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(54) **Drum type washing machine**

(57) A drum type washing machine (100) includes a tub (130), a case (110) receiving the tub, a connection tube (200) having a first end connected to the tub to define a passage along which air flows from the tub, the connection tube being provided with an uneven portion having a plurality of peaks and valleys and a plurality of

straight sections connecting the peaks to the valleys, the peaks and valleys being asymmetrically formed, and an exhaust duct connected to a second end of the connection tube to exhaust air flowing along the connection tube to an external side.

EP 1 655 405 A2

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a drum type washing machine, and more particularly, to a connection pipe assembly of a drum type washing machine, which connects a tub to an exhaust duct that exhausts high temperature and humidity air in a drum to an external side during a drying process.

Description of the Related Art

[0002] Generally, a washing machine is designed to remove dirt from the laundry using surface activation of detergent dissolved in washing water as well as water current generated by the rotation of a drum.

[0003] In recent years, a drum type washing machine performing the washing process by allowing laundry to collide with washing water by lifting and dropping the laundry has been widely used. The drum type washing machine has advantages of providing less damage, increasing washing efficiency and washing a large amount of laundry at a time.

[0004] In addition, as a drum type washing machine having a heat-drying function as well as a washing function has been developed, there is no need of preparing additional separated laundry dryer. The drum type washing machine with the heat-drying function can be classified according to a drying method into a condensing type and an exhaust type.

[0005] The drum type washing machine with the condensing type heat-drying function is designed to eliminate humidity remaining in the laundry through a heat exchange of air circulating between a drum and a drying duct. The drum type washing machine with the exhaust type heat-drying function is designed to eliminate humidity remaining in the laundry by allowing high temperature and humidity air in the drum to be exhausted through an exhaust duct via a tub.

[0006] That is, in the drum type washing machine with the exhaust type heat-drying function, to allow the high temperature and humidity air in the drum to be exhausted, a connection tube is mounted to an outer circumference of the tube to the exhaust duct mounted on a case.

[0007] Meanwhile, the drum type washing machine is designed to generate vibration by the rotation of the drum during washing, rinsing and spin-drying processes. At this point, since the vibration is transmitted to the connection tube, the connection tube may be damaged. To prevent this, the connection tube is provided with an uneven portion. The vibration transmitted to the connection tube is absorbed by the uneven surface, thereby preventing the connection tube from being damaged.

[0008] However, the uneven portion causes the change of the flow of the air flowing along the connection

tube.

[0009] That is, due to the uneven portion of the connection tube, pressure loss is incurred in the connection tube, whereby the wind run is reduced in proportion to the pressure loss. Furthermore, a flow resistance of the air flowing along the connection tube is increased.

[0010] In addition, foreign objects such as naps are caught on the uneven portion of the connection tube, deterioration the airflow.

SUMMARY OF THE INVENTION

[0011] Accordingly, the present invention is directed to a drum type washing machine with a heat-drying function that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0012] An object of the present invention is to provide a drum type washing machine with a heat-drying function, which can minimize an airflow resistance caused by an uneven portion formed on a connection tube when high temperature and humidity air in a drum is exhausted to an external side.

[0013] Another object of the present invention is to provide a drum type washing machine with a heat-drying function, which is designed to prevent foreign objects such as naps from being accumulated in a connection tube when high temperature and humidity air in a drum is exhausted to an external side.

[0014] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0015] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, there is provided A drum type washing machine comprising: a tub; a case receiving the tub; a connection tube having a first end connected to the tub to define a passage along which air flows from the tub, the connection tube being provided with an uneven portion having a plurality of peaks and valleys and a plurality of straight sections connecting the peaks to the valleys, the peaks and valleys being asymmetrically formed; and an exhaust duct connected to a second end of the connection tube to exhaust air flowing along the connection tube to an external side.

[0016] In another aspect of the present invention, there is provided a drum type washing machine, including: a tub; a connection tube having a first end connected to the tub to define a passage along which air flows from the tub, the connection tube being provided with an uneven portion absorbing vibration transmitted from the tub; a auxiliary pipe inserted in the connection tube; an exhaust duct connected to a second end of the connection

tube to exhaust air flowing along the connection tube to an external side.

[0017] According to the present invention, the damage of the connection tube connecting the tub to the exhaust duct is not damaged by vibration generated during washing, rinsing and spin-drying processes and the flow resistance of the air flowing along the connection tube can be minimized.

[0018] In addition, by improving an internal structure of the connection tube, the airflow may be improved by minimizing the accumulation of foreign objects such as nips in the connection tube.

[0019] Furthermore, pressure loss in the connection tube can be minimized by improving the structure of the connection tube.

[0020] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0022] FIG. 1 is a perspective view of a drum type washing machine to which a feature of the present invention can be applied;

[0023] FIG. 2 is a side sectional view of a drum type washing machine depicted in FIG. 1;

[0024] FIG. 3 is a perspective view of a connection tube according to one embodiment of the present invention;

[0025] FIG. 4 is a partial sectional view of a connection tube depicted in FIG. 3;

[0026] FIG. 5 is a perspective view of a connection tube according to another embodiment of the present invention;

[0027] FIG. 6 is a partial sectional view of a connection tube depicted in FIG. 5; and

[0028] FIG. 7 is a perspective view of a connection tube according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0029] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0030] FIGs. 1 and 2 show a drum type washing machine with an exhaust type heat-drying function, to which

a feature of the present invention can be applied.

[0031] Referring to FIGs. 1 and 2, a drum type washing machine 100 with an exhaust type heat-drying function includes a case 2 defining an outer appearance, a front cover 111 attached on a front portion of the case 110, a door 120 pivotally mounted on a center of the front cover 110 to selectively opening and closing a laundry loading/unloading opening, a tub 130 disposed in the case 110 to storing washing water, a drum 135 disposed in the tub 130 and storing laundry.

[0032] The drum type washing machine 100 further includes a driving motor 140 connected to a shaft of the drum 135 to rotate the drum 135, a control panel 112 mounted on a part of an upper portion of the front cover 111 and provided with a variety of buttons for inputting an operation mode of the washing machine, a dispenser 150 inserted into the case 110 to dispense a variety of laundry aiding agents such as a softening agent and a detergent, and a water supply valve 180 mounted on a rear surface of the case 110 to supply the washing water to the dispenser 150.

[0033] The drum type washing machine 100 further includes a water supply tube 181 connecting the water supply valve 180 to the dispenser 150 to allow the washing water to be directed to the dispenser 150 and a bellows connecting the dispenser 150 to the tub 130 to allow the washing machine directed to and mixed with the laundry aid agents to flow into the tub 130.

[0034] The drum type washing machine 100 further comprises a damper 131 mounted on an outer bottom of the tub 130 to absorb vibration generated when the drum rotates 135, a drain tube 171 connected to the outer bottom of the tube 130 to define a passage to drain wastewater after the washing process is finished, a drain pump 170 connected to a distal end of the drain tube 171 to pump out the wastewater, and a drain hose 172 draining the wastewater pumped by the drain pump 170 out of the case 110.

[0035] The drum type washing machine further includes a drying duct 161 directing indoor air into the drum 135 when the drying process is initiated after the washing and rinsing processes are finished, a heater 162 mounted in the drying duct 161 to heat the indoor air passing through the drying duct 161, a dry fan 160 mounted in the drying duct 161 to suck the indoor air, a connection tube exhausting the high temperature and humidity air existed in the drum 135 to an external side, an exhaust duct 190 connected to a distal end of the connection tube 200 and mounted on a sidewall of the case 110.

[0036] The operation of the above-described drum type washing machine 100 with the heat-drying function will be described hereinafter.

[0037] The user first loads the laundry in the drum 135 after opening the door 120 and fills the laundry aid agents such as detergent and softener in the dispenser 150. Then, the user inputs the washing condition using the washing condition input buttons provided on the control panel 112.

[0038] Then, the water supply valve 180 is turned on to supply the washing water to the dispenser 150 through the water supply tube 181. The washing water supplied to the dispenser 150 is mixed with the laundry aid agents stored in the dispenser 150 and is then dropt into the tube 130 through the bellows 151. Then, washing water is further supplied to the tub 130 until the water is filled up to a predetermined level.

[0039] When the washing water reaches the predetermined level in the tub 130, the water supply valve 180 is turned off and the driving motor 140 is driven. As a result, the drum 135 shaft-connected to the driving motor 140 rotates to lift the laundry. The laundry lifted to a top point is dropt so that the laundry can be washed by the collision action with the washing water as well as the surface activation of the laundry aid agents.

[0040] When the washing process performed for a preset time is finished, the wastewater flows to the drain pump 170 along the drain tube 171. The wastewater directed to the drain pump 170 is drained out of the washing machine along the drain hose 172 by the pumping operation of the drain pump 170. When the rinsing process is initiated, clean washing water is introduced into the drum 135 along the water supply tube 181. When the rinsing process is finished, the spin-drying process is started. In the spin-drying process, the drum 135 spins at a high speed so that the water absorbed in the laundry can be removed by centrifugal force. When the spin-drying process is finished, the heat-drying process is performed.

[0041] When the heat-drying process is initiated, the heater 162 is turned on and the indoor air between the case 110 and the tub 130 is directed into the drying duct 161 by the rotation of the dry fan 160. The air directed into the drying duct 161 is heated by the heater 162, thereby being changed into a high temperature and dry state. The high temperature and dry air is directed into the drum 135 to absorb the moisture soaked in the laundry, thereby being changed into the high temperature and humidity state and exhausted out of the washing machine after being directed to the exhaust duct 190 along the connection tube 200 mounted on an upper portion of the tub 130.

[0042] That is, the connection tube 200 has a first end connected to the tub 130 and a second end connected to the exhaust duct 190. Therefore, the vibration generated by the rotation of the drum 135 is transmitted to the connection tube 200 via the tub 130. The vibration transmitted to the connection tube 200 is absorbed by an uneven portion having a zigzag section of the connection tube 200. This will be described in more detail later.

[0043] FIGs. 3 and 4 show the connection tube according to one embodiment of the present invention.

[0044] According to a feature of the present invention, as shown in FIGs. 3 and 4, the uneven portion of the connection tube 200 is asymmetrically formed. The connection tube 200 is formed of a material having a predetermined flexibility and elasticity such as a synthetic rubber

so that it can effectively absorb the vibration transmitted from the tub 130.

[0045] That is, the uneven portion 230 of the connection tube 200 includes a plurality of circumferential peaks 231, a plurality of circumferential valleys 232 disposed between the peaks 231, and a plurality of circumferential straight sections 233 interconnecting the circumferential peaks 231 and the circumferential valleys 232. The circumferential peaks 231 are elevated from the circumferential valleys 232 by a predetermined height H. A diameter of each circumferential valley 232 is identical to an inner diameter of an even portion of the connection tube 200.

[0046] Describing in more detail, vertical lines L1 extending from the circumferential peaks 231 are spaced by a predetermined distance Q1 from respective vertical lines L2 each dividing a pitch P between the adjacent valleys 232 into equal two parts such that the adjacent peaks 230 is asymmetrically located with reference to the respective vertical lines L2. That is, the circumferential peaks are not located on the respective vertical lines L2. Preferably, the circumferential peaks are located on an upstream side of the airflow.

[0047] Generally, when the connection tube 200 is provided with the uneven portion, the wind run is reduced by 20-30% and the pressure loss is increased by 50-60% as compared with a case the connection pipe is not provided with the uneven portion.

[0048] In addition, when the uneven portion 230 is asymmetrically formed as described above, it can be noted that the pressure loss is reduced and the wind run is increased as compared with a case where the uneven portion 230 is symmetrically formed. That is, with reference to an airflow direction, an angle $\square 1$ between one C1 of the adjacent straight sections 233, which is located at the upstream side of the airflow, and a horizontal plane is designed to be greater than an angle $\square 2$ between the other C2 of the adjacent straight sections 233, which is located at the downstream side of the airflow, and the horizontal plane. In this case, the wind run is increased and the pressure loss is reduced.

[0049] A test for measuring the wind run and the pressure loss in the case where the uneven portion is designed having adjacent peaks asymmetrically located as described above was conducted. The test was conducted in a state where that a ratio between the distance Q1 and the pitch P is set to be about 1:5. According to the test results, the pressure loss was reduced by 8.3% and the wind run was increased by 7.5% as compared with a case where the adjacent peaks are symmetrically located.

[0050] For the test results, it can be noted that, when the vertical lines 1 extending from the peaks are spaced from the respective vertical lines L2, the airflow loss is reduced and the wind run is increased.

[0051] As described above, by forming the above-described uneven portion 230 on the connection tube 200, the transmission of the vibration and noise from the tub

130 to the exhaust duct 190 can be prevented. Furthermore, since the peaks of the uneven portion 230 are asymmetrically formed, the airflow loss in the connection tube 200 is reduced while the wind run is increased.

[0052] FIGs. 5 and 6 show a connection tube according to another embodiment of the present invention.

[0053] Referring to FIGs. 5 and 6, a connection tube 300 of this embodiment interconnects the tub 130 and the exhaust duct 190. The exhaust duct 190 is mounted on a sidewall of the case 110, preferably, on a rear-upper surface of the case 110.

[0054] That is, the connection tube 300 has a tub connection portion 310 connected to the tub 130 and an exhaust duct connection portion 320 connected to the exhaust duct 190. An uneven portion 330 is formed between the tub connection portion 310 and the exhaust duct connection portion 320. The connection tube 320 may be bent when the heights of the tub 130 and the exhaust duct 190 are not identical to each other. The connection tube 300 is formed of a material having a predetermined flexibility and elasticity so that it can effectively absorb the vibration transmitted from the tub 130. An evenly-surfaced sub pipe 340 is inserted in an inner circumference with an even surface pipe 340. The connection tube 300 is provided with a fixing member 350 fixing an upstream end of the auxiliary pipe 340.

[0055] The uneven portion 330 includes a plurality of circumferential peaks 331, a plurality of circumferential valleys 332 located between the circumferential peaks, and a plurality of circumferential straight sections 333 connecting circumferential peaks 331 to the circumferential valleys 332. A diameter of each circumferential valley 332 is identical to an inner diameter of an even portion of the connecting tube 300.

[0056] The upstream end of the auxiliary pipe 340 is fixed on the inner circumference of the connection tube 300 by the fixing member 350. The fixing member 350 is a fastener such as screws and strip penetrating the connection tube 300 and the auxiliary pipe 340. That is, the fixing member 350 may be formed of a plurality of screws screwed around the connection pipe 300 at a predetermined distance from each other.

[0057] The fixing member 350 is not limited to a specific element, but formed of a variety of elements that can fix the auxiliary pipe 340 to the inner circumference of the connection tube 300.

[0058] In addition, the auxiliary pipe 340 may be formed of a material that is more flexible than the connection tube 300. When the air does not flow along the connection tube 300, a downstream end of the auxiliary pipe 340, which is not fixed on the connection tube 300, is slightly sagged by self-gravity. The uneven portion 330 of the connection tube 330 is repeatedly contracted and expanded by the vibration generated by the drum 135 rotating by the driving motor 140, thereby absorbing the vibration transmitted from the tub 130.

[0059] When the high temperature and humidity air flows along the connection tube 300 during the heat-dry-

ing process, the downstream end of the auxiliary pipe 340 is returned to completely contact the inner circumference of the connection tube 300. As a result, the air flowing along the connection tube 300 does not collide with the uneven portion 330, thereby avoiding the vortex phenomenon. That is, the air flowing along the connection tube 300 is not affected by the uneven portion 330 by the auxiliary pipe 340.

[0060] In addition, it is preferable that the auxiliary pipe 340 is designed having a length at least identical or greater than that of the uneven portion 330 to completely cover the inner circumference of the uneven portion 330, thereby preventing the air flowing along the connection tube 300 from flowing into the uneven portion 330.

[0061] FIG. 7 shows a connection tube according to another embodiment of the present invention.

[0062] Referring to FIG. 7, both downstream and upstream ends of the auxiliary pipe 340 are fixed on the connection tube 300 by fixing members 350.

[0063] In this case, the auxiliary pipe 340 is formed of a material having a high flexibility. Therefore, the vibration generation from the drum may be absorbed by the auxiliary pipe 340 as well as the uneven portion 330. The uneven portion 330 of the connection tube 330 is repeatedly contracted and expanded by the vibration, thereby absorbing the vibration transmitted from the tub 130. At this same time of this, the auxiliary pipe 340 is flexibly moved to absorb the vibration.

[0064] According to this embodiment, since the auxiliary pipe 340 having an even surface is inserted around the inner circumference of the connection tube 300 to cover the uneven portion 330, the pressure loss of the air is reduced and the wind run is increased.

[0065] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims

1. A drum type washing machine comprising:

- a tub;
- a case receiving the tub;
- a connection tube having a first end connected to the tub to define a passage along which air flows from the tub, the connection tube being provided with an uneven portion having a plurality of peaks and valleys and a plurality of straight sections connecting the peaks to the valleys, the peaks and valleys being asymmetrically formed; and
- an exhaust duct connected to a second end of the connection tube to exhaust air flowing along the connection tube to an external side.

2. The drum type washing machine according to claim 1, wherein the peaks and valleys are formed along a circumference of the connection tube.
3. The drum type washing machine according to claim 1, wherein first vertical lines extending from the circumferential peaks are spaced by a predetermined distance from respective second vertical lines each dividing a pitch between the adjacent valleys into equal two parts to an upstream side of the airflow. 5
4. The drum type washing machine according to claim 1, wherein an angle between one of the adjacent straight sections, which is located at an upstream side of airflow, and a horizontal plane is designed to be greater than an angle between the other of the adjacent straight sections, which is located at a downstream side of the airflow, and the horizontal plane. 10
5. The drum type washing machine according to claim 1, wherein the connection tube is formed of a material having a predetermined flexibility to absorb vibration transmitted from the tub. 15
6. The drum type washing machine according to claim 1, wherein the connection tube is formed of a synthetic rubber. 20
7. The drum type washing machine according to claim 1, wherein a ratio between a distance between vertical lines extending from the adjacent valleys and a distance between a vertical line and a vertical line dividing the distance between the adjacent valleys into equal two parts is about 5:1. 25
8. The drum type washing machine according to claim 1, further comprising a pipe inserted in the connection tube. 30
9. The drum type washing machine according to claim 8, wherein at least a downstream end of the pipe is fixed on an inner circumference of the connection tube. 35
10. The drum type washing machine according to claim 8, wherein the pipe is inserted to cover the uneven portion so that the airflow can be smoothly realized. 40
11. A drum type washing machine comprising: 45
 - a tub;
 - a connection tube having a first end connected to the tub to define a passage along which air flows from the tub, the connection tube being provided with an uneven portion absorbing vibration transmitted from the tub;
 - a auxiliary pipe inserted in the connection tube; 50
- and 55
 - an exhaust duct connected to a second end of the connection tube to exhaust air flowing along the connection tube to an external side.
12. The drum type washing machine according to claim 11, wherein at least downstream end of the auxiliary pipe is fixed on the connection tube.
13. The drum type washing machine according to claim 11, further comprising a fixing member fixing at least downstream end of the auxiliary pipe on the connection tube.
14. The drum type washing machine according to claim 13, wherein the fixing member is formed in a strip-shape formed around the connection tube.
15. The drum type washing machine according to claim 13, wherein the fixing member is provided in plurality provided around the connection tube at a predetermined distance from each other.
16. The drum type washing machine according to claim 13, wherein the fixing member is formed of at least one screw.
17. The drum type washing machine according to claim 11, wherein the auxiliary pipe is formed in a cylindrical shape having an even inner circumference.
18. The drum type washing machine according to claim 11, wherein the auxiliary pipe is formed of a material having a predetermined flexibility.
19. The drum type washing machine according to claim 11, wherein the auxiliary pipe is formed of a rubber material to effectively absorb vibration.
20. The drum type washing machine according to claim 11, wherein a flexibility of the auxiliary pipe is greater than that of the connection tube.
21. The drum type washing machine according to claim 11, wherein a length of the auxiliary pipe is equal to or greater than that of the uneven portion.
22. The drum type washing machine according to claim 11, wherein the uneven portion having a plurality of peaks and valleys and a plurality of straight sections connecting the peaks to the valleys, the peaks and valleys being asymmetrically formed with reference to a first vertical line dividing a pitch between the adjacent valleys into equal two parts.
23. The drum type washing machine according to claim 11, wherein an angle between one of the adjacent straight sections, which is located at an upstream

side of airflow, and a horizontal plane is designed to be greater than an angle between the other of the adjacent straight sections, which is located at a downstream side of the airflow, and the horizontal plane.

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Fig.1

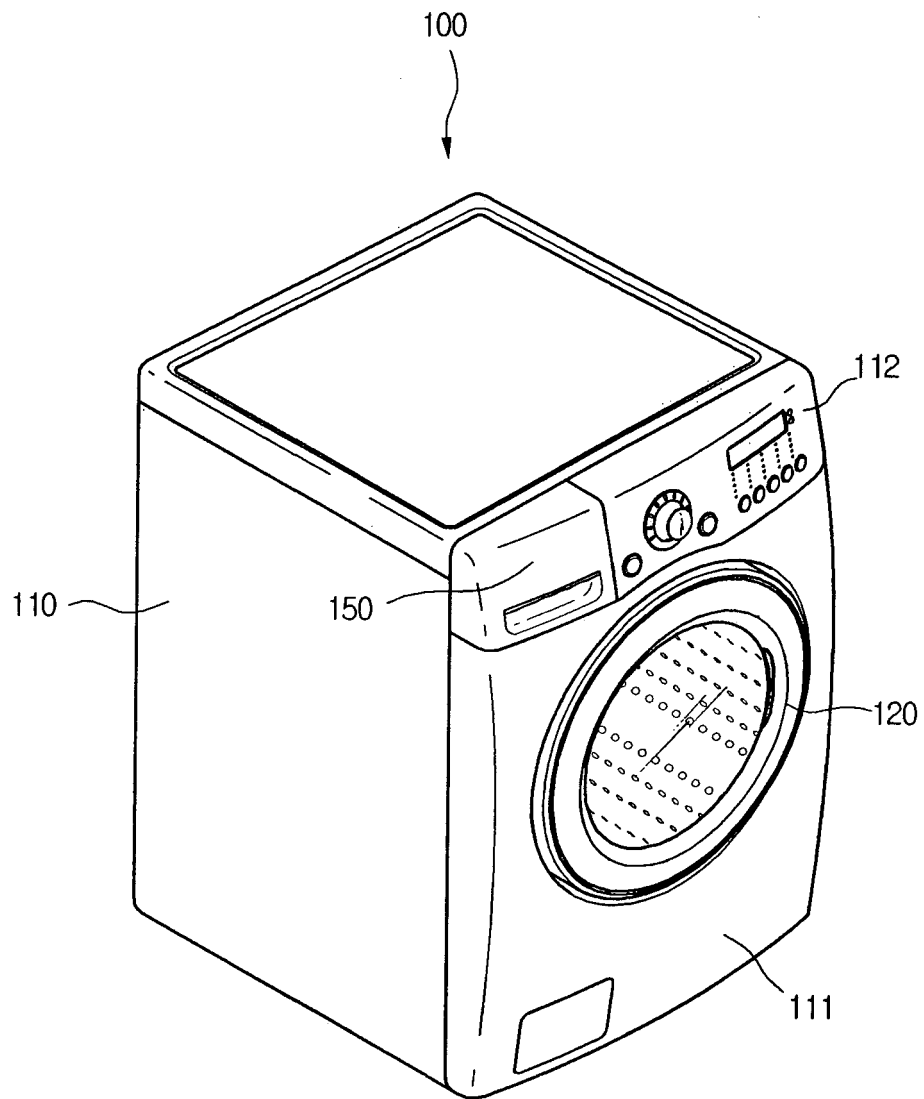


Fig.2

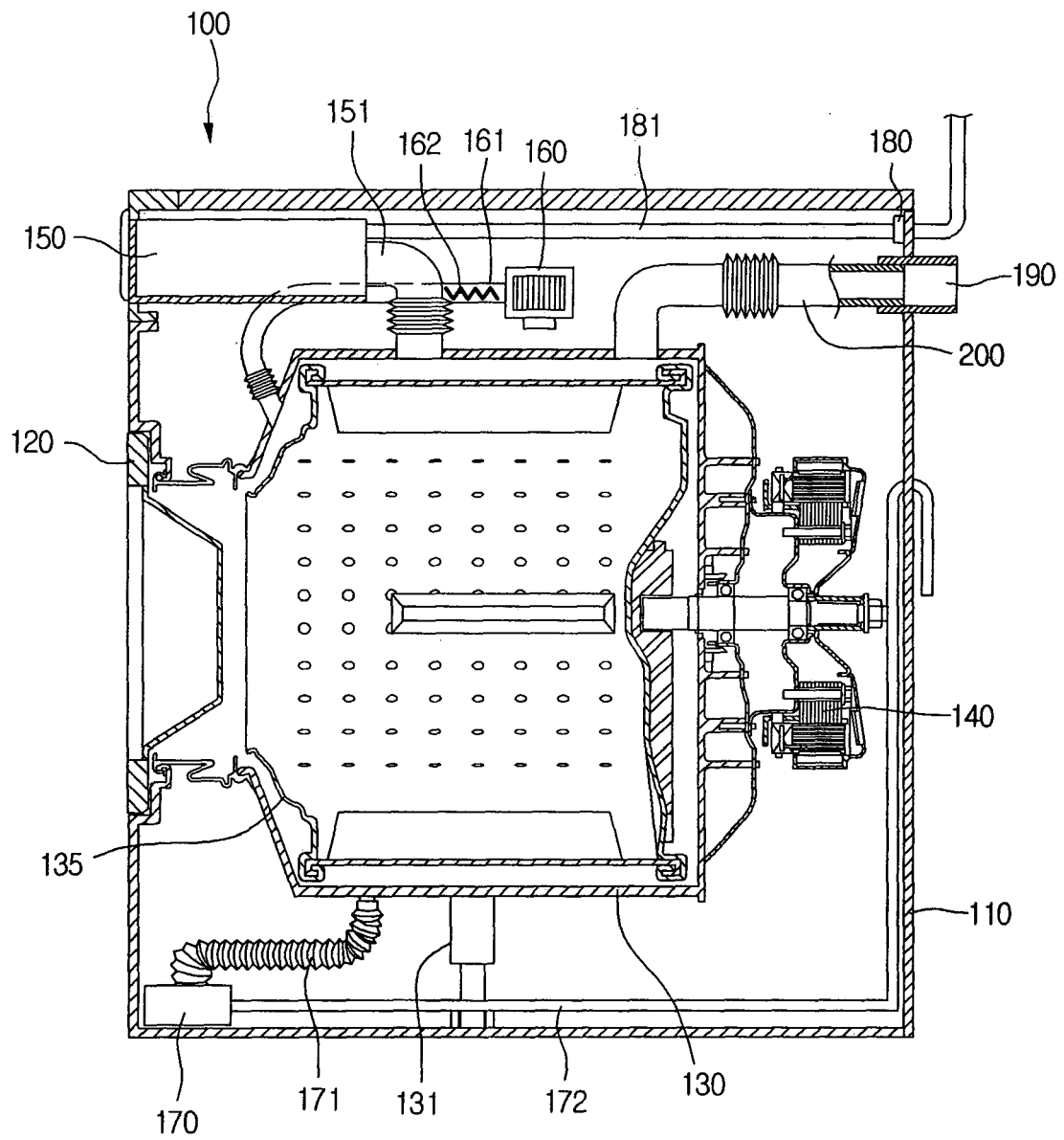


Fig.3

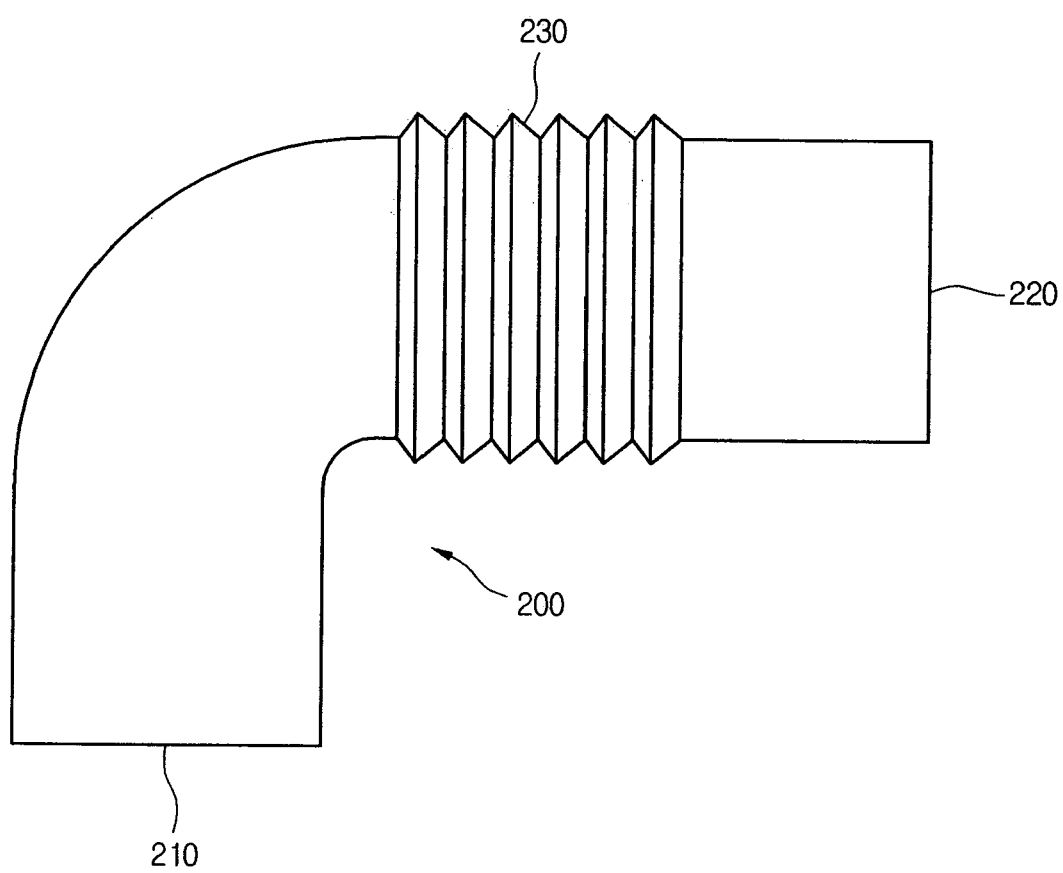


Fig.4

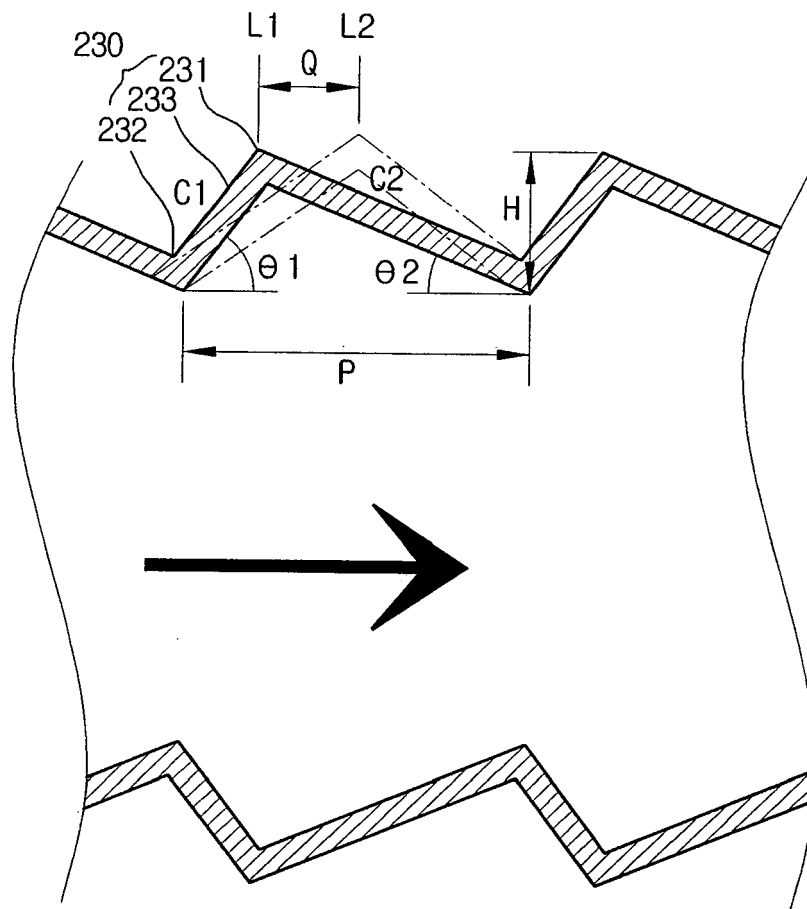


Fig. 5

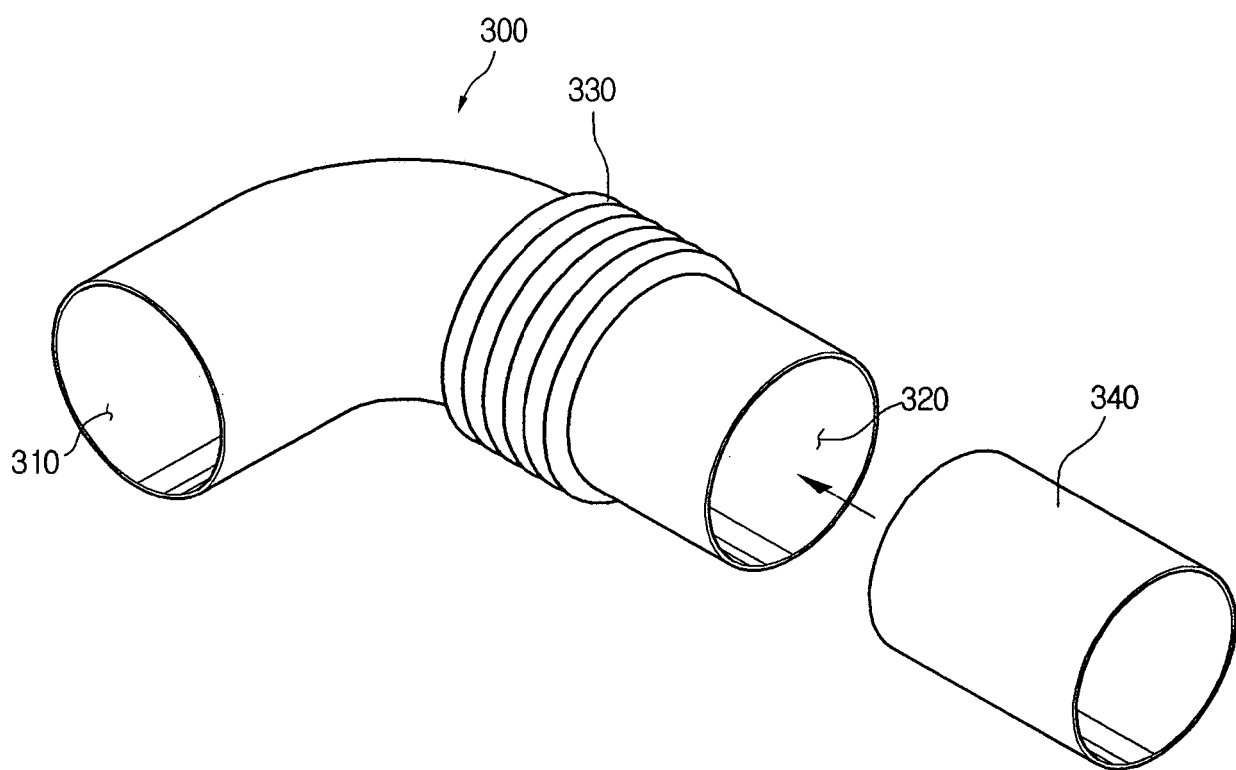


Fig.6

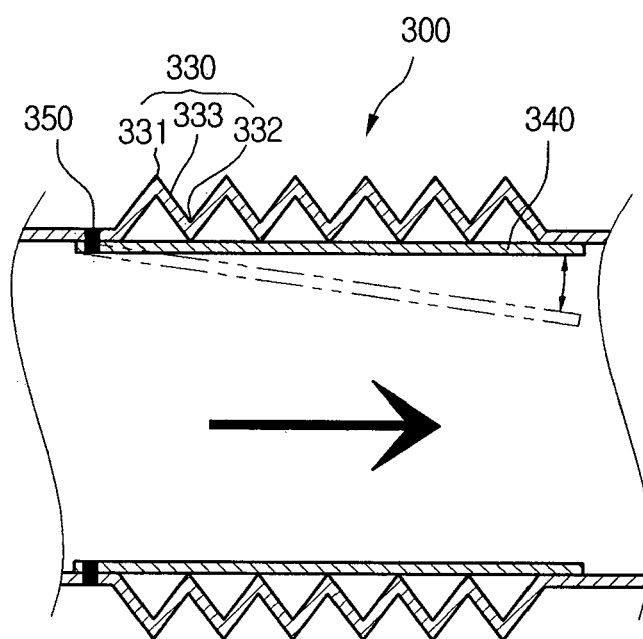


Fig.7

