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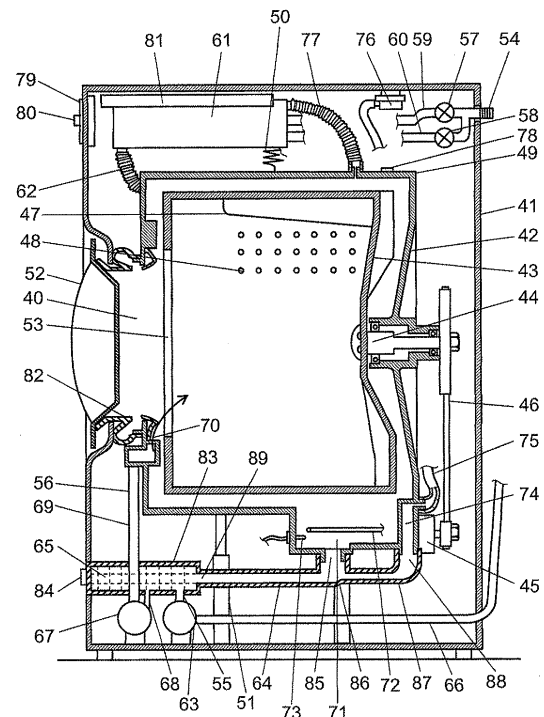
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(54) **DRUM-TYPE WASHING MACHINE**

(57) An air trap 74 is integrated with a water tank 42 in a side wall part of an outer periphery on the rear side of a bottom of the water tank 42, and has an opening 88 on the lower side, a water level detection tube 87 integrally formed on the one end side of a drainage tube 64 which is connected to a drainage port 85 formed in the bottom of the water tank 42 communicates with the air trap 74 at the opening 88, the drainage tube 64 is connected to a case connection port 89 of a filter case 83, and the air trap 74, the water level detection tube 87, the drainage port 85, the drainage tube 64, and the case connection port 89 are substantially horizontally arranged. Thus, a drainage water flow is straightened and foreign substances such as lint contained in washing water do not easily flow into the air trap 74, so that a water level in the water tank 42 is stabilized.

FIG. 1



## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a drum-type washing machine for washing a load accommodated in a rotary drum.

### BACKGROUND ART

**[0002]** Conventionally, this type of drum-type washing machine is provided with a water level detection structure for detecting a water level in a water tank (for example, refer to Patent Document 1).

**[0003]** Fig. 3 is a vertically sectional view showing a configuration of major parts of a conventional drum-type washing machine described in Patent Document 1, and Fig. 4 is a sectional view showing a water level detector of the conventional drum-type washing machine.

**[0004]** As shown in Fig. 3, in the conventional drum-type washing machine, a water tank 3 is supported in a washing machine casing 2 via a suspension structure (not shown), and a cylindrical rotary drum 5 with a bottom is rotatably arranged in this water tank 3. In a bottom of the water tank 3, a drainage passage 7 for discharging washing water in the water tank 3 is arranged. As shown in Fig. 4, the water level detector includes an air trap 100 integrated with the drainage passage 7 and a water level sensor (not shown) connected to the air trap 100 by an air tube 104, and the water level of the washing water in the water tank 3 is detected by the water level detector.

**[0005]** In the drainage passage 7, a connection portion 101 of a drainage tube 107 is coupled to a drainage groove 20 formed in the water tank 3. The drainage tube 107 is integrated with a water level detection tube 108 having a decreased diameter, the water level detection tube being provided with an inclination portion 109 on the lower side, and one end of the water level detection tube 108 is opened in the air trap 100. One end of the drainage tube 107 is coupled to a drainage port 102 and connected to an external drainage tube 103 via a drainage valve 27.

Patent Document(s)

**[0006]** Patent Document 1: JP 2005-137645 A

### SUMMARY OF THE INVENTION

#### Problems to be solved by the Invention

**[0007]** However, with the configuration of the water level detector in the conventional drum-type washing machine, at the time of draining the washing water in the water tank 3 through the drainage passage 7, the washing water flows toward the air trap 100. Thus, foreign substances such as lint easily come into the air trap 100. When lint comes into the air trap 100, there is sometimes

a case where an error is generated between a set water level of the water tank 3 and an actual water level.

**[0008]** The present invention is to solve the above conventional problem, and an object thereof is to provide a drum-type washing machine in which foreign substances such as lint do not easily come into an air trap in a piping structure of a bottom of a water tank, the drum-type washing machine being capable of stably detecting a water level of the water tank.

#### Means to Solve the Problems

**[0009]** In order to solve the above conventional problems, a drum-type washing machine of the present invention comprises:

- a washing machine casing;
- a water tank arranged in the washing machine casing;
- a rotary drum accommodated in the water tank;
- a filter case arranged in an inner lower part of the washing machine casing;
- an air trap having an opening on a lower side;
- a water level detector detecting a water level of the water tank from air pressure of the air trap;
- a drainage tube connected to a drainage port of a bottom of the water tank and a connection port of the filter case; and
- a water level detection tube providing communication between the drainage tube and the opening of the air trap, wherein
- the water level detection tube has an inclination portion in a vicinity of a lower side of the drainage port so as to have a smaller diameter than the drainage tube, and further, the water level detection tube, the drainage tube, and the connection port of the filter case are substantially horizontally arranged.

**[0010]** With such a configuration, at the time of draining washing water in the water tank, a water flow from the drainage port of the bottom of the water tank toward the connection port of the filter case through the drainage tube can be straightened. Therefore, foreign substances such as lint contained in the washing water cannot easily flow into the air trap, so that air pressure in the air trap is stabilized. Thus, the water level of the water tank can be stably detected.

#### Effects of the Invention

**[0011]** The drum-type washing machine of the present invention in which the foreign substances such as lint do not easily come into the air trap can stably detect the water level of the water tank.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0012]** These aspects and features of the invention will

be apparent from the following description concerning a preferred embodiment with reference to the accompanying drawings, in which:

Fig. 1 is a vertically sectional view of a drum-type washing machine in an embodiment of the present invention.

Fig. 2 is a perspective view of major parts when a lower piping part of the drum-type washing machine in the embodiment is seen from the lower side.

Fig. 3 is a vertically sectional view of a conventional drum-type washing machine.

Fig. 4 is a sectional view showing a water level detector of the conventional drum-type washing machine.

## DESCRIPTION OF EMBODIMENTS

**[0013]** According to a first aspect of the invention, there is provided a drum-type washing machine, comprising:

- a washing machine casing;
- a water tank arranged in the washing machine casing;
- a rotary drum accommodated in the water tank;
- a filter case arranged in an inner lower part of the washing machine casing;
- an air trap having an opening on a lower side;
- a water level detector detecting a water level of the water tank from air pressure of the air trap;
- a drainage tube connected to a drainage port of a bottom of the water tank and a connection port of the filter case; and
- a water level detection tube providing communication between the drainage tube and the opening of the air trap, wherein the water level detection tube has an inclination portion in a vicinity of a lower side of the drainage port so as to have a smaller diameter than the drainage tube, and further, the water level detection tube, the drainage tube, and the connection port of the filter case are substantially horizontally arranged.

**[0014]** Since the water level detection tube, the drainage tube, and the connection port of the filter case are substantially horizontally arranged, at the time of draining washing water in the water tank, a water flow from the drainage port of the bottom of the water tank toward the connection port of the filter case through the drainage tube can be straightened. Further, the water level detection tube providing communication between the drainage tube and the opening of the air trap has the inclination portion in the vicinity of the lower side of the drainage port and the water level detection tube has a smaller diameter than the drainage tube. Thus, the water flow cannot easily come into the air trap. Therefore, foreign substances such as lint contained in the washing water cannot easily flow into the air trap, so that air pressure in the

air trap is stabilized. Thus, the water level of the water tank can be stably detected.

**[0015]** According to a second aspect of the invention, there is provided the drum-type washing machine according to the first aspect, wherein the air trap and the drainage port are further arranged substantially horizontally with respect to the water level detection tube, the drainage tube, and the connection port of the filter case. With such a configuration, the foreign substances such as lint contained in the washing water further cannot easily flow into the air trap, so that the air pressure in the air trap is stabilized. Thus, the water level of the water tank can be stably detected.

**[0016]** According to a third aspect of the invention, there is provided the drum-type washing machine according to the first or second aspect, wherein the water tank and the air trap are integrally formed from a reinforced plastic material. With such a configuration, the air pressure in the air trap can be more stabilized.

**[0017]** Hereinafter, an embodiment of the present invention will be described with reference to the drawings. It should be noted that the present invention is not limited to this embodiment.

(Embodiment)

**[0018]** Fig. 1 shows a vertically sectional view of a drum-type washing machine in the embodiment of the present invention.

**[0019]** As shown in Fig. 1, a water tank 42 is oscillatably arranged in an interior of a washing machine casing 41, and a rotary drum 43 is rotatably arranged in the water tank 42. A rotation shaft (rotation center axis) 44 arranged in the horizontal direction is provided in a rotation center of the rotary drum 43. A motor 45 attached to the vicinity of the back surface side of the water tank 42 is coupled to this rotation shaft 44 via a belt 46. Rotation drive force of the motor 45 is transmitted to the rotation shaft 44 via the belt 46, so that the rotary drum 43 is driven and rotated in the forward direction or in the reverse direction. On an inner wall surface of the rotary drum 43, several protuberances 47 (baffles) for agitating a load (clothing) are provided. On the entire surface of an inner wall surface of the rotary drum 43, a large number of water passage holes 48 passing through an interior and an exterior of the rotary drum 43 are provided. It should be noted that in the drum-type washing machine of Fig. 1, the left side in the figure is the front surface side, and the right side in the figure is the back surface side.

**[0020]** A water tank unit 49 as a vibration system includes the water tank 42, the rotary drum 43, the motor 45, and the like. This water tank unit 49 is supported by a plurality of spring bodies 50 from an upper part of the washing machine casing 41 and anti-vibration supported by a plurality of anti-vibration dampers 51 from a lower part of the washing machine casing 41. Thereby, vibration generated in the water tank unit 49 is absorbed, so that transmission to the washing machine casing 41 is

suppressed.

**[0021]** The washing machine casing 41 has a casing opening 40 into and from which the clothing is brought on a front surface, and this casing opening 40 is openably and closably covered by a lid body 52. Between a front surface of the water tank 42 and an opening edge of the casing opening 40, a seal packing 82 for coupling the both and playing a role of anti-vibration and water sealing is provided. The lid body 52 can seal or open the casing opening 40 via this seal packing 82. By opening this lid body 52, the load can be brought between an exterior of the washing machine casing 41 and the interior of the rotary drum 43 through a clothing outlet/inlet 53 formed on a front surface of the rotary drum 43.

**[0022]** This drum-type washing machine has a function of automatically controlling the motor 45, a water supply passage 54, a drainage passage 55, and a water circulation passage 56 in accordance with mode setting and a control program, so as to perform at least a wash step, a rinsing step, and a spin-drying step.

**[0023]** The water supply passage 54 is a passage for supplying water supplied from a water source in an exterior of the drum-type washing machine to an interior of the water tank 42. In the water supply passage 54, a first water supply hose 59 and a second water supply hose 60 connected to the water source are connected to a detergent accommodating portion 61 accommodating a drawer portion (not shown) storing detergent and softener, the drawer portion to be freely pulled out from the exterior in an interior. A first electromagnetic valve 57 (first water supply portion) is provided in the first water supply hose 59, and a second electromagnetic valve 58 (second water supply portion) is provided in the second water supply hose 60. The detergent accommodating portion 61 is connected to the interior of the water tank 42 through the water supply passage 62. By opening the first electromagnetic valve 57 or the second electromagnetic valve 58, the water supplied from the water source is supplied into the detergent accommodating portion 61 through the first water supply hose 59 or the second water supply hose 60. The water supplied to the interior of the detergent accommodating portion 61 is supplied into the water tank 42 through the water supply passage 62 at a proper time.

**[0024]** The drainage passage 55 is a passage for draining the washing water in the water tank 42 to the exterior of the drum-type washing machine. In the drainage passage 55, a drainage port 85 is provided in a recessed portion 71 formed in a bottom of the water tank 42, and a drainage tube 64 is connected to this drainage port 85. One end of the drainage tube 64 is connected to a case connection port 89 of a filter case 83. The filter case 83 accommodates a lint filter 65 (drainage filter) for collecting lint, and the lint filter 65 can be removed from the outer side of a lower part on the front surface of the washing machine casing 41 by a filter grip 84. A drainage pump 63 is connected to the filter case 83, and a drainage hose 66 arranged from the interior of the washing machine

casing 41 to the upper side of the exterior is connected to the discharge side of the drainage pump 63. When required such as a time of finishing the wash step and a time of finishing the rinsing step, by drive of the drainage pump 63, the washing water in the water tank 42 flows into the filter case 83 via the drainage tube 64 connected to the recessed portion 71 in the bottom of the water tank 42. After passing through the lint filter 65 in the filter case 83, the washing water is drained to the exterior of the drum-type washing machine through the drainage pump 63 and the drainage hose 66.

**[0025]** The other end of the drainage tube 64 is connected to a water level detection tube 87, and the drainage tube 64 and the water level detection tube 87 are integrated with each other. An inclination portion 86 is provided in the vicinity of the lower side of the drainage port 85 of the water level detection tube 87, and thereby, a diameter of the water level detection tube 87 is formed to be smaller than a diameter of the drainage tube 64. One end of the water level detection tube 87 communicates with an opening 88 of an air trap 74. It should be noted that the drainage tube 64 is preferably made of a soft material such as a rubber material in consideration with a connection property to other members, prevention of leakage from a connection point, and a vibration absorption property of the water tank unit 49 at the time of the spin-drying step.

**[0026]** The air trap 74 is integrated with the water tank 42 in a side wall part of an outer periphery on the rear side of the bottom of the water tank 42. An air tube 75 is connected to this air trap 74, and a water level detector 76 such as a pressure sensor or the like is provided on the inner side of the upper part of the washing machine casing 41 so as to be connected to the air trap 74 via the air tube 75. When the water is supplied to the interior of the water tank 42, the air in the air trap 74 is compressed in accordance with a water level of the supplied water, and air pressure is transmitted to the water level detector 76 through the air tube 75. Thereby, the water level detector 76 can detect a plurality of water levels in the water tank 42 from a change in the air pressure.

**[0027]** It should be noted that the filter case 83 is arranged in a right lower part on the front surface of the washing machine casing 41 for handleability of the filter grip 84. The drainage port 85 is provided on the right side of a vertical center of the water tank 42 when seen from a front in order to efficiently arrange the drainage tube 64. It should be noted that a piping structure of the bottom will be described later with reference to Fig. 2.

**[0028]** The water circulation passage 56 is a passage for circulating the water in the water tank 42 in order to circulate the water in the water tank 42 in accordance with need such as a time of a pre-wash step, the time of the wash step, and the time of the rinsing step, so as to prevent early dissolution or leaning of the detergent and improve functions of wash and rinsing.

**[0029]** In this water circulation passage 56, the drainage tube 64 and the lint filter 65 also used for the drainage

passage 55 are connected to an inflow side passage 68 of a circulation pump 67. A discharge side passage 69 of the circulation pump 67 communicates with the interior of the water tank 42 at jet ports 70 on the inner side of the front surface of the water tank 42. By driving the circulation pump 67, the washing water in the water tank 42 is guided to the inflow side passage 68 going toward the circulation pump 67 through the drainage tube 64 and the lint filter 65. After that, the washing water is discharged into the rotary drum 43 as circulated water from the jet ports 70 in the direction shown by a solid arrow through the circulation pump 67 and the discharge side passage 69. The circulated water discharged into the rotary drum 43 is utilized as the washing water, and circulated again in the water circulation passage 56. It should be noted that the water tank 42 has the circular opening on the front surface, the plurality of jet ports 70 is provided along a circumference of this opening edge, and the circulated water is discharged into the rotary drum 43 from all directions of the circumference of the opening edge.

**[0030]** A hot water heater (heating portion) 72 for heating the washing water is arranged in the recessed portion 71 formed in the bottom of the water tank 42. For example, a sheathed heater or the like is used as such a hot water heater 72 and arranged so as to extend in the horizontal direction in the recessed portion 71. By discharging the washing water in the water tank 42 heated by this hot water heater 72 into the rotary drum 43 through the plurality of jet ports 70 as described above, the washing water is sprinkled on the clothing, and this washing water is circulated again. Since the heated washing water is sprinkled on the clothing, activation of the detergent is increased in accordance with an increase in molecule activities of the washing water. Thus, a washing ability can be increased and wash non-uniformity can be reduced. In the vicinity of the hot water heater 72, a temperature detector 73 for detecting a water temperature such as a thermistor is provided.

**[0031]** An upper part on a rear surface of the detergent accommodating portion 61 provided on the inner side of the upper part of the washing machine casing 41 and an upper part of the water tank 42 are connected by a coupling hose 77. The coupling hose 77 plays a role of evacuating the air in the water tank 42 pressurized by a step operation action.

**[0032]** In a rear part on an upper surface of the water tank 42, a vibration detector 78 for detecting vibration of the water tank unit 49 is arranged. For example, a multi-axis acceleration sensor is used as the vibration detector 78, and detects not acceleration in one direction but vibration in the three-axis directions of the front and rear direction (X axis direction), the left and right direction (Y axis direction), and the up and down direction (Z axis direction) when seen from the front surface side of the drum-type washing machine, so as to control an operation of the drum-type washing machine. This is because actual vibration of the water tank unit 49 cannot always be limited to one direction, and thus the multiaxis accel-

eration sensor is used for detection with high precision.

**[0033]** A user selects modes such as an operation course and various functions in the operation of the drum-type washing machine by making an input to an input setting portion 80 from an operation panel 79 provided in the upper part of the front surface of the washing machine casing 41. A control device 81 is arranged on the inner side of the upper part of the washing machine casing 41, and the control device 81 displays a display corresponding to information inputted through the input setting portion 80 on a display portion (not shown) on the operation panel 79 so as to notify the user.

**[0034]** Fig. 2 is a perspective view of major parts when the piping structure such as the drainage passage 55 in the bottom of the water tank 42 of the drum-type washing machine in the embodiment of the present invention is seen from the lower side.

**[0035]** As shown in Fig. 2, when seen from the front surface side of the drum-type washing machine, the drainage port 85 of the water tank 42 is arranged on the right side of the vertical center of the water tank 42, and the filter case 83 coupled to the one end of the drainage tube 64 which is connected to the drainage port 85 is arranged in the right lower part on the front surface side of the washing machine casing 41. On the left and right sides of the filter case 83, the circulation pump 67 connected to the discharge side passage 69 and the drainage pump 63 connected to the drainage hose 66 are arranged. The air trap 74 formed on the rear side of the drainage port 85, the water level detection tube 87, the drainage port 85, the drainage tube 64, and the case connection port 89 of the filter case 83 are substantially horizontally arranged.

**[0036]** Operations of the drum-type washing machine of the present embodiment formed as above will be described below.

**[0037]** The water tank 42 and the air trap 74 are integrally formed from a reinforced plastic material such as polypropylene containing glass (for example, formed by integral molding or the like). Therefore, in the wash step and the rinsing step, the air pressure in the air trap 74 is stabilized, so that variation in the water level detected by the water level detector 76 is suppressed.

**[0038]** In a drainage step, the washing water with which the water tank 42 and the drainage passage 55 are filled is drained at once from the drainage hose 66 to the exterior by drive of the drainage pump 63. At this time, a strong water flow from the drainage port 85 to the filter case 83 via the drainage tube 64 is generated. Since the air trap 74, the water level detection tube 87, the drainage port 85, the drainage tube 64, and the case connection port 89 of the filter case 83 are substantially horizontally arranged, the water flow is straightened so as to come into the filter case 83. Since the inclination portion 86 is provided in the vicinity of the lower side of the drainage port 85 in the water level detection tube 87, the water level detection tube 87 has a smaller diameter than the drainage tube 64. Therefore, the water in the drainage

tube 64 is suppressed from flowing into the water level detection tube 87. Thus, foreign substances such as lint contained in the washing water in the water tank 42 cannot easily be reversed so as to flow into the air trap 74, so that a change in the air pressure due to accumulation of lint and the like over time and consequent instability of the water level are suppressed.

**[0039]** The drainage tube 64 is preferably formed from a soft material such as a rubber material. By using a soft material for the drainage tube 64, a task for connection to the drainage port 85, connection to the opening 88 of the air trap 74, or connection to the case connection port 89 is easily performed, and water leakage from the connection point can be prevented.

**[0040]** As described above, according to the present embodiment, since the air trap 74, the water level detection tube 87, the drainage port 85, the drainage tube 64, and the case connection port 89 of the filter case 83 are substantially horizontally arranged, at the time of draining the washing water in the water tank 42, the water flow from the drainage port 85 of the bottom of the water tank 42 toward the case connection port 89 of the filter case 83 through the drainage tube 64 can be straightened. Further, in the water level detection tube 87 providing communication between the drainage tube 64 and the opening 88 of the air trap 74, the inclination portion 86 is provided in the vicinity of the lower side of the drainage port 85 and the water level detection tube 87 has a smaller diameter than the drainage tube 64. Thus, the water flow cannot easily come into the air trap 74. Therefore, the foreign substances such as lint contained in the washing water cannot easily flow into the air trap 74, so that the air pressure in the air trap 74 is stabilized. Thus, the water level of the water tank 42 can be stably detected by the water level detector 76.

**[0041]** It should be noted that a case where the rotation center of the rotary drum 43 is arranged in the horizontal direction in the drum-type washing machine is described above as an example. However, the rotation center of the rotary drum may be arranged while being inclined with respect to the horizontal direction.

**[0042]** When at least the water level detection tube 87, the drainage tube 64, and the case connection port 89 of the filter case 83 are substantially horizontally arranged in the drainage passage 55, the water flow toward the case connection port 89 of the filter case 83 in the drainage tube 64 can be straightened. In addition, by also arranging the air trap 74 and the drainage port 85 substantially horizontally, a straightening effect can be enhanced. It should be noted that a substantially horizontally arranged state includes a state that the members are arranged while being slightly inclined with respect to the horizontal direction to an extent that straightening of the water flow is not essentially influenced in addition to a state that the members are respectively horizontally arranged.

**[0043]** It is to be noted that, by properly combining the arbitrary embodiments of the aforementioned various

embodiments, the effects possessed by them can be produced.

**[0044]** Although the present invention has been fully described in connection with the preferred embodiment thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Such changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims unless they depart therefrom.

**[0045]** The entire disclosure of Japanese Patent Application No. 2011-036754 filed on February 23, 2011 including specification, drawings, and claims is incorporated herein by reference in its entirety.

## Industrial Applicability

**[0046]** As described above, the drum-type washing machine according to the present invention in which the foreign substances such as lint do not easily come into the air trap can stably detect the water level of the water tank. Thus, the present invention can be applied to a use for a drum-type washing machine and other washing machines.

## Explanation of reference numerals

### [0047]

|    |                            |
|----|----------------------------|
| 41 | Washing machine casing     |
| 42 | Water tank                 |
| 43 | Rotary drum                |
| 64 | Drainage tube              |
| 65 | Lint filter                |
| 74 | Air trap                   |
| 76 | Water level detector       |
| 83 | Filter case                |
| 85 | Drainage port              |
| 86 | Inclination portion        |
| 87 | Water level detection tube |
| 88 | Opening                    |
| 89 | Case connection port       |

## Claims

### 1. A drum-type washing machine, comprising:

- a washing machine casing;
- a water tank arranged in the washing machine casing;
- a rotary drum accommodated in the water tank;
- a filter case arranged in an inner lower part of the washing machine casing;
- an air trap having an opening on a lower side;
- a water level detector detecting a water level of the water tank from air pressure of the air trap;
- a drainage tube connected to a drainage port of

a bottom of the water tank and a connection port of the filter case; and

a water level detection tube providing communication between the drainage tube and the opening of the air trap, wherein

the water level detection tube has an inclination portion in a vicinity of a lower side of the drainage port so as to have a smaller diameter than the drainage tube, and further, the water level detection tube, the drainage tube, and the connection port of the filter case are substantially horizontally arranged.

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2. The drum-type washing machine according to claim 1, wherein the air trap and the drainage port are further arranged substantially horizontally with respect to the water level detection tube, the drainage tube, and the connection port of the filter case.

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3. The drum-type washing machine according to claim 1 or 2, wherein the water tank and the air trap are integrally formed from a reinforced plastic material.

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FIG. 1

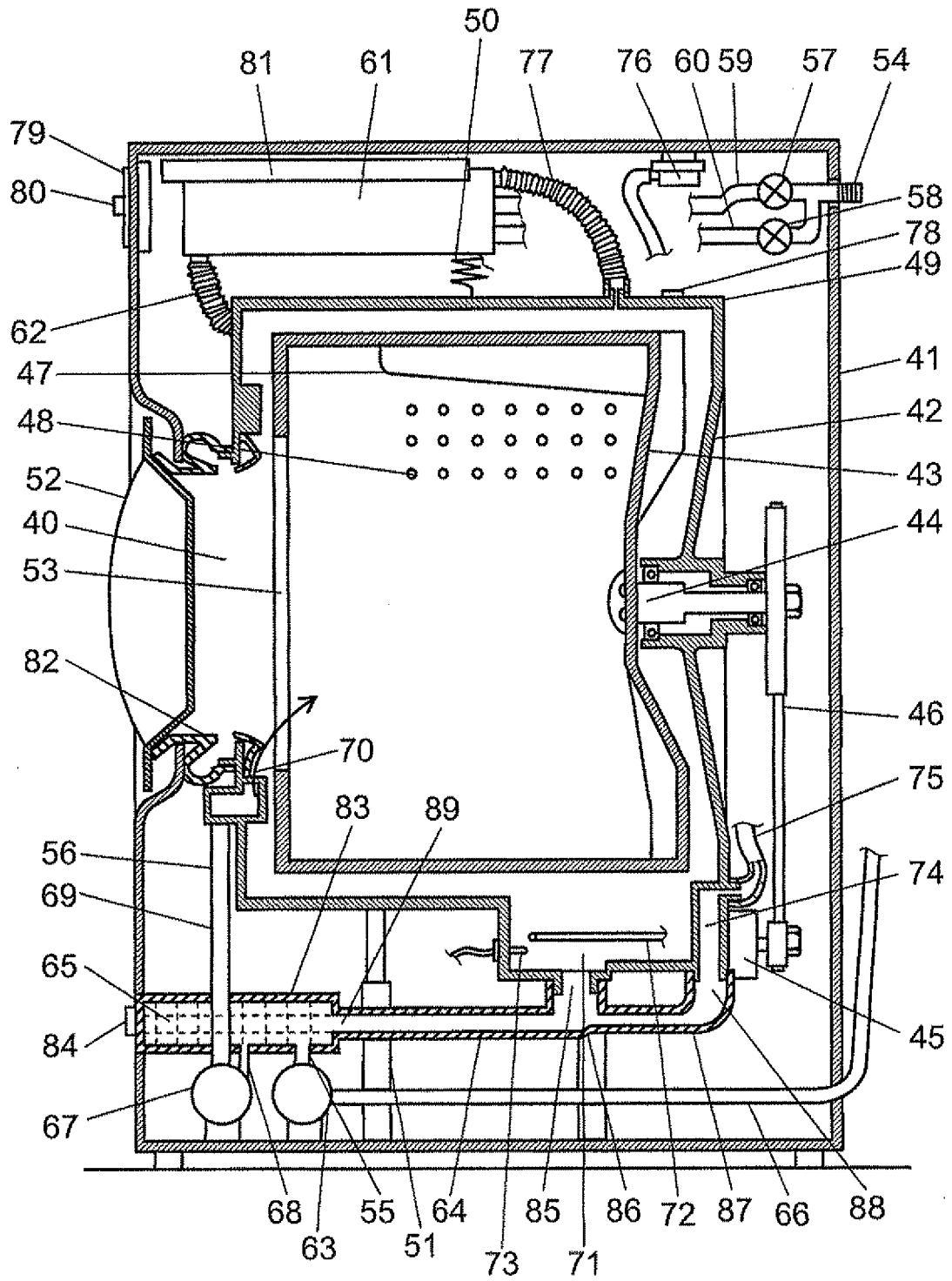


FIG. 2

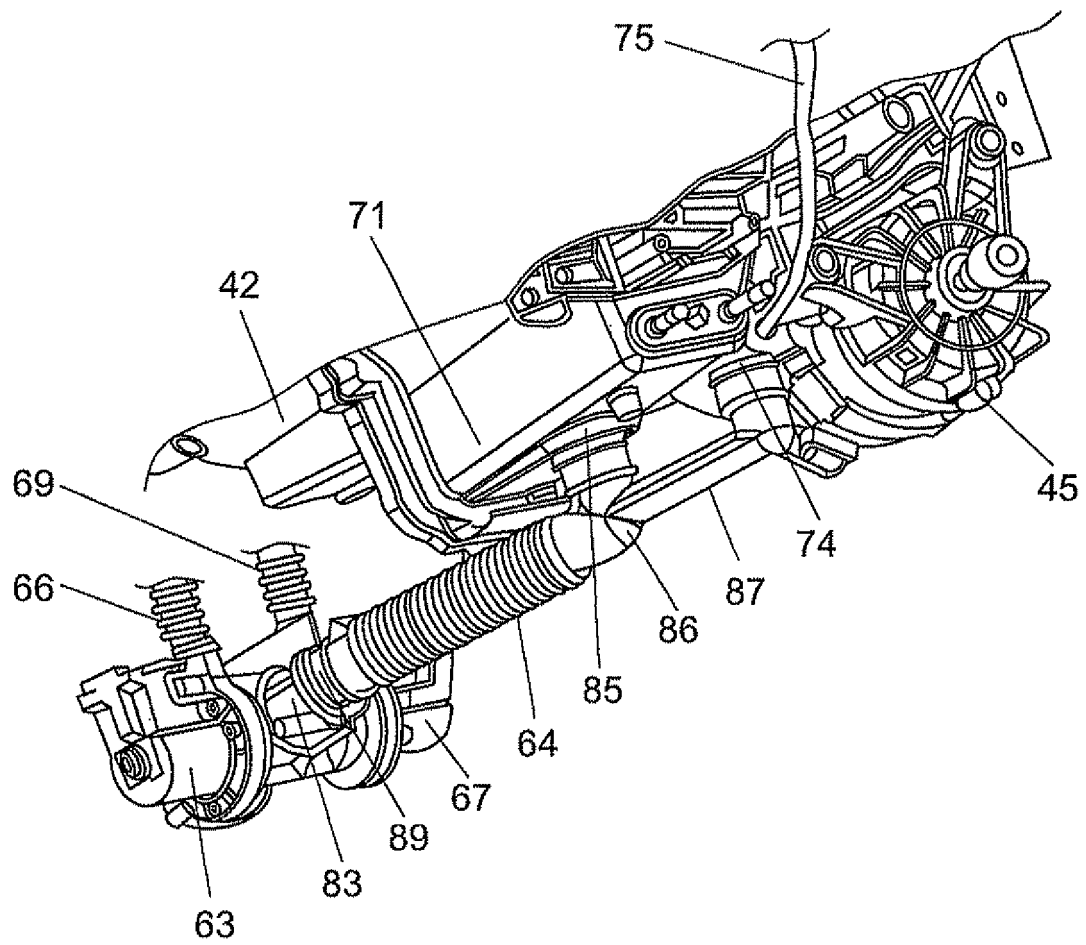


FIG. 3

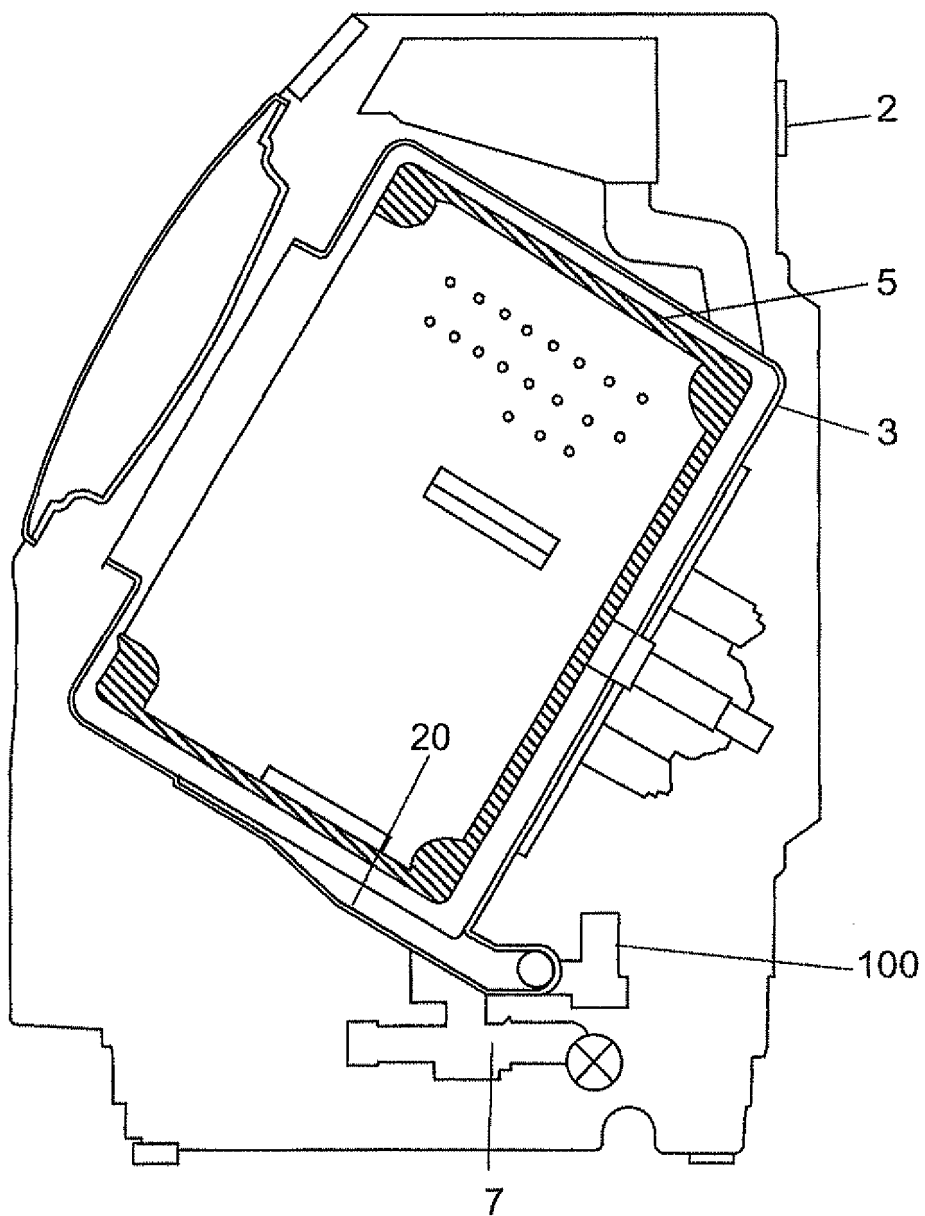
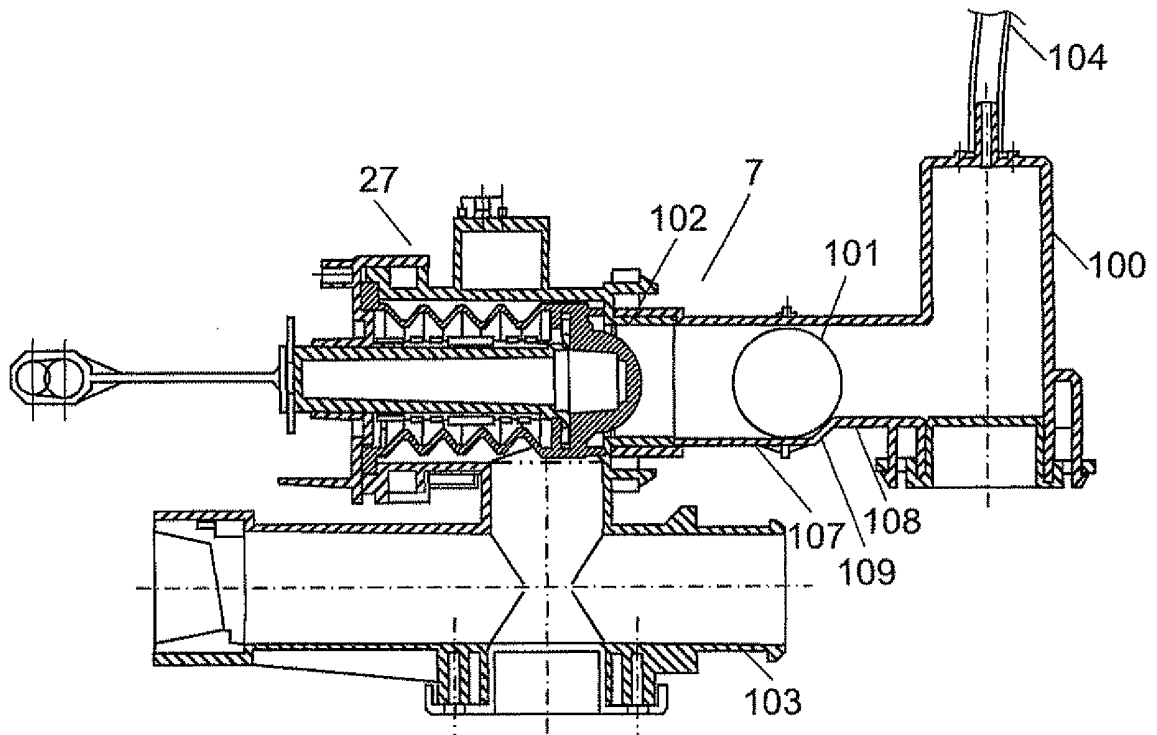


FIG. 4



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/001234

## A. CLASSIFICATION OF SUBJECT MATTER

D06F39/02 (2006.01) i, D06F23/02 (2006.01) i, D06F39/08 (2006.01) i, D06F39/10 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F39/02, D06F23/02, D06F39/08, D06F39/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

|                           |           |                            |           |
|---------------------------|-----------|----------------------------|-----------|
| Jitsuyo Shinan Koho       | 1922-1996 | Jitsuyo Shinan Toroku Koho | 1996-2012 |
| Kokai Jitsuyo Shinan Koho | 1971-2012 | Toroku Jitsuyo Shinan Koho | 1994-2012 |

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                    | Relevant to claim No. |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Y         | US 4321809 A (GENERAL ELECTRIC CO.),<br>30 May 1982 (30.05.1982),<br>fig. 1<br>(Family: none)                                         | 1-3                   |
| Y         | JP 2005-137645 A (Matsushita Electric Industrial Co., Ltd.),<br>02 June 2005 (02.06.2005),<br>fig. 3<br>& CN 1614120 A & CN 2760080 Y | 1-3                   |
| Y         | JP 2006-255317 A (Sharp Corp.),<br>28 September 2006 (28.09.2006),<br>fig. 1<br>(Family: none)                                        | 1-3                   |

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&amp;" document member of the same patent family

Date of the actual completion of the international search  
27 April, 2012 (27.04.12)Date of mailing of the international search report  
15 May, 2012 (15.05.12)Name and mailing address of the ISA/  
Japanese Patent Office

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                        | Relevant to claim No. |
|-----------|-----------------------------------------------------------------------------------------------------------|-----------------------|
| Y         | JP 2010-136740 A (Panasonic Corp.),<br>24 June 2010 (24.06.2010),<br>fig. 4<br>(Family: none)             | 1-3                   |
| Y         | JP 7-136381 A (Toshiba Corp.),<br>30 May 1995 (30.05.1995),<br>paragraph [0016]; fig. 1<br>(Family: none) | 3                     |

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**REFERENCES CITED IN THE DESCRIPTION**

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