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(71) Applicant: **LG ELECTRONICS INC.**  
**Seoul 150-721 (KR)**

(72) Inventors:  
• **Ahn, In Geun**  
**Changwon-si**  
**Gyeongsangnam-do, 641-711 (KR)**  
• **Lee, Kyu Won**  
**Changwon-si**  
**Gyeongsangnam-do, 641-711 (KR)**  
• **Moon, Seong Il**  
**Changwon-si**  
**Gyeongsangnam-do, 641-711 (KR)**

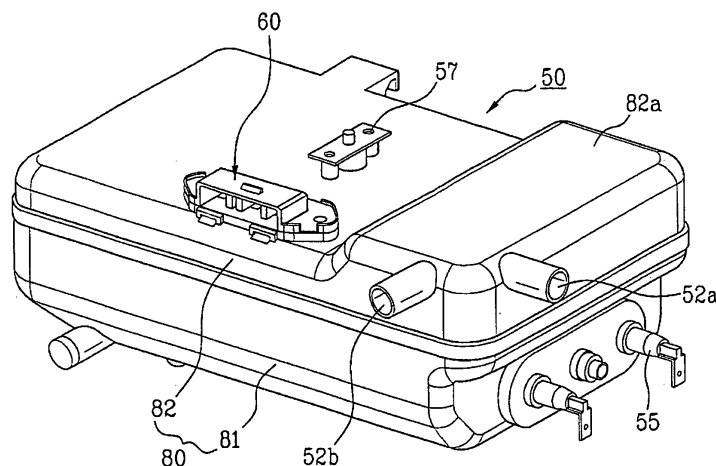
(74) Representative: **TER MEER - STEINMEISTER & PARTNER GbR**  
**Mauerkircherstrasse 45**  
**81679 München (DE)**

(54) **Steam generating device and washing machine having the same**

(57) A steam generating device (50) and a washing machine having the same are disclosed. The steam generating device (50) includes a case (80) for containing water, the case (80) receiving a heater, a water level sensor (60) for sensing a water level of the case, and a receptacle extending downwardly from a top of the case (80) while enclosing the water level sensor (60), to pre-

vent the water level sensor from malfunctioning, the receptacle having an open bottom directly communicating with an interior of the case (80), to prevent foreign matter from being accumulated in the receptacle. The structure of the receptacle covering the water level sensor (60) is improved. Accordingly, it is possible to reduce the accumulation of foreign matter in the receptacle, and thus to prevent the water level sensor (60) from malfunctioning.

**FIG. 2**



## Description

[0001] This application claims the benefit of Korean Patent Application Nos. 10-2006-0058056 and 10-2006-0058058, filed on June 27, 2006, which are hereby incorporated by reference as if fully set forth herein.

## BACKGROUND OF THE INVENTION

### Field of the Invention

[0002] The present invention relates to a steam generating device and a washing machine having the same, and more particularly to a steam generating device, in which a receptacle for covering a water level sensor has an improved structure capable of reducing accumulation of foreign matter in the receptacle, thereby preventing the water level sensor from malfunctioning, and a washing machine having the steam generating device.

### Discussion of the Related Art

[0003] Generally, washing machines are classified into a pulsator type, in which a washing operation is carried out using a flow of water generated in accordance with the rotation of a pulsator, and a drum type, in which a washing operation is carried out using the heads of wash water and laundry falling down in a horizontally-installed drum and frictional force generated between the drum and the laundry during rotation of the drum.

[0004] Recently, a washing machine, in particular, a drum washing machine, which has a function capable of washing laundry using steam, has been proposed. When steam is used in a washing operation, as in such a washing machine, it is possible to reduce the consumption of water and electricity, to achieve an enhancement in washing performance, to remove creases and odor, and to prevent generation of static electricity.

[0005] A general drum washing machine using steam will be described hereinafter with reference to FIG. 7.

[0006] The drum washing machine includes a cabinet 10 forming an appearance of the washing machine, a cylindrical tub 20 horizontally supported by the cabinet 10 in the interior of the cabinet 10, to store wash water, a drum 30 rotatably installed in the tub 20, and a drive motor (not shown) for driving the drum 30.

[0007] An inlet 13 is formed at a front side of the cabinet 10. The inlet 13 communicates with the interior of the drum 30 so that laundry can be put into or taken out of the drum 30 through the inlet 13. A door 11 is mounted to the inlet 13, to open or close the inlet 13.

[0008] Water supply valves 15 are provided at one side of the drum washing machine. The water supply valves 15 are connected to external water pipes (not shown), respectively, so as to supply water to the tub 20. The water valves 15 are connected to a detergent box 27 via a hot water pipe 25a and a cold water pipe 26, respec-

tively.

[0009] The drum washing machine also includes a steam generating device 50 for supplying steam to the drum 30. A water supply hose 25 and a steam hose 53 are connected to the steam generating device 50. The water supply hose 25 supplies water to the steam generating device 50, whereas the steam hose 53 supplies steam generated from the steam generating device 50 to the drum 30.

[0010] The configuration of the steam generating device 50 will be described in more detail with reference to FIGs. 8 and 9.

[0011] The steam generating device 50 includes a case 80. The case 80 includes a lower housing 81 forming an appearance of the steam generating device 50 and an upper housing 82 coupled to an upper end of the lower housing 81. A space for storing water is defined in the lower housing 81. The steam generating device 50 also includes a heater 55 for heating water stored in the case 80.

[0012] A water supply port 52b is formed at one side of the housing 82. The water supply port 52b is connected to the water supply hose 25, to introduce water from the water support hose 25 into the steam generating device 50. A steam discharge port 52a is formed at the other side of the housing 82. The steam discharge port 52a is connected to the steam hose 53, to supply steam from the steam hose 53 to the drum 20.

[0013] A water level sensor 60 and a temperature sensor 57 are installed at one side of the upper housing 82. The water level sensor 60 senses the level of water stored in the steam generating device 50. The temperature sensor 57 measures the temperature of water heated by the heater 55 and the temperature of steam generated in accordance with the heating of the water.

[0014] The water level sensor 60 includes a receptacle housing 61 forming an appearance of the water level sensor 60. The receptacle housing 61 is fixedly mounted to the steam generating device 50. The water level sensor 60 also includes electrodes arranged in the receptacle housing 61 such that they extend downwardly, to sense the level of water stored in the steam generating device 50.

[0015] The electrodes comprise at least a common electrode 62 functioning as a reference electrode for sensing a water level, a low-water-level electrode 63 for sensing a low water level, and a high-water-level electrode 64 for sensing a high water level.

[0016] When water boils, air bubbles may be abruptly generated, and may be attached to the electrodes 62, 63, and 64. In this case, the electrodes 62, 63, and 64 may malfunction. Furthermore, it is difficult to completely prevent generation of vibration during operation of the washing machine. For this reason, the steam generating device 50 may also vibrate during operation of the washing machine, so that the water stored in the steam generating device 50 may roll.

[0017] In order to prevent the water level sensor 60

from malfunctioning due to the above-mentioned factors, a receptacle 70 is provided. The receptacle 70 is configured to enclose the electrodes 62, 63, and 64. The receptacle 70 also has an opening 70s.

**[0018]** As shown in FIG. 9, the receptacle 70 includes an upper receptacle 71 extending downwardly from the upper housing 82, to protect an upper portion of the water level sensor 70, and a lower receptacle 73 extending upwardly from the lower housing 81, to protect a lower portion of the water level sensor 70. Each of the receptacles 71 and 73 has a chamber structure.

**[0019]** The above-mentioned conventional steam generating device and the washing machine equipped with the same have the following problems.

**[0020]** When the steam generating device 50 operates, water stored in the steam generating device 50 is heated, thereby generating steam. During the heating operation, foreign matter contained in the water, for example, lime, is accumulated in the case 80.

**[0021]** In particular, foreign matter contained in the water introduced into the receptacle 70 of the water level sensor 60 may be accumulated in the receptacle 70, as shown in FIG. 11.

**[0022]** Typically, the foreign matter is gradually upwardly accumulated in the receptacle 70, starting from the bottom of the lower receptacle 73. For this reason, moisture contained in the accumulated foreign matter may electrically connect the low-water-level electrode 63 and common electrode 62. As a result, the water level sensor 60 may malfunction, in a state in which there is no water in the steam generating device 50.

**[0023]** In this case, since the water level sensor 60 erroneously detects that there is water in the steam generating device 50, in spite of the fact that there is no water in the steam generating device 50, the heater 55 continuously operates, so that it is overheated. As a result, there is a problem in that the fuse of the heater 55 may be damaged.

### **SUMMARY OF THE INVENTION**

**[0024]** Accordingly, the present invention is directed to a steam generating device and a washing machine having the same that substantially obviate one or more problems due to limitations and disadvantages of the related art.

**[0025]** An object of the present invention is to provide a steam generating device, in which a receptacle for covering a water level sensor has an improved structure capable of reducing accumulation of foreign matter in the receptacle, thereby preventing the water level sensor from malfunctioning, and a washing machine having the steam generating device.

**[0026]** Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention.

The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

**[0027]** To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a steam generating device comprises: a case for containing water, the case receiving a heater; a water level sensor for sensing a water level of the case; and a receptacle extending downwardly from a top of the case while enclosing the water level sensor, to prevent the water level sensor from malfunctioning, the receptacle having an open bottom directly communicating with an interior of the case, to prevent foreign matter from being accumulated in the receptacle.

**[0028]** The receptacle may communicate with the interior of the case through the entire portion of the open bottom.

**[0029]** The receptacle may extend to a position approximate to a bottom of the case.

**[0030]** The receptacle may include an opening for allowing water to be introduced toward the water level sensor.

**[0031]** Preferably, the opening is formed at the bottom of the receptacle.

**[0032]** More preferably, the opening is formed at a side wall portion of the receptacle.

**[0033]** The steam generating device may further comprise a lower barrier wall extending downwardly from a bottom of the case.

**[0034]** The receptacle may include a first barrier wall arranged adjacent to the heater, and a second barrier wall arranged to be spaced apart from the first barrier wall.

**[0035]** The second barrier wall may be arranged beneath the first barrier wall.

**[0036]** The second barrier wall may be arranged such that an upper end of the second barrier wall overlaps with a lower end of the first barrier wall.

**[0037]** Preferably, the first barrier wall has a plate shape.

**[0038]** Preferably, the water level sensor is arranged to be misaligned from an intermediate portion of the second barrier wall toward one side of the second barrier wall.

**[0039]** More preferably, the receptacle includes openings respectively formed at opposite side wall portions of the receptacle, to allow water to be introduced toward the water level sensor.

**[0040]** In another aspect of the present invention, a washing machine comprises: a body; a tub installed in the body; a drum rotatably installed in the tub; and a steam generating device for supplying steam to the drum, the steam generating device including a case for containing water, the case receiving a heater, a water level sensor for sensing a water level of the case, and a receptacle extending downwardly from a top of the case

while enclosing the water level sensor, to prevent the water level sensor from malfunctioning, the receptacle having an open bottom directly communicating with an interior of the case, to prevent foreign matter from being accumulated in the receptacle.

[0041] In the washing machine, the receptacle may extend to a position approximate to a bottom of the case while communicating with the interior of the case through the entire portion of the open bottom.

[0042] The receptacle may include an opening for allowing water to be introduced toward the water level sensor.

[0043] Preferably, the opening comprises openings respectively formed at the bottom of the receptacle and side wall portions of the receptacle.

[0044] The steam generating device may further include a lower barrier wall extending downwardly from a bottom of the case.

[0045] The receptacle may include a first barrier wall arranged adjacent to the heater, and a second barrier wall arranged to be spaced apart from the first barrier wall.

[0046] The second barrier wall may be arranged beneath the first barrier wall.

[0047] Preferably, the second barrier wall is arranged such that an upper end of the second barrier wall overlaps with a lower end of the first barrier wall.

[0048] Preferably, the water level sensor is arranged to be misaligned from an intermediate portion of the second barrier wall toward one side of the second barrier wall.

[0049] More preferably, the receptacle includes openings respectively formed at opposite side wall portions of the receptacle, to allow water to be introduced toward the water level sensor.

[0050] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0051] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0052] FIG. 1 is a vertical sectional view illustrating a washing machine according to the present invention;

[0053] FIG. 2 is a perspective view illustrating a steam generating device according to the present invention;

[0054] FIG. 3 is a partially-broken perspective view corresponding to FIG. 2;

[0055] FIG. 4 is a perspective view illustrating a receptacle of the steam generating device according to the present invention;

[0056] FIG. 5 is a perspective view illustrating a receptacle according to another embodiment of the present invention;

5 [0057] FIG. 6 is a cross-sectional view illustrating a receptacle according to another embodiment of the present invention;

[0058] FIG. 7 is a perspective view illustrating a conventional drum washing machine;

10 [0059] FIG. 8 is a perspective view illustrating a conventional steam generating device;

[0060] FIG. 9 is a partially-broken perspective view illustrating a steam generating device shown in FIG. 8;

[0061] FIG. 10 is a perspective view illustrating a conventional receptacle; and

15 [0062] FIG. 11 is a cross-sectional view illustrating accumulation of foreign matter in the receptacle of FIG. 10.

#### **DETAILED DESCRIPTION OF THE INVENTION**

20 [0063] The present invention now will be described more fully hereinafter with reference to the accompanying figures, in which embodiments of the invention are shown. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts, and no repeated description thereof will be given.

25 [0064] FIG. 1 is a vertical sectional view illustrating a washing machine according to the present invention. FIG. 2 is a perspective view illustrating a steam generating device according to the present invention. FIG. 3 is a partially-broken perspective view corresponding to FIG. 2.

30 [0065] As shown in FIGs. 1 to 3, the washing machine of the present invention mainly includes a body 110, a tub 120, a drum 130, a steam supplier, a temperature sensor 150, a circulation pump 160, a circulation passage 170, and a water level sensor 250 for sensing the level of wash water in the tub 120. The following description will be given in conjunction with an embodiment in which the washing machine is of a drum type.

35 [0066] The body 110 forms an appearance of the drum washing machine. An inlet 111 is formed at a front side of the body 110.

40 [0067] A door 140 is mounted to a region where the inlet 111 of the body 110 is formed, to open or close the inlet 111. A gasket 112 is fitted around an inner peripheral edge of the inlet 111, in order to provide a seal between the door 140 and the inlet 111.

45 [0068] A wash water supply pipe 113 is provided at the body 110, to supply wash water to the tub 120. A detergent box 114 is arranged in a flow path of the wash water supply pipe 113.

50 [0069] The tub 120 is arranged in the body 110 while being supported by the body 110. A water draining passage 121 for draining wash water is connected to a bottom of the tub 120. A wash water heater 122 is arranged at the bottom of the tub 120, to heat wash water supplied to the tub 120.

**[0070]** The drum 130 is rotatably mounted in the tub 120. The drum 130 has an opening directed to the inlet 111 of the body 110.

**[0071]** A plurality of pores are formed through a peripheral wall of the drum 130, to allow wash water and steam supplied to the tub 120 to be introduced into the drum 130.

**[0072]** The steam supplier is configured to supply a certain amount of steam into one or both of the tub 120 and the drum 130. One or more steam suppliers, which have the above-described structure, may be provided.

**[0073]** The circulation pump 160 is arranged in the water draining passage 121 connected to the tub 120. The circulation pump 160 operates to pump wash water supplied to the tub 120, and thus to circulate the wash water.

**[0074]** The circulation passage 170 is connected to the circulation pump 160, and functions as a flow path for guiding circulation of the wash water pumped by the circulation pump 160.

**[0075]** Preferably, the circulation passage 170 extends through the gasket 112 such that an end of the circulation passage 170, from which wash water is discharged, is directed to the interior of the drum 130. The circulation passage 170 may be connected to the steam supply line 220, as shown in FIG. 1. Alternatively, the circulation passage 170 may be connected to the interior of the drum 130, separately from the steam supply pipe 220.

**[0076]** Meanwhile, the temperature sensor 15 is arranged at a certain position in the tub 120, to sense the internal temperature of the tub 120. The temperature sensed by the temperature sensor 150 may be used to control the operation of the steam supplier and the operation of the wash water heater 122 which will be described.

**[0077]** In the drawings, reference numeral "180" designates a water supply valve assembly for selectively supplying wash water received from the external of the washing machine to the detergent box 114 or to the steam supplier. The water supply valve assembly includes a wash water supply valve 181 for controlling supply of wash water to the tub 120 via the detergent box 114, and a steam-associated water supply valve 182 for controlling supply of water to the steam supplier.

**[0078]** The steam generating device includes a steam generator 200 for supplying high-temperature heat, to boil water, and thus to generate steam, and supplying the generated steam to the tub 120 and/or the drum 130, a steam supply pipe 220, through which the steam from the steam generator 200 flows, and a spray nozzle 221 for spraying the steam flowing through the steam supply pipe 220 into the tub 120 and/or the drum 130.

**[0079]** The spray nozzle 221 has a nozzle structure capable of effectively spraying the steam. The tip of the spray nozzle 221, from which the steam emerges, extends through the gasket 112 such that it is directed to the interior of the drum 130.

**[0080]** As shown in FIGs. 2 and 3 associated with one embodiment of the present invention, the steam gener-

ator 200 includes a case 210 constituted by upper and lower housings 211 and 213, a steam heater 230, a steam-side temperature sensor 240, a water level sensor 250, and a receptacle 300.

**[0081]** The case 210 may have a rectangular box structure forming an appearance of the steam generator 210 and defining a steam generating space.

**[0082]** A water supply port (not shown) is formed at one side of the case 210. The water supply port is connected to the water supply valve 182, to introduce water from the water supply valve 182 into the case 210. A steam discharge port 201 is formed at the other side of the case 210. The steam discharge port 201 is connected to the steam supply pipe 220, to supply steam from the steam supply pipe 220 to the drum 130.

**[0083]** The steam heater 230 is arranged in the case 210. The steam heater 230 generates heat, to heat water introduced into the case 210, and thus to generate steam.

**[0084]** For the steam heater 230, a sheath heater may be used. Although not shown, a fuse is installed in the steam heater 230, to cut off the supply of electricity when the steam heater 230 is overheated, and thus to protect the steam heater 230 and steam generator 200.

**[0085]** The steam-side temperature sensor 240 is arranged in the case 210, and is electrically connected to a controller (not shown) included in the washing machine. The steam-side temperature sensor 240 functions to sense the internal temperature of the case 210 when the steam heater 230 generates heat.

**[0086]** The water level sensor 250 is also arranged in the case 210, to sense the level of water supplied to the case 210. The water level sensor 250 includes a receptacle housing 251 forming an appearance of the water level sensor 250. The receptacle housing 251 is fixedly mounted to the steam generator 200. The water level sensor 250 also includes three electrodes, namely, a common electrode 252, a low-water-level electrode 253, and a high-water-level electrode 254.

**[0087]** The water level sensor 250 is electrically connected to the controller (not shown) of the washing machine, which controls the overall operation of the constituent elements of the washing machine including the water supply valve assembly 180, steam heater 213, etc.

**[0088]** The common electrode 252 and low-water-level electrode 253 is arranged such that the terminals thereof are positioned at a level corresponding to a minimum water level required for the generation of steam. The high-water-level electrode 254 has a length relatively shorter than those of the common electrode 252 and low-water-level electrode 253 such that the terminal of the high-water-level electrode 254 is positioned at a level corresponding to a maximum water level required for the generation of steam.

**[0089]** Preferably, the level, at which the terminals of the low-water-level electrode 253 and common electrode 252 are positioned, is set to a water level causing the steam heater 230 to be completely submerged under water.

**[0090]** In accordance with a preferred embodiment of the present invention, the receptacle 300 functions to protect the water level sensor 250 from air bubbles and water supplied to the steam generator 200, and thus to prevent the water level sensor 250 from malfunctioning.

**[0091]** For example, when water boils, air bubbles may be abruptly generated, and may be attached to the electrodes 252, 253, and 254. In this case, the water level sensor 250 may malfunction. When water supplied through the water supply port splashes, the water level sensor 250 may malfunction.

**[0092]** Furthermore, it is difficult to completely prevent generation of vibration during operation of the washing machine. For this reason, the steam generator 200 may also vibrate during operation of the washing machine, so that the water stored in the steam generator 200 may roll. In order to prevent the water level sensor 250 from malfunctioning due to the above-described factors, a receptacle 300 is provided.

**[0093]** In accordance with the illustrated embodiment of the present invention, as shown in FIGs. 2 to 4, the receptacle 300 extends downwardly from the top of the case 210 while enclosing the water level sensor 250. An opening 350 is formed at a lower end of the receptacle 300, to allow water to be introduced into the receptacle 300.

**[0094]** In accordance with such a structure of the receptacle 300, it is possible to protect the water level sensor 250 from air bubbles, etc., and to minimize accumulation of foreign matter in the receptacle 300.

**[0095]** In detail, the receptacle 300 includes a first barrier wall 310 arranged near the steam heater 230 while extending in a longitudinal direction of the water level sensor 250, and a second barrier wall 330 arranged opposite to the first barrier wall 310 while being spaced apart from the first barrier wall 310 by a certain distance.

**[0096]** Preferably, the first and second barrier walls 310 and 330 extend downwardly from the top of the case 210 to a position approximate to the bottom of the case 210. Preferably, openings 350 are formed at lower ends of the first and second barrier walls 310 and 330, respectively, in order to allow water to be introduced into the receptacle 300.

**[0097]** Another opening 350 may also be formed at a side wall portion of each barrier wall 310 or 330.

**[0098]** Since the receptacle 300 is configured to extend from the top of the case 210 to the bottom of the case 210, the amount of foreign matter accumulated in the receptacle 300 is very small. Accordingly, it is possible to prevent the electrodes of the water level sensor 320 from being electrically connected by foreign matter, and thus to prevent the water level sensor 320 from malfunctioning.

**[0099]** The reason why the amount of foreign matter accumulated in the receptacle 300 is very small is that the bottom of the receptacle 300 (preferably, the entire bottom portion of the receptacle 300) is open such that it communicates directly with the interior of the case 210.

**[0100]** Although foreign matter is typically upwardly accumulated in a receptacle, starting from the bottom of the receptacle, as in conventional cases, it is difficult for foreign matter to be accumulated in the receptacle 300 of the present invention because the receptacle 300, which has an open bottom communicating directly with the case 210, does not interfere with a water flow introduced into or discharged out of the receptacle 300.

**[0101]** Accordingly, the amount of foreign matter accumulated in the receptacle 300 is very small, so that it is possible to prevent the water level sensor 250 from malfunctioning due to the foreign matter.

**[0102]** In accordance with another embodiment of the present invention, as shown in FIG. 5, the receptacle 300 may include an upper receptacle 310' for protecting an upper portion of the water level sensor 250, and a lower barrier wall 330' arranged beneath the upper receptacle 310', to protect a lower portion of the water level sensor 250.

**[0103]** Similarly to the above-described embodiment, the upper receptacle 310' preferably includes a first barrier wall 311 and a second barrier wall 313. In this case, the first barrier wall 211 is arranged near the steam heater 230.

**[0104]** Preferably, the lower barrier wall 330' is arranged beneath a lower portion of the first barrier wall 311 (namely, at a position approximate to the steam heater 230). In accordance with the present invention, the lower barrier wall 330' is arranged such that an upper portion of the lower barrier wall 330' overlaps with the lower portion of the first barrier wall 311.

**[0105]** Meanwhile, the second barrier wall 313 substantially has a "C"-shape. Also, the first barrier wall 311 has a shape corresponding to the second barrier wall 313. Thus, the first and second barrier walls 311 and 313 form the upper receptacle 310', which has a chamber shape. Preferably, the lower barrier wall 330' has a plate shape.

**[0106]** Since the amount of foreign matter accumulated in the upper receptacle 310', which is adapted to protect the upper portion of the water level sensor 250, is small, the upper receptacle 310' is formed to have a chamber shape, in order to mainly protect the upper portion of the water level sensor 250. On the other hand, if the lower barrier wall 330' has a chamber shape, the amount of foreign matter accumulated in the lower barrier wall 330' may be large. For this reason, the lower barrier wall 330' is formed to have a plate shape, in order to more surely prevent the accumulation of foreign matter and to prevent air bubbles from moving to the lower portion of the water level sensor 320.

**[0107]** Preferably, the upper receptacle 310' has an opening 350, in order to allow water to enter the water level sensor 250. The opening 350 may be formed at the bottom of the upper receptacle 310' or at one of the opposite side wall portions of the upper receptacle 310'. However, it is preferred that the upper receptacle 310' have openings 350 formed at the bottom of the upper

receptacle 310' and at the opposite side wall portions of the upper receptacle 310', respectively, in order to achieve easy introduction of water into the upper receptacle 310'.

**[0108]** Meanwhile, although a small amount of foreign matter is accumulated around the lower barrier wall 330', which does not have a chamber shape, but has a plate shape, as compared to conventional cases, the accumulated amount of foreign matter increases to a certain degree as the steam generating device is used for a prolonged period of time.

**[0109]** In this case, the accumulated amount of foreign matter is large around an intermediate portion of the lower barrier wall 300' arranged between opposite sides of the lower barrier wall 300', while being small around a region where a large amount of water flows. For this reason, when the water level sensor 250 is installed near the intermediate portion of the lower barrier wall 330', the electrodes of the water level sensor 250 may be electrically connected by the foreign matter accumulated in a large amount around the intermediate portion of the lower barrier wall 330'. In this case, the water level sensor 250 may malfunction.

**[0110]** Therefore, it is preferred that the water level sensor 250 be installed such that it is misaligned from the intermediate portion of the lower barrier wall 330', without being installed near an intermediate portion of the lower barrier wall 330'.

**[0111]** Of course, as shown in FIG. 5, the lower barrier wall 330' may extend from one side of the water level sensor 250 spaced apart from the intermediate portion of the water level sensor 250.

**[0112]** When the lower portion of the receptacle 300 does not have a chamber structure, but has a barrier wall structure, different from conventional cases, it is possible to considerably reduce the accumulation of foreign matter.

**[0113]** Also, when the water level sensor 250 is installed such that it is misaligned from the intermediate portion of the lower barrier wall 330', or extends from one side of the water level sensor 250 spaced apart from the intermediate portion of the water level sensor 250, as described above, it is possible to prevent the electrodes from being electrically connected by the accumulated foreign matter.

**[0114]** Hereinafter, operation of the steam generating device having the above-described configuration, operation of the drum washing machine having the same, and effects according to the operations will be described.

**[0115]** When electric power is supplied to the drum washing machine, the controller (not shown) included in the drum washing machine controls the wash water supply valve 181 of the water supply valve assembly 180 such that wash water is supplied to the tub 120 such that the level of the supplied wash water reaches a predetermined water level. The controller then drives the circulation pump 160, so as to circulate the wash water present in the tub 120 to the top of the drum 130 via a water path

defined outside the tub 120. The controller also controls the drum 130 to rotate, in order to perform a laundry wetting operation.

**[0116]** The controller also controls the steam-associated water supply valve 182 of the water supply valve assembly 180 to supply a certain amount of water to the case 210 of the steam generator 200.

**[0117]** When water is supplied to the case 210, the supplied water is introduced into the receptacle 300 through the openings 350 formed at the bottom and opposite side wall portions of the receptacle 300. At this time, the water level sensor 250 senses the level of water introduced into the receptacle 300.

**[0118]** Meanwhile, the water introduced into the case 210 is heated by the steam heater 230, so that it is converted to steam. During this procedure, the receptacle 300 prevents water splashed or air bubbles generated in accordance with a water heating operation from coming into direct contact with the electrodes of the water level sensor 250.

**[0119]** The steam generated in the case 210 is discharged into the drum 130, in which laundry is contained, after being guided by the steam supply pipe 220 connected to the case 210 and drum 130. Thus, the steam is supplied to the laundry contained in the drum 130.

**[0120]** The steam generator 200 continuously supplies steam to the drum 130 while repeating the above-described procedure.

**[0121]** Meanwhile, foreign matter contained in the water introduced into the receptacle 300 is accumulated during the operation of the steam generator 200. In accordance with the present invention, as described, it is possible to minimize the accumulation of foreign matter in the receptacle 300, and thus to prevent the water level sensor 250 from malfunctioning due to the foreign matter because the receptacle 300 is downwardly elongated from the upper case 210 while having an opening 350 at the bottom such that it directly communicates with the interior of the case 200.

**[0122]** Also, since high-temperature steam is rapidly sprayed into the drum via the steam generator 210 according to the present invention during the laundry wetting operation carried out in accordance with the re-supply of water to the tub 120, the rotation of the drum, and the operation of the circulation pump 160, it is possible to maintain the atmosphere of the interior of the drum 130 at a temperature optimal for a desired washing performance.

**[0123]** The laundry wetting procedure and the steam supply procedure carried out through the steam generator 200 are carried out until the temperature sensed by the temperature sensor 150 reaches a target temperature. When the temperature sensed by the temperature sensor 150 reaches a target temperature, the supply of steam through the steam generator 200 is stopped. Simultaneously, the wash water supply valve 181 is controlled to supply water to the tub 120 until the level of water in the tub 120 reaches a predetermined water level.

Thereafter, the drum 130 is rotated in clockwise and counter-clockwise directions, and post-washing is carried out in accordance with a set program.

[0124] The post-washing may be carried out under the condition in which the wash water is heated to a predetermined temperature by the wash water heater 122. Also, the post-washing may be carried out under the condition in which the circulation pump 160 operates at intervals of a predetermined time, to circulate the wash water.

[0125] After completion of the post-washing, desired or selected cycles, for example, rinsing and spin-drying cycles, are sequentially carried out in accordance with general procedures.

[0126] The steam generating device having the above-described configuration according to the present invention and the washing machine having the same provide the following effects.

[0127] First, since the receptacle extends downwardly from the top of the case, and the opening formed through the entire bottom portion of the receptacle directly communicates with the interior of the case, it is possible to minimize the accumulation of foreign matter in the receptacle.

[0128] When the receptacle has a chamber structure at an upper portion thereof, and a plate-shaped barrier wall structure at a lower portion thereof, the accumulation of foreign matter in the receptacle can be remarkably reduced.

[0129] Accordingly, it is possible to prevent the water level sensor and steam heater from malfunctioning due to the accumulated foreign matter, and thus to extend the life span of the fuse of the heater.

[0130] Second, since the water level sensor is arranged to be misaligned from the intermediate portion of the lower barrier wall, it is possible to prevent the electrodes of the water level sensor from being electrically connected, and thus to prevent the water level sensor from malfunctioning.

[0131] Third, since the receptacle has an elongated single receptacle structure or a receptacle structure added with a simple barrier wall, different from a double receptacle structure including upper and lower receptacles as in conventional cases, it is possible to reduce the manufacturing costs and manufacturing processes of the steam generating device and washing machine.

[0132] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

## Claims

1. A steam generating device comprising:

a case for containing water, the case receiving a heater;

a water level sensor for sensing a water level of the case; and

a receptacle extending downwardly from a top of the case while enclosing the water level sensor, to prevent the water level sensor from malfunctioning, the receptacle having an open bottom directly communicating with an interior of the case, to prevent foreign matter from being accumulated in the receptacle.

2. The steam generating device according to claim 1, wherein the receptacle communicates with the interior of the case through the entire portion of the open bottom.

3. The steam generating device according to claim 1, wherein the receptacle extends to a position approximate to a bottom of the case.

4. The steam generating device according to claim 1, wherein the receptacle includes an opening for allowing water to be introduced toward the water level sensor.

5. The steam generating device according to claim 4, wherein the opening is formed at the bottom of the receptacle.

6. The steam generating device according to claim 4, wherein the opening is formed at a side wall portion of the receptacle.

7. The steam generating device according to claim 1, further comprising:

a lower barrier wall extending downwardly from a bottom of the case.

8. The steam generating device according to claim 7, wherein the receptacle includes a first barrier wall arranged adjacent to the heater, and a second barrier wall arranged to be spaced apart from the first barrier wall.

9. The steam generating device according to claim 8, wherein the second barrier wall is arranged beneath the first barrier wall.

10. The steam generating device according to claim 8, wherein the second barrier wall is arranged such that an upper end of the second barrier wall overlaps with a lower end of the first barrier wall.

11. The steam generating device according to claim 8, wherein the first barrier wall has a plate shape.



12. The steam generating device according to claim 8, wherein the water level sensor is arranged to be misaligned from an intermediate portion of the second barrier wall toward one side of the second barrier wall. 5
13. The steam generating device according to claim 8, wherein the receptacle includes openings respectively formed at opposite side wall portions of the receptacle, to allow water to be introduced toward the water level sensor. 10
14. A washing machine comprising:
- a body; 15
  - a tub installed in the body;
  - a drum rotatably installed in the tub; and
  - a steam generating device for supplying steam to the drum, the steam generating device including a case for containing water, the case receiving a heater, a water level sensor for sensing a water level of the case, and a receptacle extending downwardly from a top of the case while enclosing the water level sensor, to prevent the water level sensor from malfunctioning, the receptacle having an open bottom directly communicating with an interior of the case, to prevent foreign matter from being accumulated in the receptacle. 20 25 30
15. The washing machine according to claim 14, wherein the receptacle extends to a position approximate to a bottom of the case while communicating with the interior of the case through the entire portion of the open bottom. 35
16. The washing machine according to claim 14, wherein the receptacle includes an opening for allowing water to be introduced toward the water level sensor. 40
17. The washing machine according to claim 16, wherein the opening comprises openings respectively formed at the bottom of the receptacle and side wall portions of the receptacle. 45
18. The washing machine according to claim 14, wherein the steam generating device further includes a lower barrier wall extending downwardly from a bottom of the case. 50
19. The washing machine according to claim 18, wherein the receptacle includes a first barrier wall arranged adjacent to the heater, and a second barrier wall arranged to be spaced apart from the first barrier wall. 55
20. The washing machine according to claim 19, wherein the second barrier wall is arranged beneath the first barrier wall.
21. The washing machine according to claim 19, wherein the second barrier wall is arranged such that an upper end of the second barrier wall overlaps with a lower end of the first barrier wall.
22. The washing machine according to claim 19, wherein the water level sensor is arranged to be misaligned from an intermediate portion of the second barrier wall toward one side of the second barrier wall.
23. The washing machine according to claim 19, wherein the receptacle includes openings respectively formed at opposite side wall portions of the receptacle, to allow water to be introduced toward the water level sensor.

FIG. 1

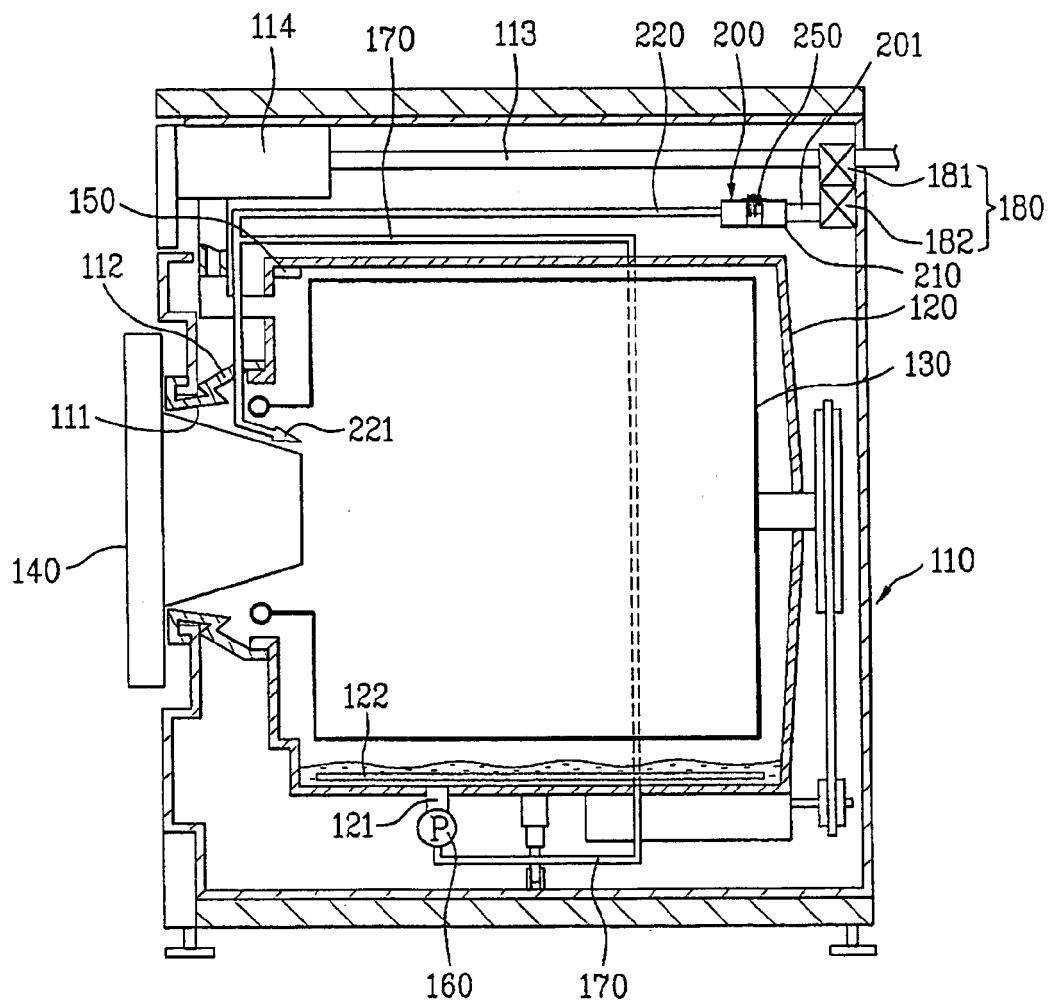


FIG. 2

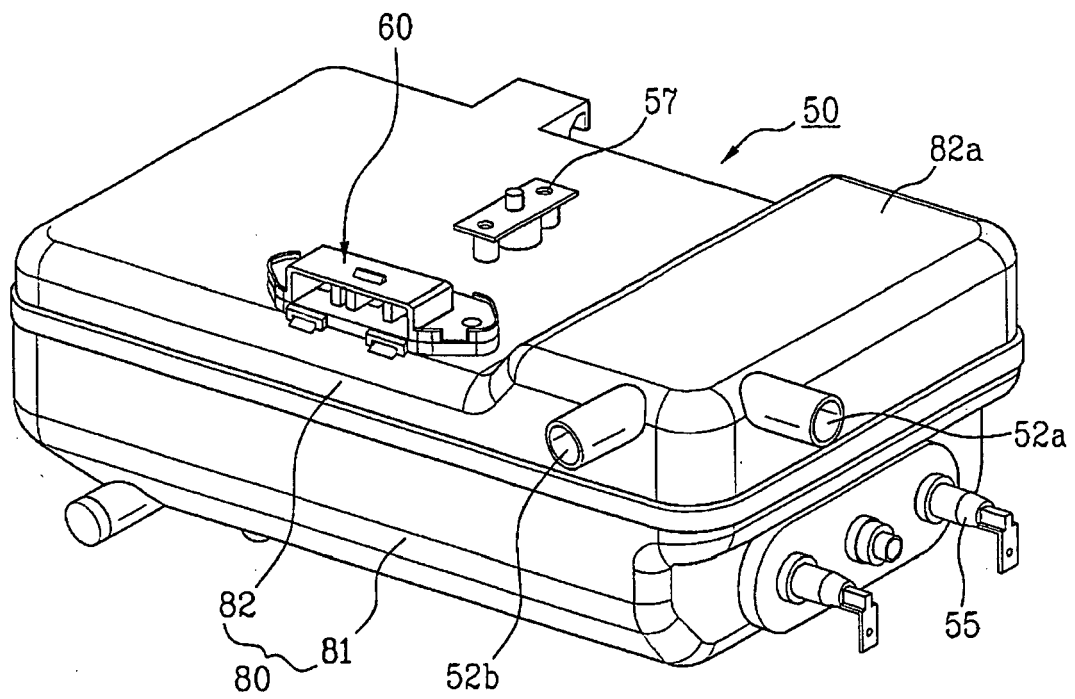


FIG. 3

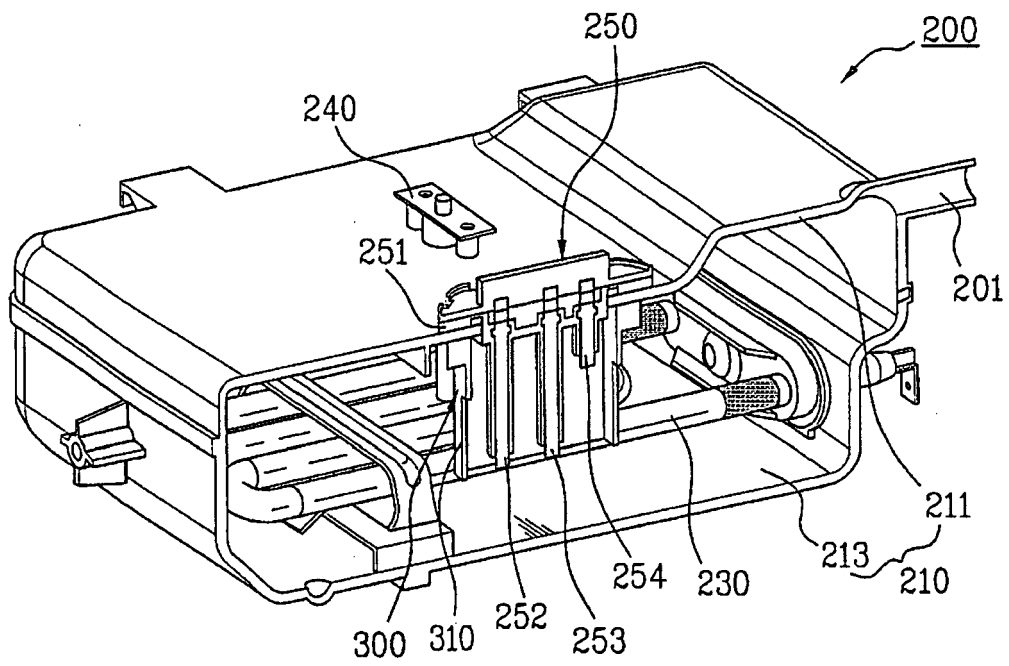


FIG. 4

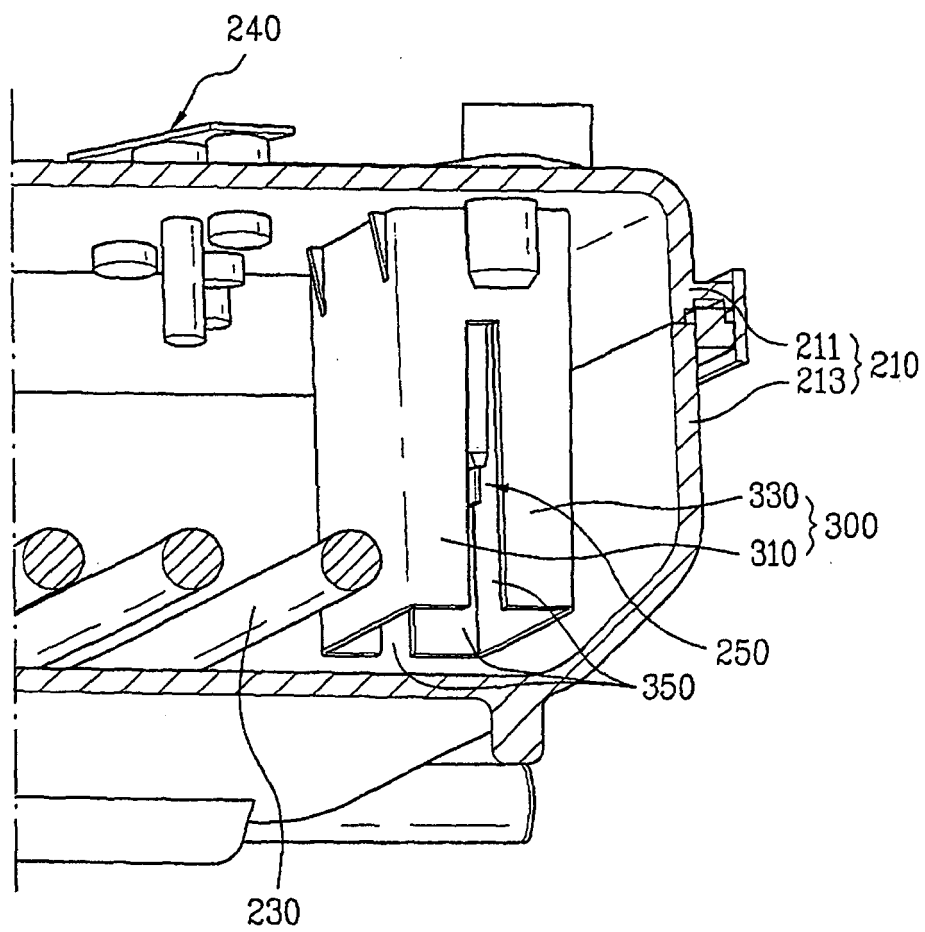


FIG. 5

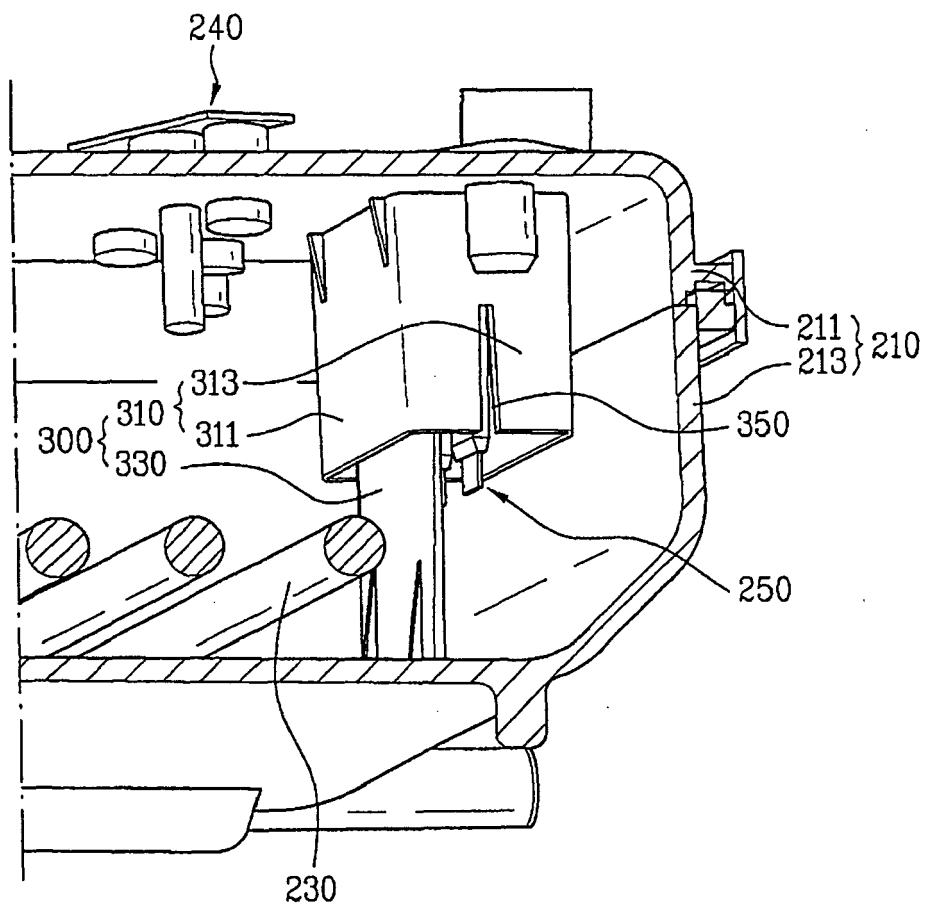


FIG. 6

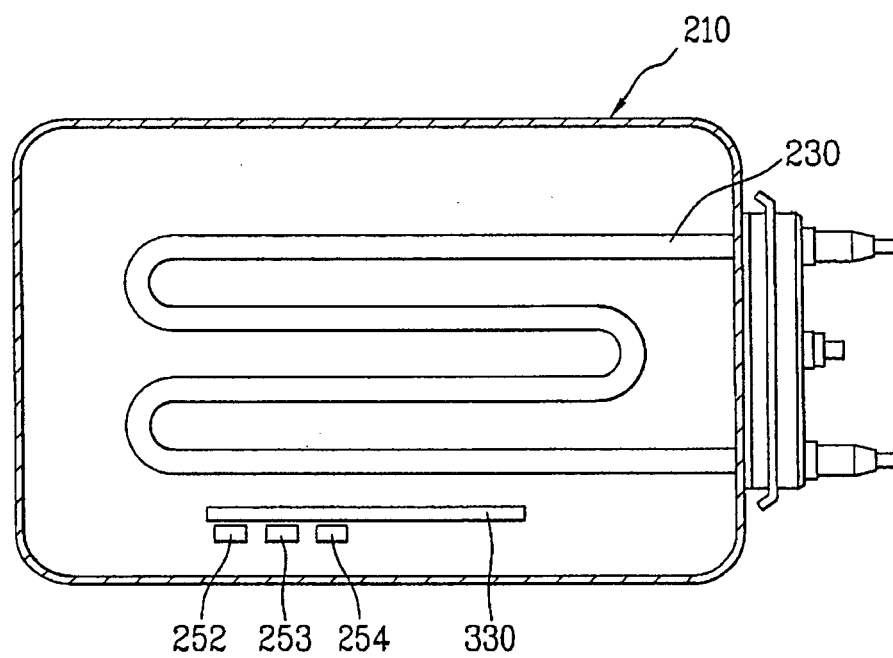


FIG. 7

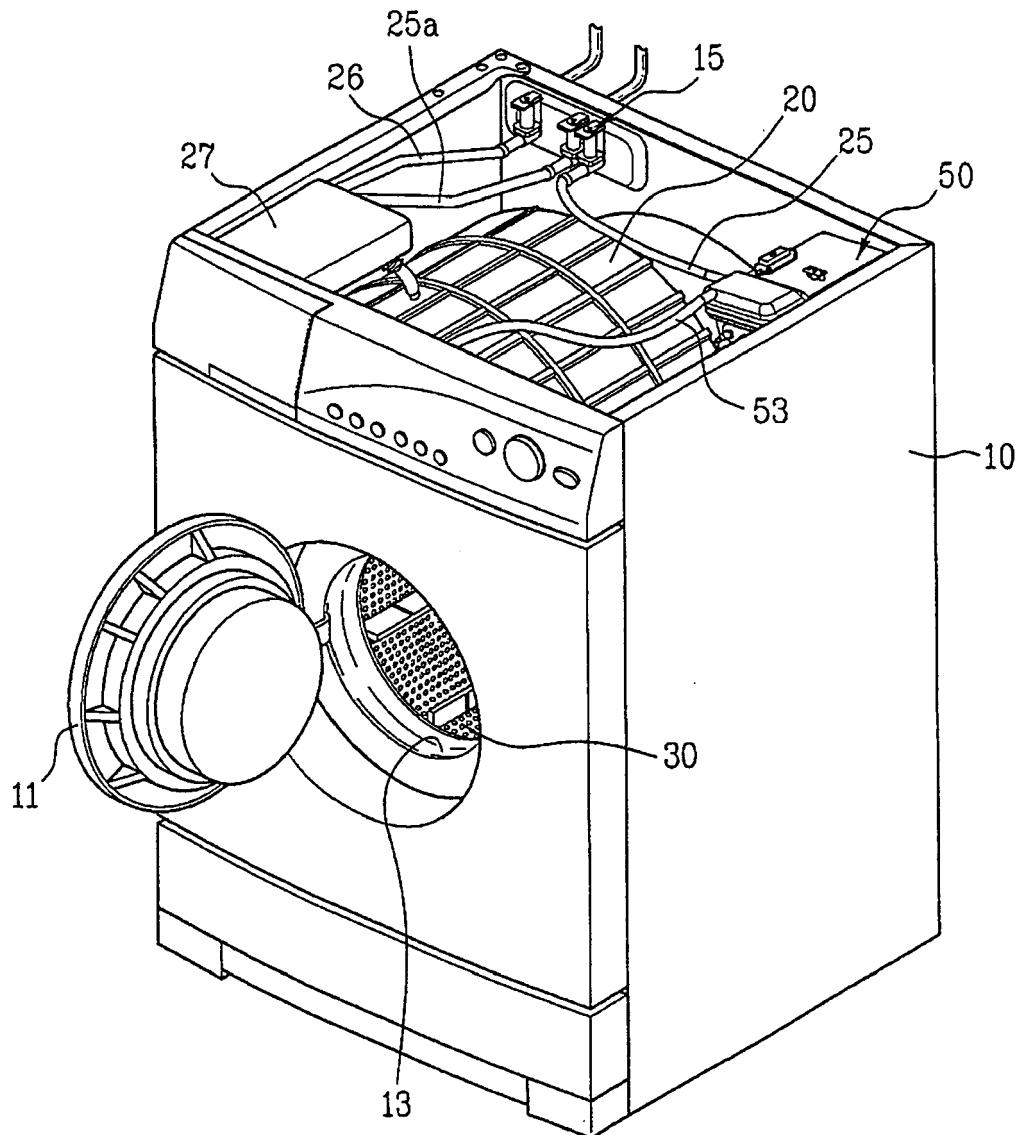




FIG. 8  
Related Art

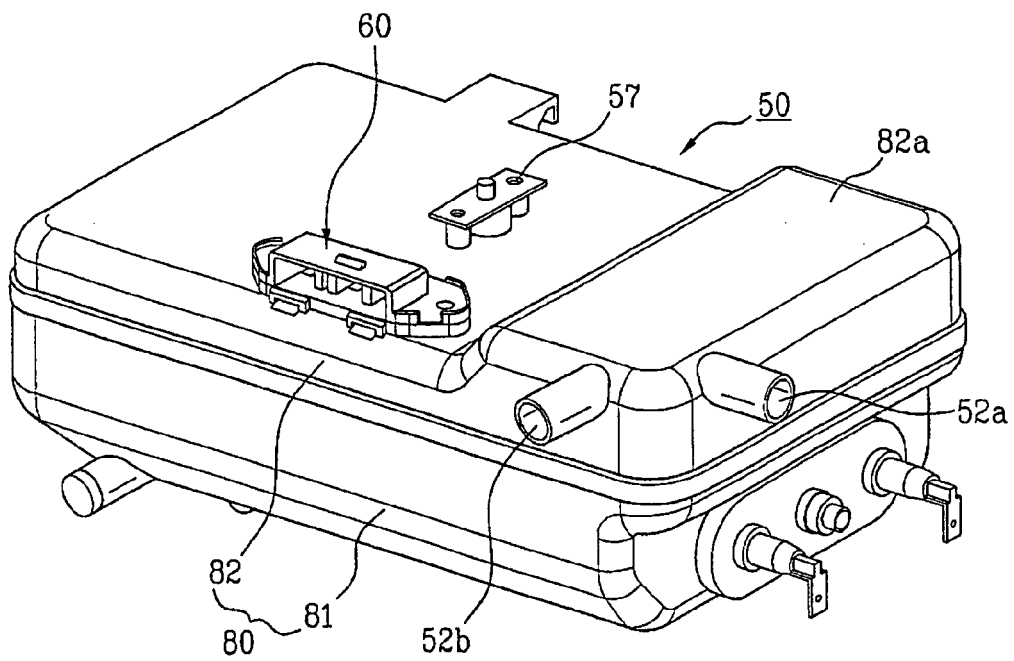




FIG. 10  
Related Art

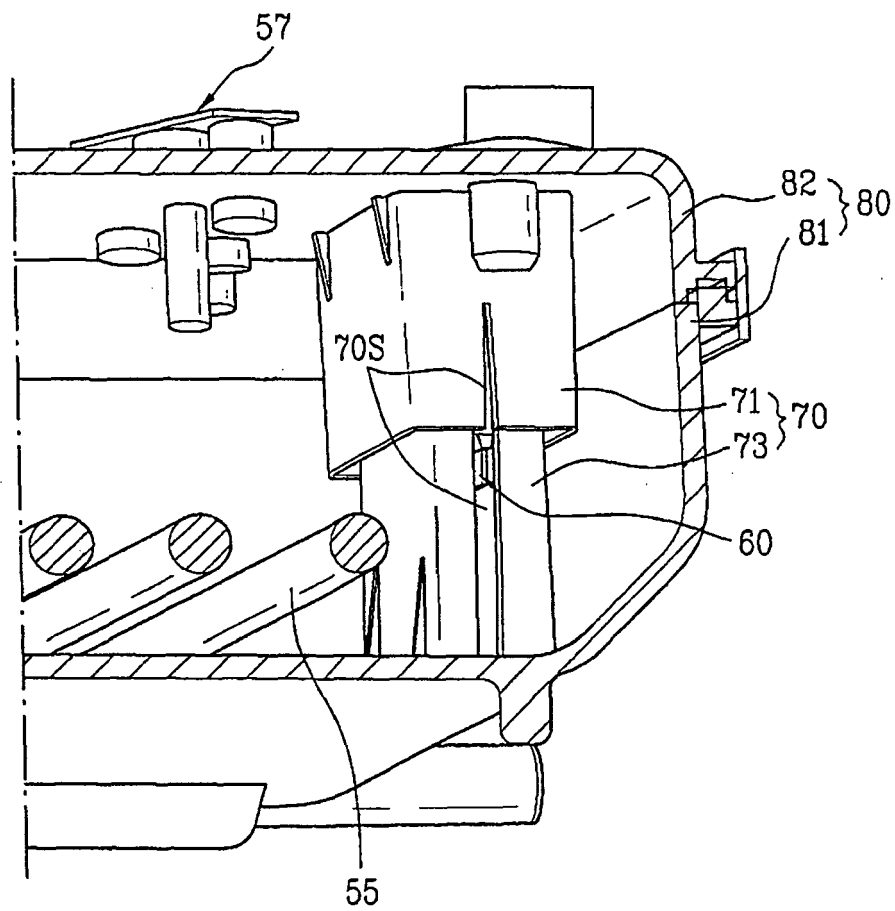
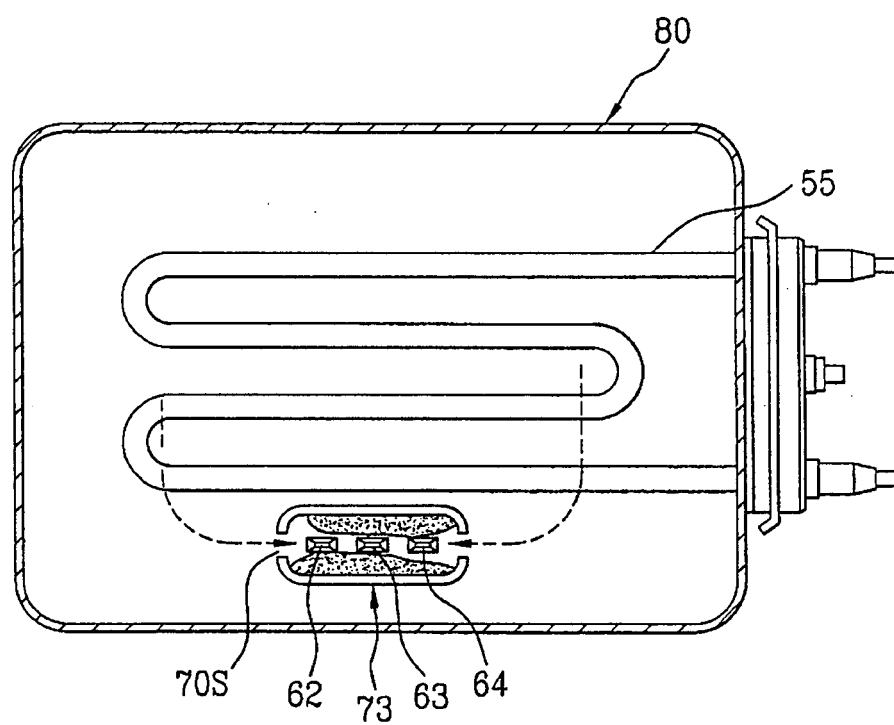


FIG. 11  
Related Art



**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- KR 1020060058056 [0001]
- KR 1020060058058 [0001]