

(19)



(11)

**EP 1 852 536 A1**

(12)

**EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 158(3) EPC

(43) Date of publication:

**07.11.2007 Bulletin 2007/45**

(51) Int Cl.:

**D06F 25/00 (2006.01)**

**D06F 39/04 (2006.01)**

(21) Application number: **06713176.3**

(86) International application number:

**PCT/JP2006/302033**

(22) Date of filing: **07.02.2006**

(87) International publication number:

**WO 2006/090576 (31.08.2006 Gazette 2006/35)**

(84) Designated Contracting States:

**DE GB IT**

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(30) Priority: **24.02.2005 JP 2005048550**

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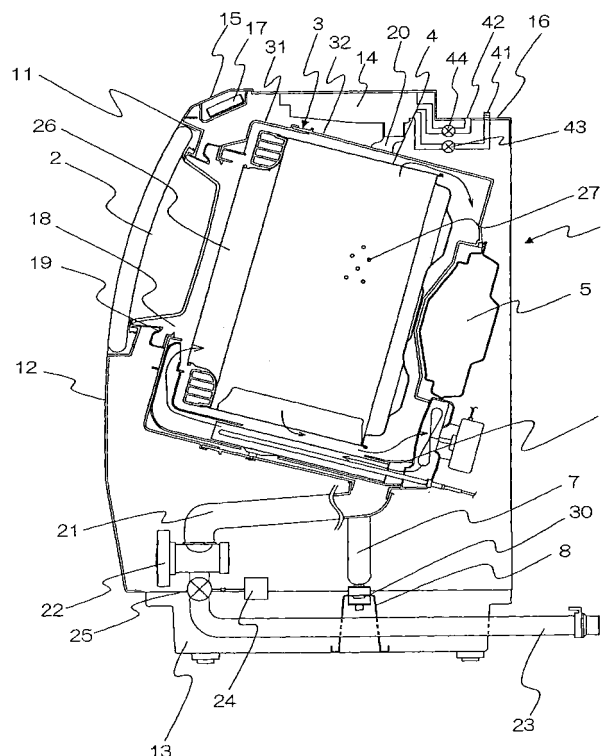
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(54) **WASHER-DRYER**

(57) The washer dryer is capable of suppressing discomfort or uneasy feeling for the user without causing increases in manufacturing cost and moreover enhancing the drying efficiency for laundry. A water tank 3 is placed in a housing 1. Within the water tank 3, a drum 4 for accommodating laundry is rotatably placed. Part of a

drying system 6 for drying the laundry in the drum 4 is provided between the water tank 3 and the drum 4. As a result of this, without using any heat insulating material, it becomes possible to prevent an upper portion outer wall of the housing 1 from elevating in temperature and to confine at least part of radiation heat of the drying system 6 to within the water tank 3.

*Fig.1*



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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a washer dryer.

### BACKGROUND ART

**[0002]** Conventionally, there has been provided a washer dryer disclosed in JP 2000-342880 A. This washer dryer includes a housing, a water tank placed in this housing, a drum which is placed in this water tank and which accommodates laundry, and a drying system placed between a top face of the housing and an outer upper portion of the water tank.

**[0003]** The drying system has a blower mechanism part, a heating mechanism part for heating air blown by the blower mechanism part, and a hot air blower part for guiding air heated by the heating mechanism part into the drum.

**[0004]** At a central portion of the frontage of the housing is provided an opening portion for allowing laundry to be put in and out therethrough. The opening portion of the housing is to be opened and closed by a door which is pivotably fitted to the housing.

**[0005]** At the frontage of the drum is provided an opening portion which faces the opening portion of the housing. Also, the frontage of the drum is inclined to an angle of 5° to 20° with respect to a vertical plane.

**[0006]** According to the washer dryer of this construction, after laundry are thrown into the drum through the opening portion of the housing by a user, at least one of washing operation, rinsing operation, dewatering operation and drying operation according to operation contents set by the user.

**[0007]** In the drying operation, while laundry that have completely been dewatered are in the drum, the drying system operates with the drum rotating both leftward and rightward, alternately. As a result of this, air heated by the heating mechanism part is fed into the drum via a hot air blower part to blow against the laundry that is being stirred, so that moisture with which the laundry are impregnated can be evaporated.

**[0008]** In the prior-art washer dryer described above, however, since the drying system is located between the top face of the housing and the outer upper portion of the water tank, the temperature of an upper external wall of the housing, in particular, is elevated by radiation heat of the exterior wall of the drying system during the drying operation. In such a case, the user, when touching the upper exterior wall of the housing, would feel discomfort or uneasy. Therefore, it is necessary to add a heat insulating material to the exterior wall of the drying system or add a heat insulating material to lower portion of the top face of the housing. However, the addition of the heat insulating material would cause a problem of an increase in manufacturing cost.

**[0009]** Also, since the drying system is placed outside

the water tank, radiation heat of the exterior wall of the drying system is hardly transferred to the laundry in the drum. That is, the radiation heat of the exterior wall of the drying system does not contribute to the drying of the laundry, wastefully. This leads to a problem of low efficiency of drying of laundry relative to the energy applied to the drying system.

### SUMMARY OF THE INVENTION

**[0010]** Accordingly, an object of the present invention is to provide a washer dryer which is capable of suppressing discomfort or uneasy feeling for the user without causing increases in manufacturing cost and moreover enhancing the drying efficiency for laundry.

**[0011]** In order to achieve the above object, according to the present invention, there is provided a washer dryer comprising:

- a housing;
- a water tank placed within the housing;
- a washing and dewatering tank which is rotatably placed within the water tank and which accommodates laundry; and
- a drying system for drying the laundry within the washing and dewatering tank, wherein at least part of the drying system is provided between the water tank and the drum.

**[0012]** In this washer dryer, by virtue of the provision of at least part of the drying system between the water tank and the washing and dewatering tank, radiation heat directed from at least part of the drying system toward the housing is intercepted by the water tank. Thus, without placement of any heat insulating material on the outer wall of the drying system or the housing, temperature elevations of the upper portion outer wall of the housing can be prevented even if no heat insulating material is added to the upper portion of the housing. Therefore, user's discomfort or uneasy feeling can be suppressed without causing increases in manufacturing cost.

**[0013]** Further, heat radiated from at least part of the outer wall of the drying system provided within the water tank can be confined within the water tank. That is, heat radiated from at least of the outer wall of the drying system can be utilized as the heat that contributes to the drying of laundry in the washing and dewatering tank. Accordingly, heat radiation loss of the drying system can be suppressed to a minimum, so that efficient drying of laundry can be achieved.

**[0014]** In the washer dryer of one embodiment, the drying system has:

- a blower mechanism part;
- a heating mechanism part for heating air blown by the blower mechanism part; and
- a hot air blower part for guiding air heated by the heating mechanism part into the washing and dewatering tank.

tering tank, wherein

the heating mechanism part and the hot air blower part are provided between the water tank and the washing and dewatering tank.

**[0015]** In this case, by virtue of the provision of the heating mechanism part and the hot air blower part between the water tank and the washing and dewatering tank, component parts of the drying system that are subject to particularly high outer wall temperature, the heat radiated from the outer walls of the mechanism parts can be utilized as heat for use of drying of the laundry in the washing and dewatering tank. Therefore, heat radiation loss of the drying system can be suppressed to a minimum.

**[0016]** Further, in a case where the blower mechanism part is placed outside the water tank, installation and maintenance of the blower mechanism part can be achieved more simply.

**[0017]** In the washer dryer of one embodiment, the heating mechanism part has:

a heater;

a metallic heater casing which is provided with a support part for supporting the heater and which surrounds a heat generation part of the heater; and

a heat-resistant resin component which is fixed to the water tank and which supports the heater casing in the water tank.

**[0018]** In this case, by the arrangement that the metallic heater casing is provided so as to surround the heat generation part of the heater, even if waste threads have adhered to the heat generation part of the heater and caught fire, spreading of the fire of the waste threads to the resin component or the water tank can be prevented by the heater casing. Therefore, the safety of the washer dryer can be enhanced.

**[0019]** Further, by the arrangement that the heater casing is supported in the water tank by the heat-resistant resin component fixed to the water tank, influences of the heat applied from the heater casing to the water tank can be relaxed. That is, the amount of heat applied from the heater casing to the water tank can be reduced. Therefore, thermal deformation of the water tank can be prevented, so that safety of the washer dryer can be further enhanced.

**[0020]** In the washer dryer of one embodiment, part of the heater casing faces an outer circumferential surface of the washing and dewatering tank.

**[0021]** In this case, by the arrangement that part of the heater casing is set to face the outer circumferential surface of the washing and dewatering tank, the radiation heat of the outer wall of the heater casing can be transferred to the washing and dewatering tank with high efficiency.

**[0022]** In the washer dryer of one embodiment, part of the resin component is positioned between the heater

casing and the washing and dewatering tank.

**[0023]** In this case, by the arrangement that part of the resin component is positioned between the heater casing and the washing and dewatering tank, the amount of heat applied from the heater casing to part of the water tank to which influences of radiation heat due to the outer wall of the heater casing should be avoided can be further reduced.

**[0024]** In the washer dryer of one embodiment, the resin component has a first hole provided at a portion facing the water tank, the water tank has a second hole provided at a portion facing the first hole,

a temperature control component for controlling temperature of the heater casing is inserted into the second hole, and

the temperature control component and the heater casing are in contact with each other via the first hole.

**[0025]** In this case, by the arrangement that the temperature control component for controlling temperature of the heater casing is kept in contact with the heater casing, temperature elevation of the heater casing can be detected by the temperature control component with high sensitivity. Therefore, any abnormal temperature elevation of the heater casing can be detected promptly by the temperature control component, so that heat influences from the heater casing to peripheral components can be suppressed to a minimum.

**[0026]** In the washer dryer of one embodiment, in the heater casing, a protruding portion protruding toward the water tank is provided at a portion facing the first hole,

the protruding portion is in contact with the temperature control component, and

a side face of the protruding portion is a sloped surface for keeping water from accumulating in the protruding portion.

**[0027]** In this case, by the arrangement that in the heater casing, the protruding portion protruding toward the water tank is provided at the portion facing the first hole, the temperature control component can be brought into contact with the heater casing with ease.

**[0028]** Further, by the arrangement that a side face of the protruding portion is given as a sloped surface for keeping water from accumulating in the protruding portion, for example, even if water has entered into the heater casing during the dewatering of laundry, it never occurs that water stays in the protruding portion in the drying of the laundry. Therefore, any abnormal temperature elevation of the heater casing can be detected correctly and promptly by the temperature control component.

**[0029]** In the washer dryer of one embodiment, a cushioning material is placed between the heater casing and the resin component.

**[0030]** In this case, by the arrangement that the cushioning material is placed between the heater casing and the resin component, heat of the heater casing can be prevented from being directly transferred to the resin

component. Therefore, materials of heat-resistant temperatures may be used as the material of the resin component, so that a reduction of the manufacturing cost can be achieved.

**[0031]** Further, by the arrangement that the cushioning material is placed between the heater casing and the resin component, rattling of the heater casing and the resin component due to vibrations in the dewatering of the laundry can be suppressed. Therefore, occurrence of unusual noise due to the heater casing and the resin component can be prevented.

**[0032]** In the washer dryer of one embodiment, the water tank is composed of a front portion positioned forward of the washing and dewatering tank in its rotational axis direction, and a rear portion which is combined with the front portion and which is positioned rearward of the washing and dewatering tank in its rotational axis direction,

the hot air blower part is fixed only to the front portion of the water tank, and

the heating mechanism part is fixed only to the rear portion of the water tank.

**[0033]** In this case, by the arrangement that the hot air blower part is fixed only to the front portion of the water tank while the heating mechanism part is fixed only to the rear portion of the water tank, the hot air blower part and the heating mechanism part can be combined together in combination of the front portion of the water tank and the rear portion of the water tank. Therefore, assembly of the water tank and the drying system becomes easier to achieve, so that the assemblability of the washer dryer can be enhanced.

**[0034]** In the washer dryer of one embodiment, the water tank or the blower mechanism part are provided with a third hole that communicates with inside of the heater casing, the heater is inserted into the third hole so that the heat generation part of the heater is positioned inside the heater casing, and

at a fitting portion of the heater for the third hole, a metallic flange is provided integrally with the heater and moreover a packing for sealing the third hole is provided.

**[0035]** In this case, by virtue of the structure that the heater is inserted into the third hole provided in the water tank or the blower mechanism part, even if the heater has malfunctioned, the malfunctioning heater can simply be replaced with another. Therefore, the washer dryer can be enhanced in serviceability.

**[0036]** In the washer dryer of one embodiment, the support part guides the heat generation part of the heater to a specified position within the heater casing.

**[0037]** In this case, since the support part guides the heat generation part of the heater to a specified position within the heater casing, installation of the heater can be simplified.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0038]** The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not intended to limit the present invention, and wherein:

Fig. 1 is a schematic sectional view of a drum type washing machine which is an embodiment of the washer dryer of the present invention;

Fig. 2 is a schematic front view of the water tank of the washer dryer;

Fig. 3 is a schematic sectional view of the water tank of the washer dryer;

Fig. 4 is an enlarged view of main part of Fig.

3.

## REFERENCE NUMERALS

**[0039]**

|     |                                 |
|-----|---------------------------------|
| 1   | housing                         |
| 2   | door                            |
| 3   | water tank                      |
| 4   | drum                            |
| 5   | drum-driving motor              |
| 6   | drying system                   |
| 7   | damper                          |
| 8   | damper support metal fitting    |
| 12  | front panel                     |
| 13  | bottom base                     |
| 14  | detergent casing                |
| 15  | operation part                  |
| 16  | step portion                    |
| 17  | operation circuit               |
| 18  | water tank opening portion      |
| 19  | door packing                    |
| 20  | water feed duct                 |
| 21  | drain duct                      |
| 22  | filter                          |
| 23  | drain hose                      |
| 24  | drain motor                     |
| 25  | drain valve                     |
| 26  | drum opening portion            |
| 29  | liquid balancer                 |
| 41  | tap water feed port             |
| 42  | bath water feed port            |
| 43  | water feed valve                |
| 44  | bath water pump                 |
| 100 | dehumidification heat exchanger |
| 200 | blower mechanism part           |
| 201 | fan casing                      |
| 202 | fan                             |
| 203 | fan motor                       |
| 300 | heating mechanism part          |
| 301 | sheath heater                   |

302 metallic heater casing  
 303 heater casing support component  
 311 heat generation part  
 313 metallic heater flange  
 314 heater packing  
 321 heater supporter  
 400 hot air blower part  
 500 temperature excessive-elevation prevention device  
 600 heat-resistant cushioning material  
 C1 water tank opening portion center  
 C2 drum opening portion center

#### DETAILED DESCRIPTION OF THE INVENTION

**[0040]** Hereinbelow, the washer dryer of the present invention will be described in detail by an embodiment illustrated in the accompanying drawings.

**[0041]** Fig. 1 shows a schematic sectional view of a drum type washing machine which is an embodiment of the washer dryer of the invention.

**[0042]** The drum type washing machine includes a housing 1, a bottomed cylindrical-shaped water tank 3 set within the housing 1, a bottomed cylindrical-shaped drum 4 which is rotatably set within the water tank 3 and which accommodates laundry, a drum-driving motor 5 which is mounted in the rear of the water tank 3 and which drives the drum 4 into rotation, a drying system 6 part of which is provided between the water tank 3 and the drum 4 and which serves for drying laundry in the drum 4, and two dampers 7 for elastically supporting rear portions of the water tank 3. The drum 4 is an example of the washing and dewatering tank.

**[0043]** Most of the frontage of the housing 1 is formed of a front panel 12, and bottom portion of the housing 1 is formed of a bottom base 13. Also, a housing opening portion 11 is provided at the frontage of the housing 1, and the housing opening portion 11 is opened and closed by a door 2 pivotably fitted to the housing 1 with hinges. On top of the housing 1 are provided a detergent casing 14 for housing therein detergent, bleach and softener, and an operation part 15 having operation keys and a display part. On the back side of the operation part 15 (on the interior side of the housing 1) is placed an operation circuit 17 for controlling the operation of the drum type washing machine. Further, a rear portion of the top face of the housing 1 is formed into a step portion 16 lower than a front portion of the top face. In this step portion 16 are provided a tap water feed port 41 for feeding tap water to the water tank 3 and a bath water feed port 42 for feeding bath water to the water tank 3. A water feed channel from the tap water feed port 41 to the detergent casing 14 has a water feed valve 43, while a water feed channel from the bath water feed port 42 to the detergent casing 14 has a bath water pump 44.

**[0044]** The water tank 3, which is combined with the frontage of the housing portion located on the front side of the drum 4 in its rotational axis direction, is composed

of a front portion 31, and a rear portion 32 fixed by screw in combination with the front portion 31 and located on the rear side of the drum 4 in its rotational axis direction, where the center axis is inclined with respect to the horizontal plane so that the rear portion 32 becomes lower than the front portion 31. A water tank opening portion 18 is provided at the front portion 31 of the water tank 3, and a door packing 19 formed of an elastic member such as rubber or soft resin is fitted to an opening edge of the water tank opening portion 18. As a result, the door 2, when closed, comes into close contact with the door packing 19, so that the liquid within the water tank 3 can be prevented from leaking out of the water tank 3. The water tank 3 is transversely positioned so that the water tank opening portion 18 faces the housing opening portion 11. More specifically, the center axis of the water tank 3 is inclined to form an angle of 5° to 30° with respect to the horizontal direction. A water feed duct 20 for feeding water, washing liquid or the like into the water tank 3 is connected to an upper portion of the water tank 3. Meanwhile, a drain duct 21 for draining water or washing liquid or the like within the water tank 3 to the outside is connected to a lower portion of the water tank 3. The drain duct 21 is further connected to a drain hose 23 via a filter 22. The filter 22 removes waste threads in the liquid that has flowed down from within the water tank 3. The drain hose 23 is provided with a drain valve 25 which is opened and closed by a drain motor 24.

**[0045]** The drum 4 is so positioned that its center axis is decentered toward the top face of the housing 1 with respect to the center axis of the water tank 3. That is, the center axis of the drum 4 is positioned on an upper portion side of the water tank 3 with respect to the center axis of the water tank 3. In other words, within the vertical plane containing the rotational axis of the drum 4, a distance between the lower peripheral wall of the drum 4 and the lower peripheral wall of the water tank 3 is larger than a distance between the upper peripheral wall of the drum 4 and the upper peripheral wall of the water tank 3. In short, the drum 4 is placed so as to be located on the upper portion side of the water tank 3. Also, the rotational axis of the drum 4 is inclined to form an angle of 5° to 30° with respect to the horizontal direction, so that the drum 4 has its rear portion positioned lower than its front portion. In the front portion of the drum 4 is provided a drum opening portion 26 which faces the housing opening portion 11 and the water tank opening portion 18.

**[0046]** The dampers 7 are fitted to a damper fitting surface 30 of a damper support metal fitting 8 by their end portions of one side other than the water tank 3 side.

**[0047]** Fig. 2 shows a schematic front view of the water tank 3.

**[0048]** The water tank opening portion 18 is smaller in diameter than the drum opening portion 26. Then, a water tank opening portion center C1 is positioned on one side of the housing 1 closer to the top face of the housing 1 than a drum opening portion center C2. That is, the water tank opening portion 18 is decentered from the drum

opening portion 26 toward the top face of the housing 1.

**[0049]** The drying system 6, as shown in Figs. 1 and 2, is positioned lower than a plane including the center axis of the water tank 3 and containing a horizontal axis perpendicular to the center axis. That is, the drying system 6 is installed at a lower portion of the space within the housing 1. Then, the drying system 6 has a dehumidification heat exchanger 100 for dehumidifying the air in the water tank 3, a blower mechanism part 200 for directly sucking the air dehumidified by the dehumidification heat exchanger 100, a heating mechanism part 300 for heating the air blown out by the blower mechanism part 200, and a hot air blower part 400 for guiding the air heated by the heating mechanism part 300 into the drum 4.

**[0050]** The dehumidification heat exchanger 100 is positioned at a lower portion of the space in the water tank 3. More specifically, the dehumidification heat exchanger 100 is positioned in a region which is immersed with the washing liquid between the inner circumferential surface of the water tank 3 and the outer circumferential surface of the drum 4.

**[0051]** Fig. 3 shows a schematic sectional view of the water tank 3.

**[0052]** A plurality of small holes 27 are provided all over the peripheral wall of the drum 4 (in Figs. 1 and 3, only six small holes 27 are shown and the others are not). These small holes 27 are purposed to circulate washing water, dry air or the like between a space, which is defined by the water tank 3 and the drum 4, and the space inside the drum 4. Also, radially inwardly protruding baffles 28 are provided on the inner wall surface of the drum 4. This baffles 28 are positioned at three points circumferentially at, for example, 120° intervals. The baffles 28 serve for iteratively lifting and dropping laundry along with the rotation of the drum 4. Also, a liquid balancer 29 surrounding the drum opening portion 26 of the drum 4 from outside is provided in order that any imbalance that tends to occur due to offsets of the laundry, washing liquid and the like is canceled by move of sealed liquid inside the liquid balancer 29 during the rotation of the drum 4.

**[0053]** Fig. 4 shows an enlarged view of main part of Fig. 3.

**[0054]** The blower mechanism part 200 is fitted to a rear face lower portion of the water tank 3. The blower mechanism part 200 is composed of a fan casing 201, a fan 202 housed in the fan casing 201, and a fan motor 203 which drives the fan 202 into rotation.

**[0055]** The fan casing 201 is fitted to a rear face lower portion of the water tank 3, and the space in the fan casing 201 is communicated with the space in the water tank 3. Then, the fan casing 201 is provided with a hole 204 through which a sheath heater 301 is to be inserted. The hole 204 is an example of the third hole.

**[0056]** The fan 202 is coupled directly with the rotating shaft of the fan motor 203. With the fan 202 rotated by the fan motor 203, air inside the water tank 3 can be sucked directly into the fan casing 201.

**[0057]** The heating mechanism part 300 is positioned

between a lower portion of the water tank 3 and a lower portion of the drum 4. Then, the heating mechanism part 300 has the sheath heater 301, a metallic heater casing 302 surrounding a heat generation part 311 of the sheath heater 301, and a heater casing support component 303 for supporting the heater casing 302 in the water tank 3. It is noted that the sheath heater 301 is an example of the heater and the heater casing support component 303 is an example of the resin component.

**[0058]** The sheath heater 301 is capable of heating the air in the water tank 3 as well as water, washing water or the like in the water tank 3. Also, the heat generation part 311 of the sheath heater 301 is placed inside the heater casing 302 by the insertion of the sheath heater 301 into the hole 204 of the fan casing 201. In a portion 312 of the sheath heater 301 on its terminal side (the side opposite to the heat generation part 311), a metallic heater flange 313 is provided integrally with the sheath heater 301, and moreover a heater packing 314 for sealing the hole 204 of the fan casing 201 is provided. It is noted that the portion 312 is an example of the fitting portion, the heater packing 314 is an example of the packing, and the heater flange 313 is an example of the flange.

**[0059]** Most of upper portion (a drum 4 side portion) of the heater casing 302 is not covered with the heater casing support component 303 but exposed from the heater casing support component 303. That is, most of upper portion (a drum 4 side portion) of the heater casing 302 faces the outer peripheral surface of the drum 4. On the other hand, most of lower portion of the heater casing 302 is covered with the heater casing support component 303. Also, in a lower portion of the heater casing 302 is provided a protruding portion 322 protruding toward the water tank 3. This protruding portion 322 has a sloped surface 323 for keeping water from accumulating inside the protruding portion 322. More specifically, the sloped surface 323 is so formed as to be inclined with respect to the horizontal plane during the use so that its rear portion becomes lower than the front portion. Also, on the inner wall of the heater casing 302 is provided a heater supporter 321 which is located near the protruding portion 322 to support the sheath heater 301. This heater supporter 321, during the insertion of the sheath heater 301 into the hole 204, guides the heat generation part 311 of the sheath heater 301 to a specified position within the heater casing 302. Needless to say, it is in a completed state of the drum type washing machine that the sloped surface 323 is inclined with respect to the horizontal plane as described above. It is noted that the heater supporter 321 is an example of the support part.

**[0060]** The heater casing support component 303 is fixed only to the rear portion 32 of the water tank 3. Also, the heater casing support component 303 is formed of heat-resistant resin. Then, in a lower portion of the heater casing support component 303 is provided a hole 331 that allows the protruding portion 322 of the heater casing 302 to be exposed. It is noted that the hole 331 is an example of the first hole.

**[0061]** The hot air blower part 400 is fixed only to the front portion 31 of the water tank 3. Also, a rear-side end portion of the hot air blower part 400 is coupled to a front-side end portion of the heater casing 302. Meanwhile, a front-side end portion of the hot air blower part 400 is positioned between the front lower portion of the water tank 3 and the front lower portion of the drum 4. Then, a blower hole 40 provided at the front-side end portion of the hot air blower part 400 is positioned between a lower edge of the water tank opening portion 18 and a lower edge of the drum opening portion 26, thus facing the drum opening portion 26 (see Fig. 2).

**[0062]** Between the heater casing 302 and the heater casing support component 303, and between the heater casing 302 and the hot air blower part 400, is placed a heat-resistant cushioning material 600. It is noted that the heat-resistant cushioning material 600 is an example of the cushioning material.

**[0063]** Further, a hole 33 that confronts the hole 331 is provided in a lower portion of the water tank 3. A temperature excessive-elevation prevention device 500 for controlling the temperature of the heater casing 302 is inserted into the hole 33. An end portion of the temperature excessive-elevation prevention device 500 on the heater casing 302 side is in contact with the protruding portion 322 of the heater casing 302. It is noted that the hole 33 is an example of the second hole, and the temperature excessive-elevation prevention device 500 is an example of the temperature control component.

**[0064]** According to the drum type washing machine of the above-described construction, since the heating mechanism part 300 and the hot air blower part 400 is located between the lower portion of the water tank 3 and the drum 4, radiation heat of the heating mechanism part 300 and the hot air blower part 400 is intercepted by the water tank 3 so as not to directly reach the housing 1. Therefore, the housing 1 can be prevented from getting high temperature without any heat insulating material, thus making it possible to suppress user's discomfort and uneasy feeling without involving any increase in manufacturing cost.

**[0065]** For drying of the laundry in the drum 4, the drying system 6 is operated. Upon operation of the drying system 6, as indicated by the arrow of Fig. 1, air circulates in the water tank 3. More specifically, when the drying system 6 is operated, the fan 202 of the blower mechanism part 200 is rotated, so that hot air generated by the sheath heater 301 blows off from the blower hole 40 toward lower portion of the space in the drum 4. As a result of this, moisture of the laundry in the drum 4 evaporates. Air containing the moisture, i.e., moist air goes from the small holes 27 out of the drum 4, being cooled by the dehumidification heat exchanger 100 located at a lower portion of the space in the water tank 3. Thus, the moisture contained in the moist air is condensed. That is, the moist air is dehumidified by the dehumidification heat exchanger 100 so as to become dry air. This dry air is fed into the heater casing 302 by the blower mechanism part

200, reheated by the sheath heater 301, and then blown out from the blower hole 40 toward the lower portion in the drum 4. That is, the hot air generated by the sheath heater 301 blows out from the blower hole 40 toward the lower portion of the space in the drum 4.

**[0066]** In the drying of laundry described above, by virtue of the arrangement that the heating mechanism part 300 and the hot air blower part 400 are located between the water tank 3 and the drum 4, heat radiated from the heating mechanism part 300 and the hot air blower part 400 can be confined in the water tank 3. That is, heat radiated from the outer walls of the heating mechanism part 300 and the hot air blower part 400 can be utilized as heat that contributes to the drying of laundry in the drum 4. Accordingly, heat radiation loss of the drying system 6 can be suppressed to a minimum, so that the drying efficiency for laundry can be enhanced.

**[0067]** Further, since the blower mechanism part 200 is located outside the water tank 3, installation and maintenance of the blower mechanism part 200 can be easily achieved.

**[0068]** By the arrangement that the metallic heater casing 302 is provided so as to surround the heat generation part 311 of the sheath heater 301, even if waste threads have adhered to the heat generation part 311 of the sheath heater 301 and caught fire, spreading of the fire of the waste threads to the heater casing support component 303 or the water tank 3 can be prevented by the heater casing 302. Therefore, the safety of the drum type washing machine can be enhanced.

**[0069]** Since the heater casing 302 does not make contact with the water tank 3, influences of the heat applied from the heater casing 302 to the water tank 3 can be relaxed. That is, the amount of heat applied from the heater casing 302 to the water tank 3 can be reduced. Therefore, thermal deformation of the water tank 3 can be prevented, so that safety of the drum type washing machine can be further enhanced.

**[0070]** Since most of the upper portion of the heater casing 302 that is not covered with the heater casing support component 303 faces the outer circumferential surface of the drum 4, the radiation heat of the outer wall of the heater casing 302 can be transferred to the drum 4 with high efficiency.

**[0071]** Since most of the lower portion of the heater casing 302 is covered with the heater casing support component 303, radiant heat directed from the lower portion of the heater casing 302 toward the water tank 3 can be intercepted by the heater casing support component 303. That is, the lower portion of the heater casing 302 and the water tank 3 can be heat-insulated by the heater casing support component 303. Therefore, the amount of heat applied from the heater casing 302 to the water tank 3 can be further reduced.

**[0072]** Since the temperature excessive-elevation prevention device 500 for controlling the temperature of the heater casing 302 is kept in contact with the heater casing 302, temperature elevations of the heater casing 302 can

be detected with high sensitivity by the temperature excessive-elevation prevention device 500. Therefore, any abnormal temperature elevation of the heater casing 302 can be detected promptly by the temperature excessive-elevation prevention device 500, so that heat influences from the heater casing 302 to peripheral components can be suppressed to a minimum.

**[0073]** Since the protruding portion 322 of the heater casing 302 is protruding from the hole 331 of the heater casing support component 303, it is easy to make the temperature excessive-elevation prevention device 500 brought into contact with the heater casing 302.

**[0074]** By the arrangement that the sloped surface 323 of the protruding portion 322 is so formed as to be inclined with respect to the horizontal plane so that its rear portion becomes lower than its front portion, for example, even if water has entered into the heater casing 302 during the dewatering of laundry, it never occurs that water stays in the protruding portion 322 in the drying of the laundry. Therefore, any abnormal temperature elevation of the heater casing 302 can be detected correctly and promptly by the temperature excessive-elevation prevention device 500.

**[0075]** Since the heat-resistant cushioning material 600 is placed between the heater casing 302 and the heater casing support component 303 as well as between the heater casing 302 and the hot air blower part 400, heat of the heater casing 302 is not transferred directly to the heater casing support component 303 and the hot air blower part 400. Therefore, heat applied to the heater casing support component 303 and the hot air blower part 400 from the heater casing 302 is of small amount, so that thermal deformation of the heater casing support component 303 and the hot air blower part 400 can be prevented.

**[0076]** Also, by the arrangement that the heat-resistant cushioning material 600 is placed between the heater casing 302 and the heater casing support component 303 as well as between the heater casing 302 and the hot air blower part 400, it becomes possible to suppress rattling of the heater casing 302, the heater casing support component 303 and the hot air blower part 400, for example, due to vibrations in the dewatering of the laundry. Therefore, occurrence of unusual noise due to the heater casing 302, the heater casing support component 303 and the hot air blower part 400 can be prevented.

**[0077]** The hot air blower part 400 is fixed only to the front portion 31 of the water tank 3, and the heater casing support component 303 is fixed only to the rear portion 32 of the water tank 3. Therefore, by setting a combination of the front portion of the water tank 3 and the rear portion of the water tank 3, it becomes possible to combine the heater casing 302 supported by the heater casing support component 303 and the hot air blower part 400 together. Thus, assembly of the water tank 3 and the drying system 6 becomes easier to achieve, so that the drum type washing machine of this embodiment becomes higher in assemblability.

**[0078]** Further, by virtue of the structure that the sheath heater 301 is inserted into the hole 204 provided in the blower mechanism part 200, even if the sheath heater 301 has malfunctioned, the malfunctioning sheath heater 301 can simply be replaced with another. Therefore, the washer dryer of this embodiment is enhanced in serviceability.

**[0079]** In the above-described embodiment, part of the drying system 6 is placed on one side between the water tank 3 and the drum 4, the side being lower than a plane which contains a center axis of the water tank 3 and which contains a horizontal axis perpendicular to the center axis. However, it is also possible, for example, to place part of the drying system 6 on one side between the water tank 3 and the drum 4, the side being upper than a plane which contains a center axis of the water tank 3 and which contains a horizontal axis perpendicular to the center axis. Otherwise, part of the drying system 6 may also be placed on one side between the water tank 3 and the drum 4, the side being the left side of a plane which contains a center axis of the water tank 3 and which contains a vertical axis perpendicular to the center axis. Of course, part of the drying system 6 may also be placed on one side between the water tank 3 and the drum 4, the side being the right side of a plane which contains a center axis of the water tank 3 and which contains a vertical axis perpendicular to the center axis. In short, the place where at least part of the drying system 6 is placed may be anywhere between the water tank 3 and the drum 4.

**[0080]** Although at least part of the drying system 6 is placed between the water tank 3 and the drum 4 in the above-described embodiment, yet the entirety of the drying system 6 may be placed between the water tank 3 and the drum 4. That is, all of the dehumidification heat exchanger 100, the blower mechanism part 200, the heating mechanism part 300 and the hot air blower part 400 may be placed between the water tank 3 and the drum 4.

**[0081]** The dehumidification heat exchanger 100, although placed between the water tank 3 and the drum 4 in the above-described embodiment, yet may also be placed between the housing 1 and the water tank 3.

**[0082]** Although the protruding portion 322 is provided at a lower portion of the heater casing 302 in the above-described embodiment, yet the protruding portion 322 may also be provided at a lower portion of the water tank 3. More specifically, it is also possible that the heater casing support component 303 has a first hole provided at a portion facing the water tank 3 while the water tank 3 has a protruding portion provided at a portion facing the first hole, the protruding portion protruding toward the heater casing 302 and having a second hole. In this case, the temperature excessive-elevation prevention device 500 is inserted into the second hole so that the temperature excessive-elevation prevention device 500 is brought into contact with a lower portion of the heater casing 302.

**[0083]** Although the hole 204 for insertion of the sheath



heater 301 is provided in the blower mechanism part 200 in the above-described embodiment, yet the hole 204 for insertion of the sheath heater 301 may also be provided in the water tank 3. In this case, the place where the hole 204 for insertion of the sheath heater 301 may be either in a front face lower portion of the water tank 3 or in a rear face lower portion of the water tank 3.

**[0084]** Further, in the washer dryer of the present invention, the axis of the washing and dewatering tank may be horizontal, diagonal or vertical. That is, the axis of the washing and dewatering tank may be set parallel to the horizontal plane, or diagonal to the horizontal plane, or vertical to the horizontal plane.

**[0085]** Embodiments of the invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

## Claims

### 1. A washer dryer comprising:

a housing;  
a water tank placed within the housing;  
a washing and dewatering tank which is rotatably placed within the water tank and which accommodates laundry; and  
a drying system for drying the laundry within the washing and dewatering tank, wherein at least part of the drying system is provided between the water tank and the drum.

### 2. The washer dryer as claimed in Claim 1, wherein the drying system has:

a blower mechanism part;  
a heating mechanism part for heating air blown by the blower mechanism part; and  
a hot air blower part for guiding air heated by the heating mechanism part into the washing and dewatering tank, wherein the heating mechanism part and the hot air blower part are provided between the water tank and the washing and dewatering tank.

### 3. The washer dryer as claimed in Claim 2, wherein the heating mechanism part has:

a heater;  
a metallic heater casing which is provided with a support part for supporting the heater and which surrounds a heat generation part of the heater; and  
a heat-resistant resin component which is fixed

to the water tank and which supports the heater casing in the water tank.

4. The washer dryer as claimed in Claim 3, wherein part of the heater casing faces an outer circumferential surface of the washing and dewatering tank.

5. The washer dryer as claimed in Claim 3, wherein part of the resin component is positioned between the heater casing and the washing and dewatering tank.

6. The washer dryer as claimed in Claim 5, wherein the resin component has a first hole provided at a portion facing the water tank, the water tank has a second hole provided at a portion facing the first hole, a temperature control component for controlling temperature of the heater casing is inserted into the second hole, and the temperature control component and the heater casing are in contact with each other via the first hole.

7. The washer dryer as claimed in Claim 6, wherein in the heater casing, a protruding portion protruding toward the water tank is provided at a portion facing the first hole, the protruding portion is in contact with the temperature control component, and a side face of the protruding portion is a sloped surface for keeping water from accumulating in the protruding portion.

8. The washer dryer as claimed in Claim 3, wherein a cushioning material is placed between the heater casing and the resin component.

9. The washer dryer as claimed in Claim 2, wherein the water tank is composed of a front portion positioned forward of the washing and dewatering tank in its rotational axis direction, and a rear portion which is combined with the front portion and which is positioned rearward of the washing and dewatering tank in its rotational axis direction, the hot air blower part is fixed only to the front portion of the water tank, and the heating mechanism part is fixed only to the rear portion of the water tank.

10. The washer dryer as claimed in Claim 3, wherein the water tank or the blower mechanism part are provided with a third hole that communicates with inside of the heater casing, the heater is inserted into the third hole so that the heat generation part of the heater is positioned inside the heater casing, and at a fitting portion of the heater for the third hole, a metallic flange is provided integrally with the heater

and moreover a packing for sealing the third hole is provided.

- 11.** The washer dryer as claimed in Claim 3, wherein the support part guides the heat generation part of the heater to a specified position within the heater casing.

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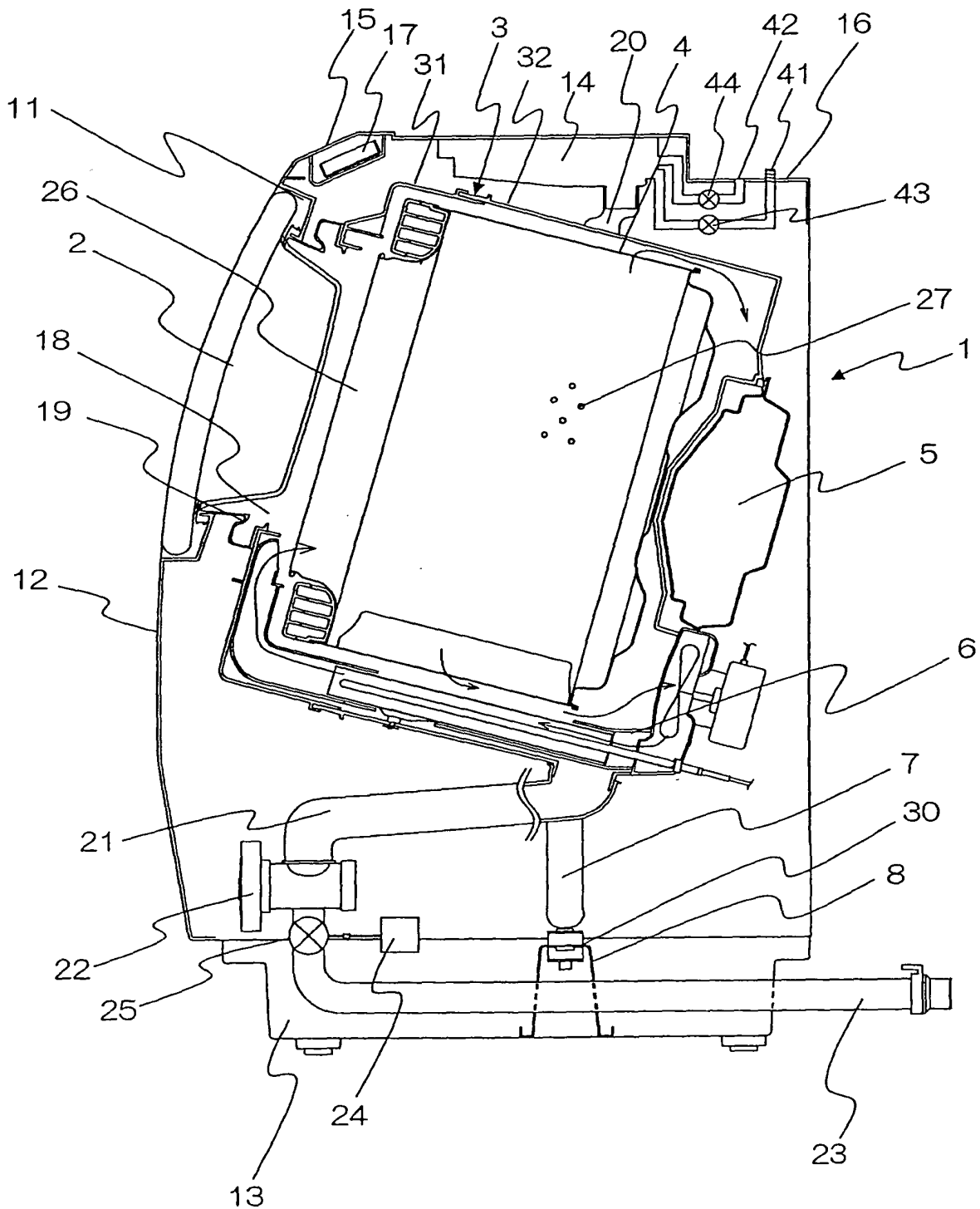
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*Fig. 1*



*Fig.2*

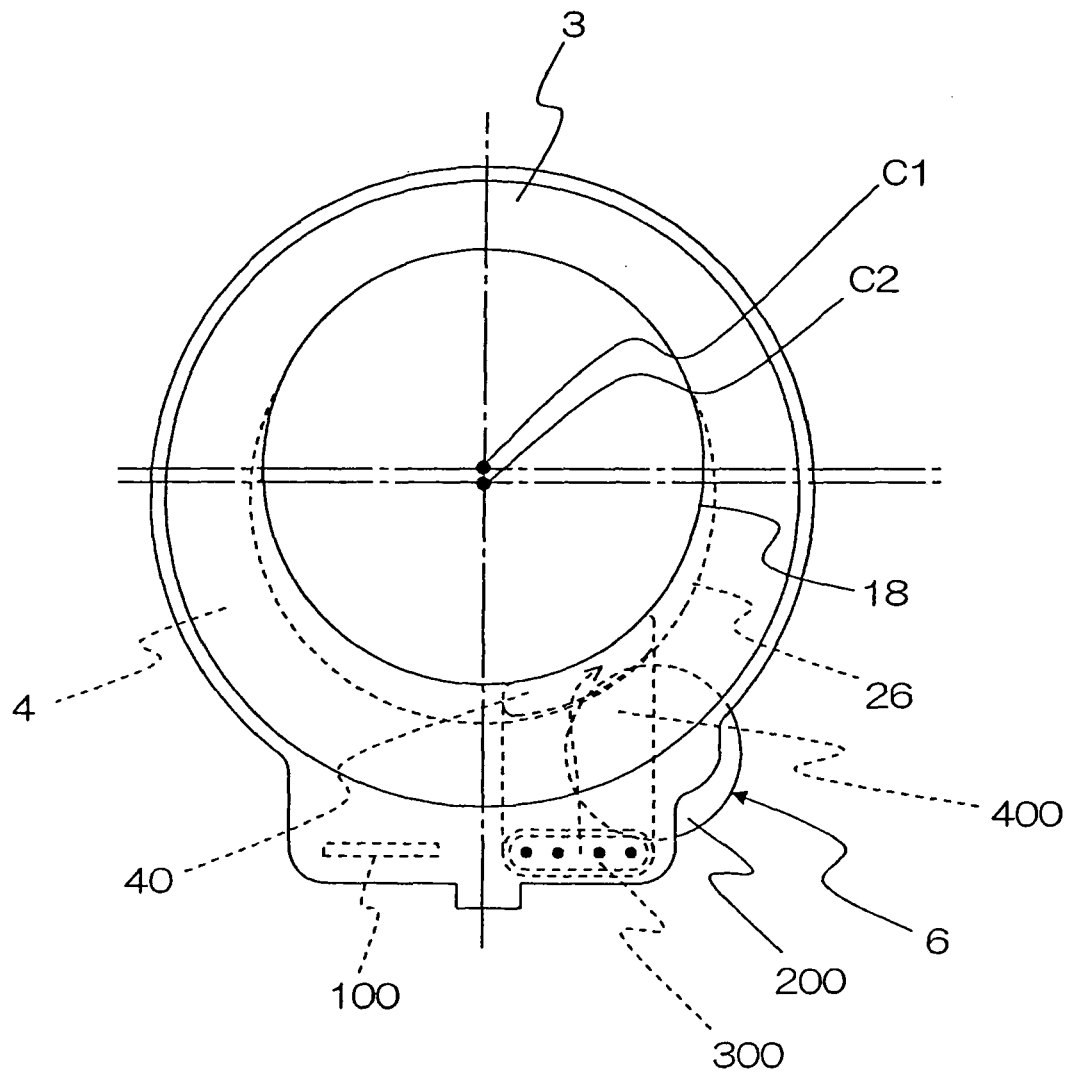
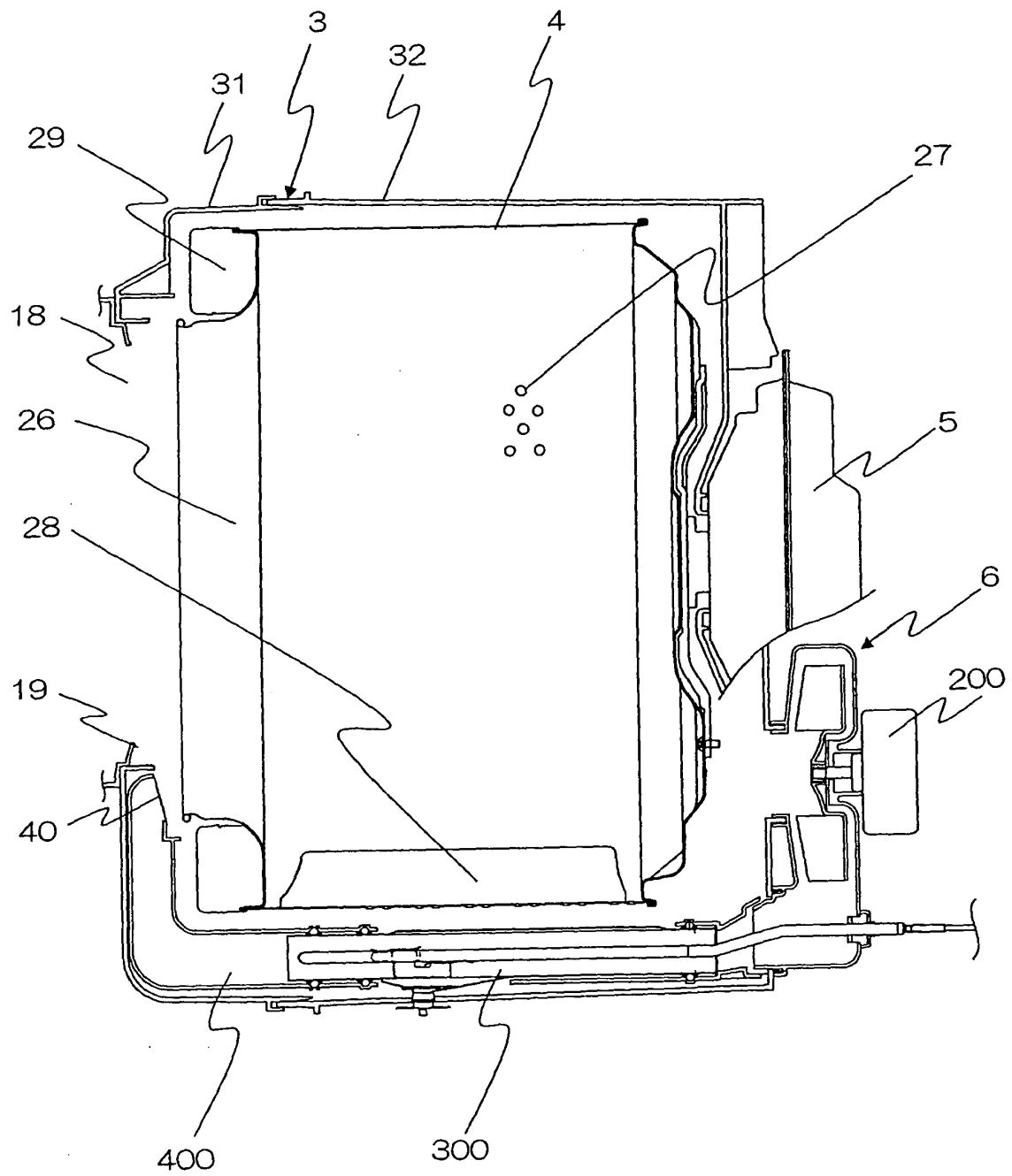
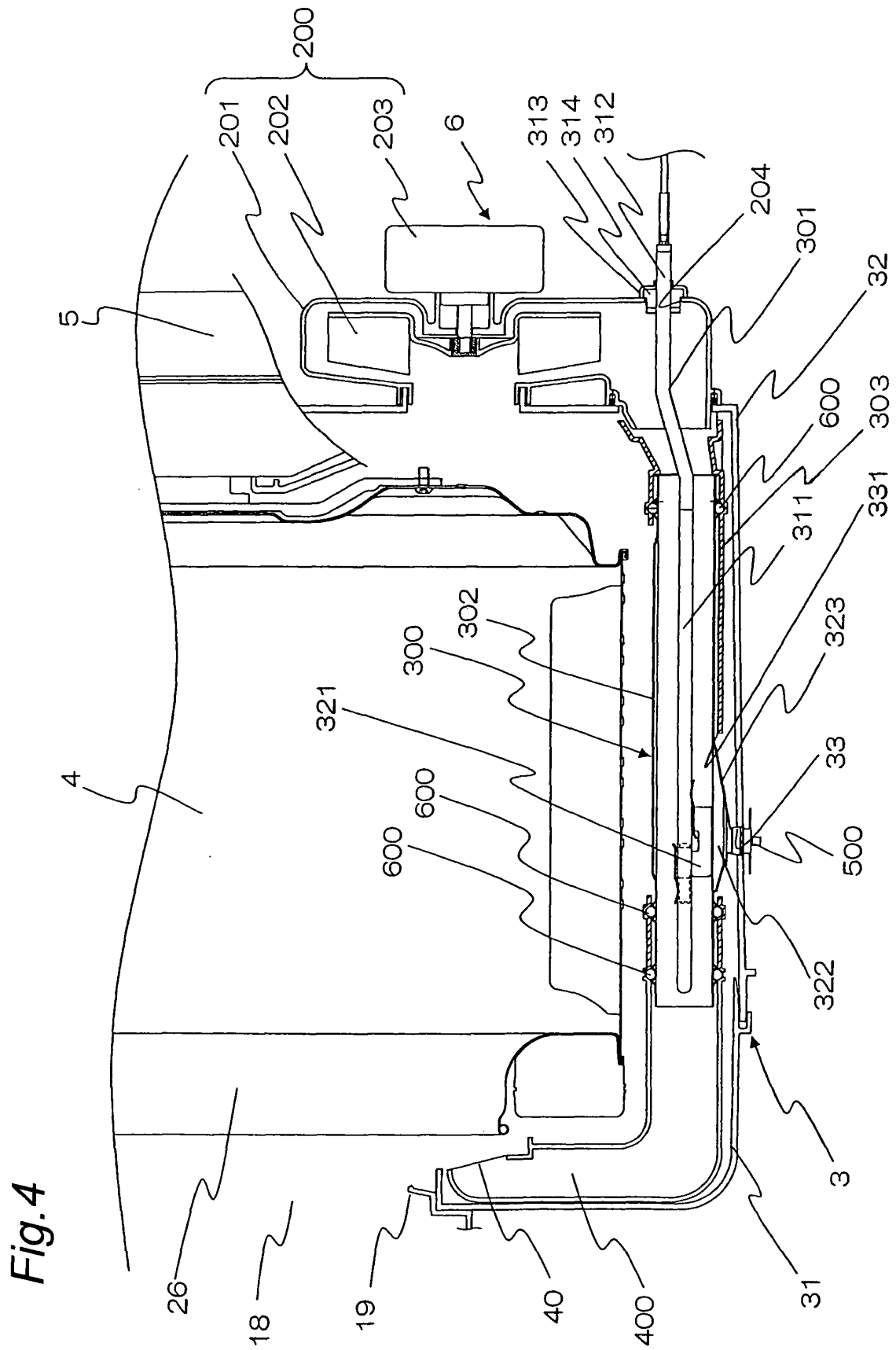


Fig.3





## INTERNATIONAL SEARCH REPORT

|                                                    |
|----------------------------------------------------|
| International application No.<br>PCT/JP2006/302033 |
|----------------------------------------------------|

| A. CLASSIFICATION OF SUBJECT MATTER<br>D06F25/00 (2006.01), D06F39/04 (2006.01)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                               |                                          |                                                                                                                                                                                                     |                                                                                                          |                                                                                                                                                                              |                                                                                           |                                                                                                                                                                                                                                                  |                                                                                                                                                                         |                                               |                                                                              |  |                                                                                                        |  |
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| 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)<br>D06F25/00, D06F39/04                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                  |                                                                               |                                          |                                                                                                                                                                                                     |                                                                                                          |                                                                                                                                                                              |                                                                                           |                                                                                                                                                                                                                                                  |                                                                                                                                                                         |                                               |                                                                              |  |                                                                                                        |  |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched<br><table border="0"> <tr> <td>Jitsuyo Shinan Koho</td> <td>1922-1996</td> <td>Jitsuyo Shinan Toroku Koho</td> <td>1996-2006</td> </tr> <tr> <td>Kokai Jitsuyo Shinan Koho</td> <td>1971-2006</td> <td>Toroku Jitsuyo Shinan Koho</td> <td>1994-2006</td> </tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                  |                                                                               | Jitsuyo Shinan Koho                      | 1922-1996                                                                                                                                                                                           | Jitsuyo Shinan Toroku Koho                                                                               | 1996-2006                                                                                                                                                                    | Kokai Jitsuyo Shinan Koho                                                                 | 1971-2006                                                                                                                                                                                                                                        | Toroku Jitsuyo Shinan Koho                                                                                                                                              | 1994-2006                                     |                                                                              |  |                                                                                                        |  |
| Jitsuyo Shinan Koho                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1922-1996                                                                                                                                                                                                                                        | Jitsuyo Shinan Toroku Koho                                                    | 1996-2006                                |                                                                                                                                                                                                     |                                                                                                          |                                                                                                                                                                              |                                                                                           |                                                                                                                                                                                                                                                  |                                                                                                                                                                         |                                               |                                                                              |  |                                                                                                        |  |
| Kokai Jitsuyo Shinan Koho                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1971-2006                                                                                                                                                                                                                                        | Toroku Jitsuyo Shinan Koho                                                    | 1994-2006                                |                                                                                                                                                                                                     |                                                                                                          |                                                                                                                                                                              |                                                                                           |                                                                                                                                                                                                                                                  |                                                                                                                                                                         |                                               |                                                                              |  |                                                                                                        |  |
| 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.                                                         |                                          |                                                                                                                                                                                                     |                                                                                                          |                                                                                                                                                                              |                                                                                           |                                                                                                                                                                                                                                                  |                                                                                                                                                                         |                                               |                                                                              |  |                                                                                                        |  |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | JP 4-28395 A (Hitachi, Ltd.),<br>30 January, 1992 (30.01.92),<br>Fig. 3<br>(Family: none)                                                                                                                                                        | 1-11                                                                          |                                          |                                                                                                                                                                                                     |                                                                                                          |                                                                                                                                                                              |                                                                                           |                                                                                                                                                                                                                                                  |                                                                                                                                                                         |                                               |                                                                              |  |                                                                                                        |  |
| <input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                  |                                                                               |                                          |                                                                                                                                                                                                     |                                                                                                          |                                                                                                                                                                              |                                                                                           |                                                                                                                                                                                                                                                  |                                                                                                                                                                         |                                               |                                                                              |  |                                                                                                        |  |
| <table border="0"> <tr> <td>* Special categories of cited documents:</td> <td>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"&amp;" document member of the same patent family</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td></td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table> |                                                                                                                                                                                                                                                  |                                                                               | * Special categories of cited documents: | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention | "A" document defining the general state of the art which is not considered to be of particular relevance | "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone | "E" earlier application or patent but published on or after the international filing date | "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art | "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "&" document member of the same patent family | "O" document referring to an oral disclosure, use, exhibition or other means |  | "P" document published prior to the international filing date but later than the priority date claimed |  |
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| Date of the actual completion of the international search<br>10 May, 2006 (10.05.06)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                  | Date of mailing of the international search report<br>23 May, 2006 (23.05.06) |                                          |                                                                                                                                                                                                     |                                                                                                          |                                                                                                                                                                              |                                                                                           |                                                                                                                                                                                                                                                  |                                                                                                                                                                         |                                               |                                                                              |  |                                                                                                        |  |
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**Patent documents cited in the description**

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