transmission mechanism 19 to rotate axis 14 of rotation.

[0021]

Upper frame 24 is provided at an upper part of housing 11. Upper frame 24 has a clothes-loading port 24a as an opening. Clothes-loading port 24a is covered with lid 25 openably and closably. A user can put clothes in and

out of washing tub 15 through clothes-loading port 24a by lifting lid 25 upward to open lid 25.

[0022]

As shown in FIG. 2, recessed container 24b is at a rear side of upper  
5 frame 24. Control device 50 is disposed at an upside of container 24b.

[0023]

Control device 50 according to the present exemplary embodiment has operation display unit 60 disposed at an upside of control device 50 and controller 70 disposed below operation display unit 60. Operation display unit  
10 60 transmits a laundry instruction or the like input by the user to controller 70. Operation display unit 60 also displays a laundry operation status. Controller 70 performs a series of laundry operations such as washing, rinsing, and spin-drying by controlling electric sections such as motor 20.

[0024]

15 Next, a detailed configuration of operation display unit 60 will be described.

[0025]

Operation display unit 60 has operation display panel 61, operation buttons 62, and operation board 63.

20 [0026]

As shown in FIGS. 2 and 3, operation display panel 61 is a resin sheet, on which various selection button displays are printed. A liquid crystal part (not shown) and operation buttons 62 are disposed below operation display panel 61. The liquid crystal part displays various numbers indicating the  
25 remaining laundry time and the like. Operation buttons 62 transmit force of pressing operation display panel 61 downward by the user. Operation buttons 62 give the user a sense of clicking when the user presses operation display

panel 61. Operation board 63 disposed below operation buttons 62 converts the force transmitted by operation buttons 62 into an electric signal and transmits the electric signal to controller 70.

[0027]

5           Subsequently, a detailed configuration of control device 50 will be described.

[0028]

          Controller 70 has power supply board 71, heat sink 73, boat-shaped case 74, and metal cover 76. As shown in FIGS. 2 and 3, boat-shaped case 74  
10   holds operation board 63 on an upper surface and holds power supply board 71 on a lower surface. Boat-shaped case 74 includes flame-retardant resin. Insulating non-combustible material sheet 75 is provided between boat-shaped case 74 and power supply board 71.

[0029]

15           On a lower surface of power supply board 71, a connector (not shown) that receives a signal from the operation board and electrical component 72 such as a power module are disposed. Electrical component 72 is provided with heat sink 73 including aluminum. Further, a potting agent (not shown) including urethane resin is filled to entirely (or substantially entirely) cover  
20   power supply board 71. This prevents water from damaging power supply board 71.

[0030]

          As shown in FIGS. 4 and 5, metal cover 76 is provided to cover a lower side of power supply board 71. Metal cover 76 is provided with opening 76a  
25   such that at least a part of heat sink 73 penetrates metal cover 76. Opening 76a is larger than heat sink 73.

[0031]

Operations of the washing machine configured as above will be described.

[0032]

First, a basic operation of the laundry operation will be described.

5 [0033]

The user opens lid 25 and puts clothes in washing tub 15, and puts detergent and softener in a predetermined place. Further, the user inputs an instruction about the laundry operation via operation display unit 60. Thus, controller 70 starts the laundry operation and performs a washing step.

10 [0034]

In the washing step, controller 70 drives motor 20 after opening water supply valve 37 to supply water to a predetermined water level. At this time, the driving force of motor 20 is transmitted to pulsator 18 via axis 14 of rotation, and an agitating operation is performed in which the clothes are agitated by the rotation of pulsator 18. After the agitating operation is performed for a predetermined period of time, controller 70 opens a drain valve (not shown) to drain away dirty washing liquid.

[0035]

Then, a spin-drying operation of rapidly rotating washing tub 15 starts.

20 When the spin-drying operation starts, controller 70 switches a clutch of transmission mechanism 19 to spin-drying. Thus, the rotational driving force of motor 20 is transmitted to washing tub 15 via axis 14 of rotation, and washing tub 15 rotates. As a result, water is separated from the clothes by centrifugal force and spin-drying is performed. When the spin-drying operation ends, the washing step ends.

[0036]

Next, a rinsing step starts. When the rinsing step starts, the drain

valve is closed, water supply valve 37 is opened, and tap water is supplied into washing tub 15. Also in the rinsing step, the water in the washing tub 15 is drained after the agitating operation by rotation of pulsator 18 is performed.

[0037]

5           Next, the spin-drying step starts. Also in the spin-drying step, the spin-drying operation of rapidly rotating washing tub 15 is performed to remove the water from the clothes. When the spin-drying operation ends, all the steps end, and the laundry operation ends.

[0038]

10           Next, operations of controller 70 during the laundry operation will be described with reference to FIG. 5.

[0039]

          When driving motor 20, controller 70 causes a current to flow to motor 20 via the electrical component on power supply board 71. Because driving  
15   motor 20 requires a large current, a large current is also supplied to electrical component 72. Thus, Joule heat is generated in electrical component 72. The generated heat is transferred to heat sink 73 in contact with electrical component 72 and dissipated to the surrounding air.

[0040]

20           At this time, a part of heat sink 73 exposed to the outside of metal cover 76 is effectively cooled by the air outside metal cover 76, which has a temperature relatively lower than a temperature inside or within metal cover 76. As shown by arrow A in FIG. 5, the warmed air rises in housing 11 and moves from container 24b to a rear side of operation display panel 61.

25   [0041]

          Disposed at the rear side of operation display panel 61 are third rib 61b, second rib 61a disposed rearward of the third rib, and first rib 24c provided

between second rib 61a and third rib 61b and extending from upper frame 24. Third rib 61b is provided with first opening 61c. At the rear side of operation display panel 61, second opening 61d is provided at a position lower than first opening 61c. The warmed air passes through second opening 61d and first opening 61c and is exhausted to the outside of housing 11.

[0042]

Further, when a large current is applied to electrical component 72, a part of heat sink 73 that is housed inside or within metal cover 76 warms the air inside or within metal cover 76 as indicated by arrow B in FIG. 5. However, because the warmed air has a property of diffusing, the warmed air is mixed with the air outside metal cover 76 through opening 76a and exhausted to the outside of housing 11 as shown by arrow C in FIG. 5. Further, a part of the heat is transferred to the air outside metal cover 76 via metal cover 76.

[0043]

Next, an operation of the present exemplary embodiment will be described.

[0044]

At least a part of heat sink 73 according to the present exemplary embodiment is exposed to the outside of metal cover 76 via opening 76a. At least a part of heat sink 73 is directly exposed to the cold air outside, and thus heat dissipation efficiency is high. Further, heat sink 73 can be larger than in a configuration in which heat sink 73 is entirely housed inside or within metal cover 76. This can be expected to further improve the heat dissipation efficiency.

[0045]

Opening 76a according to the present exemplary embodiment is larger than heat sink 73. Thus, there is a gap between a wall surface of opening 76a

and heat sink 73, and the air inside or within and outside metal cover 76 is mixed.

[0046]

Second opening 61d provided in operation display panel 61 according to  
5 the present exemplary embodiment is located above first opening 61c provided in second rib 61a. Consequently, water intrusion from the outside of housing 11 is suppressed. This improves safety.

[0047]

As described above, in the present exemplary embodiment, the washing  
10 machine includes housing 11, container 24b provided in housing 11, and controller 70 disposed in container 24b and configured to perform the laundry operation including washing, rinsing, and spin-drying. Controller 70 has power supply board 71 on which electrical component 72 is disposed, heat sink 73 provided in contact with electrical component 72, and metal cover 76  
15 disposed to cover heat sink 73. Metal cover 76 is provided with opening 76a on a surface facing heat sink 73. Heat sink 73 extends from electrical component 72 to at least partially penetrate metal cover 76 via opening 76a.

[0048]

Thus, heat sink 73 is exposed to the outside of metal cover 76, and the  
20 heat generated in control device 50 is efficiently released to the outside of metal cover 76. It is therefore possible to suppress a failure and a malfunction of control device 50 caused by the heated air staying in metal cover 76.

[0049]

Further, metal cover 76 may include metal.

25 [0050]

Then, the heat dissipation effect via metal cover 76 is expected due to thermal conductivity of the metal. This improves the heat dissipation

efficiency of the heat dissipater.

[0051]

Further, control device 50 may have operation display unit 60. Power supply board 71 may be provided below operation display unit 60. Metal cover  
5 76 may be provided to cover power supply board 71 from below operation display unit 60.

[0052]

This can make control device 50 compact.

[0053]

10 Container 24b may be provided at an upside of housing 11 and at a rear side of housing 11. Housing 11 may be provided with at least one of first opening 61c or second opening 61d located at a rear side of container 24b.

[0054]

This can be expected to further improve the heat dissipation efficiency.

15 [0055]

Further, at least one of first opening 61c and second opening 61d may be provided above opening 76a.

[0056]

This can be expected to further improve the heat dissipation efficiency.

20 [0057]

(Other exemplary embodiments)

The first exemplary embodiment has been described above to exemplify techniques disclosed in the present application. However, the techniques of the present disclosure are not limited thereto, but may be applicable to  
25 exemplary embodiments with changes, additions, omissions, or the like.

[0058]

Therefore, other exemplary embodiments will be exemplified below.

[0059]

In the first exemplary embodiment, a top-loading-type washing machine has been described as an example of washing machine 10. Washing machine 10 only has to be capable of washing clothes with water. Washing machine 10 is thus not limited to a top-loading-type washing machine, and may be a drum-type laundry machine, a two-tub washing machine, or the like.

[0060]

In the first exemplary embodiment, control device 50 including operation display unit 60 and controller 70 has been described as an example of control device 50. Control device 50 only has to include power supply board 71 on which electrical component 72 is disposed, heat sink 73 in contact with electrical component 72, and metal cover 76 disposed to cover a surface of power supply board 71 on which electrical component 72 is disposed. Thus, control device 50 does not have to include operation display unit 60, and controller 70 and operation display unit 60 may be disposed at separate positions. Control device 50 does not have to be provided on the upper part of housing 11, but may be provided at a rear side of housing 11 or at a lower side of housing 11.

[0061]

In the first exemplary embodiment, power supply board 71 and metal cover 76 that are stacked in a vertical direction are described. Metal cover 76 only has to be provided to cover the surface of power supply board 71 on which electrical component 72 is disposed. Power supply board 71 and metal cover 76 may be disposed in the vertical direction or a horizontal direction.

[0062]

In the first exemplary embodiment, opening 76a has been described as an example of the opening. Opening 76a is provided on the surface facing

power supply board 71 on which electrical component 72 is disposed, and thus opening 76a may be provided in the vertical direction or the horizontal direction.

[0063]

5           In the first exemplary embodiment, metal cover 76 has been described as an example of the cover disposed to cover the surface of power supply board 71 on which electrical component 72 is disposed. Metal cover 76 only has to have opening 76a on the surface facing power supply board 71, and a material of metal cover 76 is not limited to metal. Metal cover 76 may be a cover  
10 including, for example, resin or ceramic material. However, the heat conductivity, fire resistance, and durability of the cover can be improved by forming the cover with metal.

INDUSTRIAL APPLICABILITY

15           [0064]

The present disclosure is applicable to a washing machine including a control device. Specifically, the present disclosure is applicable to a top-loading-type washing machine, a drum-type laundry machine, a two-tub washing machine, or the like.

20

REFERENCE MARKS IN THE DRAWINGS

[0065]

- 10           washing machine
- 11           housing
- 25           12           suspension
- 13           water tub
- 14           axis (axis of rotation)

|    |     |                                    |
|----|-----|------------------------------------|
|    | 15  | washing tub                        |
|    | 16  | water passage hole                 |
|    | 17  | fluid balancer                     |
|    | 18  | pulsator                           |
| 5  | 19  | transmission mechanism             |
|    | 20  | motor                              |
|    | 21  | motor-side pulley                  |
|    | 22  | mechanism-side pulley              |
|    | 23  | belt                               |
| 10 | 24  | upper frame                        |
|    | 24a | clothes-loading port               |
|    | 24b | container                          |
|    | 24c | first rib                          |
|    | 25  | lid                                |
| 15 | 37  | water supply valve                 |
|    | 50  | control device                     |
|    | 60  | operation display unit             |
|    | 61  | operation display panel            |
|    | 61a | second rib                         |
| 20 | 61b | third rib                          |
|    | 61c | first opening (container opening)  |
|    | 61d | second opening (container opening) |
|    | 62  | operation button                   |
|    | 63  | operation board                    |
| 25 | 70  | controller                         |
|    | 71  | power supply board (board)         |
|    | 72  | electrical component               |

|    |     |                                           |
|----|-----|-------------------------------------------|
|    | 73  | heat sink (heat dissipater)               |
|    | 74  | boat-shaped case                          |
|    | 75  | insulating non-combustible material sheet |
|    | 76  | metal cover (cover)                       |
| 5  | 76a | opening                                   |
|    | 100 | mounting board                            |
|    | 102 | power module                              |
|    | 103 | electronic component                      |
|    | 104 | heat sink                                 |
| 10 | 106 | circuit case                              |
|    | 200 | electronic circuit board device           |

## CLAIMS

1. A top-loading-type washing machine comprising:
    - a housing;
    - 5 a container provided above and at a rear side of the housing; and
    - a control device disposed in the container and configured to perform a laundry operation including washing, rinsing, and spin-drying,

wherein the control device includes a board on which an electrical component is disposed, a heat dissipater provided in contact with the electrical

  - 10 component, and a cover disposed to cover the board,

the cover includes a surface facing the board and covering the board from the bottom side, and an opening opened on the surface,

the heat dissipater extends from the electrical component to penetrate the cover through the opening, and

  - 15 the container includes a container opening located at a rear side, the container opening communicating the inside of the container to the outside of the housing.
- 
2. The top-loading-type washing machine according to claim 1,
  - 20 wherein the cover includes metal.
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3. The top-loading-type washing machine according to claim 1 or 2, wherein
    - the control device further includes an operation display unit at an
    - 25 upside,
    - the board is provided below the operation display unit, and
    - the cover is provided to cover the board from below the operation display unit.