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(71) Applicant: **Samsung Electronics Co., Ltd.**
Suwon-si, Gyeonggi-do 442-742 (KR)

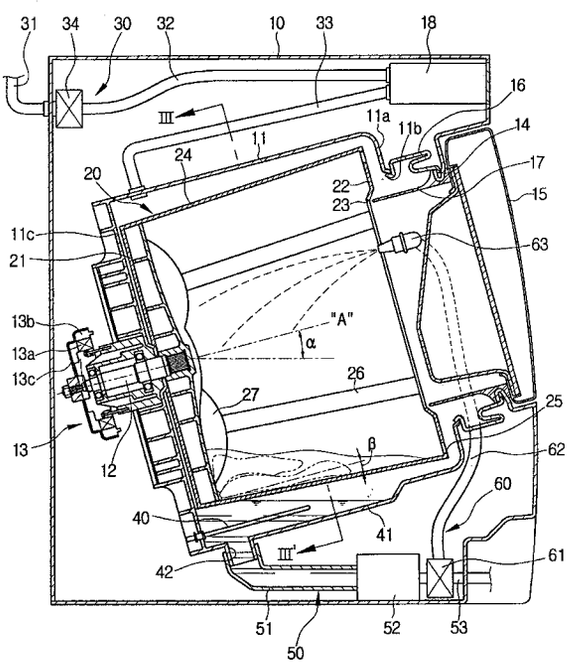
(72) Inventors:
- **Park, Jae-Ryong**
  Youngtong-Gu Suwon-Si Gyeonggi-Do (KR)
- **Kim, Hyung-Gyoon**
  Paldal-Gu Suwon-City Kyungki-do (KR)
- **Pyo, Sang-Yeon**
  Suwon-City Kyungko-do (KR)
- **Park, Seon-Woo**
  Suwon-City Kyungki-do (KR)
- **Yang, Hye Soon**
  Yongin-City Kyungki-do (KR)
- **Oak, Seong Min**
  Masan-City Kyungsangnam-Do (KR)
- **Yang, Byoung Yull**
  Ansan-City Kyungki-do (KR)
- **Kim, Hyun Sook**
  Suwon-City Kyungki-do (KR)

(74) Representative: **Grey, Ian Michael et al**
Venner Shipley LLP
20 Little Britain
London EC1A 7DH (GB)

(54) Washing machine

(57) A washing machine is disclosed. It includes a drum (11) and a rotatably mounted tub (20) within the drum (11) to receive laundry to be washed. The tub (20) has a pair of end walls (21,22) spaced from each other by a cylindrical sidewall (24) and a plurality of drain holes (25) formed in one end wall (22) adjacent to the sidewall (24) for the passage of water out of the tub (20). The tub (20) is mounted for rotation about an axis inclined relative to the horizontal so that the sidewall (24) is angled downwardly away from the end wall (22) in which the drain holes (25) are formed to allow water to collect in the tub (20) in a region between the sidewall (24) and the other end wall (21).

FIG. 1



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Description

[0001] The present invention relates to a drum washing machine including a drum and rotatably mounted tub within the drum to receive laundry to be washed, the tub having a pair of end walls spaced from each other by a cylindrical sidewall.

[0002] A conventional drum washing machine comprises a cylindrical rotary tub which is rotatably mounted in a water drum within a housing and is rotated to agitate laundry in water to wash the laundry. An example of a conventional drum washing machine is disclosed in Japanese patent laid-open Publication No. 2001-149685.

[0003] A conventional drum washing machine includes a rotary water tub, a drum and a heater. The drum contains water therein and the rotary tub has a plurality of perforations in its sidewall. The heater is installed at a predetermined position under the drum so as to heat water to a predetermined temperature. When the drum washing machine is operating and both water and detergent are fed into the drum, the tub is rotated in the drum at a low speed. During a wash cycle, the heater heats water to a predetermined temperature, thereby enhancing the washing effect of the washing machine.

[0004] A conventional drum washing machine suffers from several problems. Firstly, it is necessary to feed water into the washing machine to a level at which the laundry inside the tub is immersed in the water also allowing for a gap between the perforated rotary tub and the drum. Therefore, a conventional drum washing machine consumes an excessive amount of water. Since a conventional drum washing machine is designed so that water is fed into the drum and flows into the rotary tub through the perforations until the laundry in the rotary tub is immersed in the water, a large amount of water must be fed into the drum. Consumption of the water during the operation of the washing machine is thus excessively increased, leading to an increase in cost.

[0005] As an excessive amount of water is consumed, a long period of time for feeding or draining water into or from the drum is required. In addition, the washing time is further increased as water must be heated to a predetermined temperature by the heater, before the rotary tub starts to rotate to wash the laundry in the heater water.

[0006] Furthermore, since the large amount of water must be heated to the predetermined temperature by the heater, an excessive amount of electricity is used to heat the water.

[0007] Another disadvantage is that it is difficult to manufacture the tub as perforations must be formed around its sidewall to allow the water to flow between the drum and the rotary tub and to allow the rotary tub to spin-dry the laundry during a spin-drying operation.

[0008] A washing machine according to the present invention is characterised in that a plurality of drain holes are formed in one end wall adjacent to the sidewall for the passage of water out of the tub, the tub being mounted for rotation about an axis inclined relative to the horizontal so that the sidewall is angled downwardly away from the end wall in which the drain holes are formed to allow water to collect in the tub in a region between the sidewall and the other end wall beneath the drain holes.

[0009] In a preferred embodiment, the angle of inclination of the sidewall relative to the horizontal is different to the angle of inclination of the axis about which the tub rotates so that when the tub rotates, water contained therein is directed toward the drain holes.

[0010] Preferably, the angle of inclination of the sidewall relative to the horizontal is less than the angle of inclination of the axis of rotation of the tub relative to the horizontal.

[0011] Conveniently, the plurality of drain holes are arranged in a circular pattern in the end wall.

[0012] Alternatively, the plurality of drain holes are arranged in a first circular pattern and at least one further circular pattern concentric with the first circular pattern.

[0013] In one embodiment, additional drain holes may be formed in the sidewall adjacent to the end wall in which said plurality of drain holes are formed.

[0014] In another embodiment, the junction between said one end wall and the sidewall is curved and the drain holes are formed in the curved region.

[0015] An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of a drum washing machine according to an embodiment of the present invention during a wash cycle;
Figure 2 is a sectional view of the drum washing machine in Figure 1 during a spin-drying cycle;
Figure 3 is a sectional view taken along a line of III-III' of Figure 1;
Figure 4 is a perspective view of a rotary tub included in the drum washing machine of Figure 1;
Figure 5 is a sectional view of the rotary tub of Figure 4; and
Figures 6 and 7 are sectional views of a rotary tub with drain holes provided on the rotary tub according to a first modification and a second modification of the embodiment of Figure 1 respectively.

[0016] As shown in Figure 1, a drum washing machine according to the present invention includes a housing 10, a drum 11, and a rotary tub 20. The drum 11 is installed in the housing 10 and receives water therein for washing. The rotary tub 20 is rotatably mounted within the drum 11.

[0017] In the housing 10, the axis of the drum 11 is inclined relative to the horizontal at a predetermined first angle α of inclination, such that a front part 11a of the drum 11 having an inlet opening 11b is at a position higher than a rear part 11c of the drum 11. In the same manner as the drum 11, the tub 20 is mounted in the drum 11 such that a front part 22 of the rotary tub 20 having

an inlet opening 23 is placed at a position higher than a rear part 21 of the rotary tub 20. That is, a rotating axis A of the rotary tub 20 is inclined relative to a horizontal axis at the first angle α of inclination to allow the front part 22 having the inlet opening 23 to be placed at the position higher than the rear part 21. A rotating shaft 12, which is securely mounted to a centre of the rear part 21 of the rotary tub 20, is rotatably held in a centre of the rear part 11c of the drum 11, thus allowing the tub 20 to rotate relative to the drum 11. The drum 11 is suspended in the housing 10 by a plurality of shock absorbing suspension units (not shown) while being apart from an internal surface of the housing 10. The axis of rotation of the rotary tub 20 is coaxial with the axis of the drum 11.

[0018] A motor 13 to rotate the rotating shaft 12 of the tub 20 is mounted outside the rear part 11c of the drum 11 and includes a stator 13a mounted to the rear part 11c of the drum 11, a rotor 13b which is rotatably placed around the stator 13a, and a rotary disc 13c which couples the rotor 13b to the stator 13a.

[0019] The front of the housing 10 has an inlet opening 14 which is aligned with both the inlet opening 11b of the drum 11 and the inlet opening 23 of the rotary tub 20, to enable a user to put laundry into, or remove it from, the rotary tub 20 via the three aligned inlet openings 14,23 and 11b. A door 15 is hingedly mounted to an edge of the inlet opening 14 so as to close the opening 14. To prevent leakage of wash water from the drum 11, a cylindrical bellows 16 extends between the inlet opening 14 of the housing 10 and the inlet opening 11b of the drum 11. A cylindrical guide unit 17 is placed inside the bellows 16 to allow the user to easily put or remove laundry into or from the rotary tub 20.

[0020] A detergent supply unit 18 and a water supply unit 30 are installed in the housing 10 at positions above the water tub 11 to respectively feed detergent and water into the drum 11. The detergent supply unit 18 is placed at the front part of the housing 10 to allow the user to fill it with detergent. The water supply unit 30 comprises a first water feed pipe 32 which extends from an external water supply pipe 31 to the detergent supply unit 18, a second water feed pipe 33 which extends from the detergent supply unit 18 to the drum 11, and a first control valve 34 which is mounted to an intermediate portion of the first water feed pipe 32 to control a flow of the water to be fed into the drum 11. Due to coupled construction of the detergent supply unit 18 and the water supply unit 30, the water passes through the detergent supply unit 18, prior to reaching the drum 11. Therefore, the detergent contained in the detergent supply unit 18 is dissolved in water prior to being fed into the drum 11.

[0021] The drum washing machine has a heater 40 in a lower portion of the drum 11 to heat water contained in the drum 11. A heater holding part 41, which is a pan-shaped part, is provided at a lower portion of a sidewall of the drum 11 by drawing or deflecting the lower portion of the sidewall of the tub 11 downward, away from the rotary tub, as shown in Figures 1, 2 and 3. The heater 40 is installed in the heater holding part 41 in which a predetermined amount of water is collected so that the heater 40 is submerged in water. Since the heater 40 is placed in the heater holding part 41 the rotary tub 20 can rotate without interfering with the heater 40.

[0022] The drum washing machine also has a drain unit 50 which discharges water from the drum 11 and a water circulation unit 60 which feeds water, which is heated by the heater 40 in the drum 11, into the rotary tub 20. The drain unit 50 comprises a first drain pipe 51, a drain pump 52 and a second drain pipe 53. The first drain pipe 51 is connected to a drain port 42 in communication with the heater holding part 41 of the lower portion of the drum 11 to allow water to be discharged from the drum 11. The drain pump 52 is mounted to an intermediate portion of the first drain pipe 51 and the second drain pipe 53 extends from an outlet of the drain pump 52. The water circulation unit 60 includes a second control valve 61, a water circulation pipe 62, and a spray nozzle 63. The second control valve 61 is mounted to an intermediate portion of the second drain pipe 53 that extends from the outlet of the drain pump 52. The water circulation pipe 62 extends from the second control valve 61 to the inlet opening 23 of the rotary tub 20. The spray nozzle 63 is mounted to an outlet of the water circulation pipe 62. The second control valve 61 controls a flow direction of the wash water flowing from the outlet of the drain pump 52 so as to drain discharged wash water or to guide discharged wash water into the water circulation pipe 62. A motorized three-way valve may be used as the second control valve 61. The spray nozzle 63 is held by the guide unit 17 adjacent to the inlet opening 23 of the rotary tub 20, thus spraying wash water into the rotary tub 20 through the inlet opening 23. Due to the above-described coupled construction of the drain unit 50 and the water circulation unit 60, the water which is discharged from the lower portion of the water drum 11 may be drained to the outside of the housing 10 or be sprayed into the rotary drum 20. That is, when the drain pump 52 is operated with the second control valve 61 controlled to guide the discharged water to the water circulation pipe 62, as shown in Figure 1, the discharged water passes through both the first drain pipe 51 and the water circulation pipe 62 to be sprayed into the rotary tub 20. However, when the drain pump 52 is operated with the second control valve 61 controlled to guide the discharged water to the second drain pipe 53, as shown in Figure 2, the discharged water is drained to the outside of the housing 10.

[0023] As shown in Figures 4 and 5, the rotary tub 20, which is installed in the water drum 11 to be inclined relative to the horizontal axis of the cabinet 10 at the first angle α of inclination, comprises the front part 22 having the inlet opening 23, the rear part 21 securely coupled to the rotating shaft 12, and a cylindrical sidewall part 24 extending between the front part 22 and the rear part 21. The rear part 21 and the cylindrical sidewall part 24

are completely closed to contain water in the tub 20. The diameter of the rotary tub 20 gradually increases from the rear part 21 to the front part 22 so that the sidewall part 24 of the rotary tub 20 is inclined at an angle β relative to the rotating axis A of the rotary drum 20 as shown in Figure 5. A plurality of drain holes 25 are provided along an edge of the inlet opening 23 of the front part 22 to discharge water from the rotary tub 20 when it is rotated at a high speed. As shown in Figure 3, the rotary tub 20 also has a plurality of lifters 26 around an internal surface of the cylindrical sidewall part 24 to repeatedly lift the laundry upward along with the water so that it drops from the top to the bottom inside the rotary tub 20 due to gravity, when the rotary tub 20 rotates. To enhance the washing effect of the drum washing machine, a plurality of agitating blades 27 are provided on an internal surface of the rear part 21 of the rotary tub 20 as shown in Figure 3.

[0024] As the axis A of the rotary tub 20 is inclined relative to the horizontal axis of the housing 10 at the first angle α of inclination, a predetermined amount of water is contained in the rotary drum 20 to allow the laundry to be submerged in the water. The water is fed into the rotary tub 20 to reach a level that is not higher than a lowermost drain hole 25 of the rotary tub 20. The first angle α of inclination of the rotating axis A of the rotary tub 20 relative to the horizontal axis of the housing 10 may be set to approximately 15° in order to contain an appropriate amount of water in the rotary tub 20 and effectively wash the laundry.

[0025] As described above, the sidewall 24 of the rotary tub 20 is inclined relative to the rotating axis A of the rotary tub 20 at the second angle β of inclination, and the drain holes 25 are provided along the edge of the inlet opening 23 of the front part 22 of the rotary tub 20. As a result, water is guided to the drain holes 25 of the rotary tub 20 during rotation of the rotary tub 20. That is, when the rotary tub 20 is rotated at a high speed during a spin-drying operation of the washing machine, water is squeezed out of the laundry in the rotary tub 20 and moves in a radial direction away from the axis A due to centrifugal force. Due to the angle of inclination β of the sidewall 24 relative to the axis A, the water is guided to the drain holes 25 along the inclined internal surface of the cylindrical sidewall part 24, prior to being discharged to the outside of the rotary tub 20. To allow smooth discharge of water from the rotary tub, the second angle β of inclination of the internal surface of the rotary tub 20 relative to the rotating axis A of the rotary tub 20 may be set at 0.5° or higher.

[0026] Figures 6 and 7 are sectional views of a rotary tub 20, with drain holes provided on the rotary tub 20 according to a first modification and a second modification of the embodiment of Figure 1, respectively. In the first modification of Figure 6, a plurality of rows of drain holes 25a are provided on the front part 22 of the rotary tub 20 along the edge of the inlet opening 23 and drain holes 25b are provided around an edge of the cylindrical sidewall part 24 adjacent to the front part 22. due to the drain holes 25a,25b, the rotary tub 20 of Figure 6 more effectively discharges water in comparison with the rotary tub 20 of Figure 4.

[0027] In the second modification of Figure 7, the rotary tub 20 is rounded along a junction corner 28 between the front part 22 and the cylindrical sidewall part 24, with a plurality of drain holes 25c being formed along the rounded junction corner 28. Although this arrangement reduces the water draining effect, in comparison with the rotary drum 20 of Figure 6, it may desirably contain a large amount of water therein, without enlarging the angle α of inclination of the rotary drum 20 relative to the horizontal axis of the housing 10.

[0028] The drum washing machine having the above mentioned construction is operated as follows.

[0029] To execute a wash cycle, the washing machine is turned on after laundry is put into the rotary tub 20 and detergent is added to the detergent supply unit 18 so that the first control valve 34 of the water supply unit 30 opens to feed water into the water drum 11. When water is fed into the water drum 11, the water passes through the detergent supply unit 18 prior to reaching the water drum 11, so that the detergent is dissolved in the water. After a predetermined amount of water is fed into the water drum 11, the supply of water into the water drum 11 is stopped. Since both the rear part 21 and the cylindrical sidewall part 24 of the rotary tub 20 as well as the junction between the rear part 21 and the sidewall part 24 are completely closed, water cannot enter the rotary tub 20 during supply of the water into the drum 11, but remains in the heater holding part 41 at the lower portion of the sidewall of the water drum 11. In addition, since it is not necessary to feed water into the drum 11 to a level allowing the laundry in the rotary tub 20 to be submerged in water, as in the conventional drum washing machine, the amount of water required to wash the laundry is substantially reduced.

[0030] When the predetermined amount of water is completely fed into the water drum 11, the heater 40 is turned on to heat the water. Since the amount of water contained in the drum 11 is reduced, in comparison to the conventional drum washing machine, as described above, it is possible to quickly heat the water within a short period, thereby shortening the washing time and reducing an amount of electricity required to heat the water.

[0031] After the water in the drum 11 is completely heated by the heater 40 to a predetermined temperature, the control valve 61 of the water circulation unit 60 is operated to permit the outlet of the drain pump 52 to communicate with the water circulation pipe 62. When the drain pump 52 in the above state is operated, the heater water is discharged from the heater holding part 41 to pass through both the first drain pipe 51 and the water circulation pipe 62, thus being fed into the rotary tub 20. In the above state, an entire part of the laundry contained in the rotary tub 20 is uniformly wet with the

water since the spray nozzle 63 sprays the water onto the laundry. The rotary tub 20 is rotated at a low speed by the motor 13 simultaneously with the spraying of the water into the rotary tub 20, thus washing the laundry.

[0032] During the wash cycle, the entire laundry contained in the rotary tub 20 is sufficiently wet with the water contained in the rotary tub 20 since the rotary tub 20 is installed in the housing 10 and inclined relative to the horizontal axis of the housing 10 at the first angle α of inclination, as shown in Figure 1. The drum washing machine thus smoothly and effectively executes the wash cycle. When the level of water in the rotary tub 20 exceeds the height of a lowermost drain hole 25 of the rotary tub 20 water overflows from the rotary tub 20 into the drum 11 through the drain holes 25, prior to returning from the drum 11 to the tub 20 by an operation of the drain pump 52. The circulation of water is continued during the wash cycle. When the drum washing machine performs the wash cycle, most of the water is continuously fed from the drum 11 into the tub 20, so that the drum 11 contains only a small amount of water therein.

[0033] When the wash cycle is finished, the drum washing machine executes a rise cycle to repeatedly rinse and spin-dry the washed laundry. To execute the rinse cycle, the washed laundry must be primarily spin-dried. To spin-dry the washed laundry, the drain pump 52 is operated with the second control valve 61 controlled to permit the outlet of the drain pump 52 to communicate with the second drain pipe 53, and the rotary tub 20 is rotated at a high speed, thus spin-drying the washed laundry. While the rotary tub 20 is rotated at a high speed to spin-dry the laundry, the water is primarily squeezed out of the laundry in the rotary tub 20 and moves in a radially outward direction along the internal surface of the cylindrical sidewall part 24 of the rotary tub 20 due to a centrifugal force, and is secondarily guided to the drain holes 25, since the internal surface of the rotary tub 20 is inclined relative to the rotating axis A of the rotary tub 20 at the second angle β of inclination, as shown in Figure 2. The water in the tub 20 is thus discharged to the outside of the rotary tub 20 through the drain holes 25, and the water in the drum 11 is drained to the outside of the housing 10 by the operation of the drain pump 52. After spin-drying the washed laundry, new water enters the drum 11 by the operation of the water supply unit 30, and is introduced into the tub 20 by the operation of the water circulation unit 60, in the same manner as that described for the wash cycle, thus rinsing laundry. During the rinse cycle, the spin-drying of the laundry and the feeding of new water into the water tub 11 are repeated several times.

[0034] The rinse cycle ends with a final spin-drying of the rinsed laundry. To finally spin-dry the rinsed laundry, the drain pump 52 is operated with the second control valve 61 controlled to permit the outlet of the drain pump 52 to communicate with the second drain pipe 53, and the rotary tub 20 is rotated at a high speed for a predetermined period of time. That is, the final spin-drying of the rinsed laundry is performed in the same manner as an intermediate spin-drying of the laundry during the rinsing operation.

[0035] The present invention provides a drum washing machine in which a rotary tub is installed in a housing and is inclined relative to a horizontal axis of the housing, and both a rear part and a sidewall part of the rotary tub as well as a junction between the rear part and the sidewall part are completely closed. Water is contained in the rotary tub during a washing operation of the drum washing machine. Therefore, the drum washing machine uses less water to wash laundry, without reducing the washing effect as in a conventional drum washing machine.

[0036] In addition, the drum washing machine feeds a small amount of water from a water drum into the rotary tub after heating the small amount of water by use of a heater, thus reducing the amount of electricity required to heat the water, and reducing washing time. As the drum washing machine uses less water to wash laundry, the washing machine quickly feeds and drains the water into and from the drum, thus reducing the overall washing time.

[0037] Since the drum washing machine washes laundry using less water, the washing machine drains less water, thus reducing the amount of wastewater to cause environmental pollution.

[0038] Furthermore, as the rotary tub does not have perforations on the rear or sidewall part thereof, it has a simple construction.

[0039] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles of the invention, the scope of which is defined in the claims and their equivalents.

Claims

1. A washing machine including a drum (11) and rotatably mounted tub(20) within the drum (11) to receive laundry to be washed, the tub (20) having a pair of end walls (21,22) spaced from each other by a cylindrical sidewall (24) **characterised in that** a plurality of drain holes (25) formed in one end wall (22) adjacent to the sidewall (24) for the passage of water out of the tub (20), the tub (20) being mounted for rotation about an axis inclined relative to the horizontal so that the sidewall (24) is angled downwardly away from the end wall (22) in which the drain holes (25) are formed to allow water to collect in the tub (20) in a region between the sidewall (24) and the other end wall (21) beneath the drain holes (25).

2. A washing machine according to claim 1, wherein the angle of inclination of the side wall (24) relative

to the horizontal is different to the angle of inclination of the axis about which the tub (20) rotates so that when the tub (20) rotates, water contained therein is directed toward the drain holes (25).

3. A washing machine according to claim 2, wherein the angle of inclination of the sidewall (24) relative to the horizontal is less than the angle of inclination of the axis of rotation of the tub (20) relative to the horizontal.

4. A washing machine according to any preceding claim, wherein the plurality of drain holes (25) are arranged in a circular pattern in the end wall (22).

5. A washing machine according to claim 4, wherein the plurality of drain holes (25) are arranged in a first circular pattern and at least one further circular pattern concentric with the first circular pattern.

6. A washing machine according to any preceding claim, comprising additional drain holes (25b) in the sidewall (24) adjacent to the end wall (22) in which said plurality of drain holes (25) are formed.

7. A washing machine according to any of claims 1 to 3, wherein the junction between said one end wall (22) and the sidewall (24) is curved and the drain holes (25) are formed in the curved region.

8. A drum washing machine comprising a water tub to contain water therein, a rotary drum included in the water tub and comprising a rotating axis of the rotary drum is inclined relative to a horizontal axis at a predetermined first angle of inclination allowing an inlet opening of the rotary drum to be directed upward and forward, a drain hole provided on the rotary drum at a position adjacent to the inlet opening and an internal surface of the rotary drum being inclined relative to the rotating axis of the rotary drum at a predetermined second angle of inclination so as to guide the water to the drain hole, prior to discharging the water from the rotary drum to an outside of the rotary drum through the drain hole, a drive unit to drive the rotary drum and a water circulation unit to feed the water from the water tub into the rotary drum.

9. The drum washing machine of claim 8 further comprising a heater provided in a lower portion of the water tub which heats the water.

10. The drum washing machine of claim 9 further comprising a drain unit having a drain pipe connected to the lower portion of the water tub and a drain pump mounted to an intermediate portion of the drain pipe.

11. The drum washing machine of claim 10 wherein the water circulation unit comprising a control valve mounted to the drain pipe of the drain unit at a position around an outlet of the drain pump to control a flow direction of the water flowing from the drain pump, a water circulation pipe extending from the control valve to the inlet opening of the rotary drum and a spray nozzle mounted to an outlet of the water circulation pipe to spray the water into the rotary drum.

12. The drum washing machine of claim 8 further comprising a drain unit having a drain pipe connected to a lower portion of the water tub and a drain pump mounted to an intermediate portion of the drain pipe.

13. The drum washing machine of claim 8 wherein the water circulation unit comprising a control valve mounted to the drain pipe of the drain unit at a position around an outlet of the drain pump to control a flow direction of the water flowing from the drain pump, a water circulation pipe extending from the control valve to the inlet opening of the rotary drum and a spray nozzle mounted to an outlet of the water circulation pipe to spray the water into the rotary drum.

14. The drum washing machine of claim 8 wherein the rotary drum comprising a rear part which is closed and coupled to a rotating shaft at a centre of the rear part, a front part spaced apart from the rear part, with the inlet opening provided at a central portion of the front part, and the drain hole provided on an edge of the inlet opening of the front part, and a sidewall part which is closed and extends between the rear part and the front part wherein an inner diameter of the sidewall part increases along a direction from the rear part to the front part to allow an internal surface of the sidewall part to be inclined.

15. The drum washing machine of claim 14 wherein the drain hole comprising a plurality of rows of drain holes provided around an edge of the front part of the rotary drum.

16. The drum washing machine of claim 8 wherein the rotary drum comprising a rear part which is closed and coupled to a rotating shaft at a centre of the rear part, a front part spaced apart from the rear part, with the inlet opening provided at a central portion of the front part, and a sidewall part which is closed and extends between the rear part and the front part wherein an inner diameter of the sidewall part increases along a direction from the rear part to the front part to allow an internal surface of the sidewall to be inclined, the sidewall part having the drain hole which is provided on an edge of the side-

wall part adjacent to the front part.

17. The drum washing machine of claim 8 wherein the rotary drum comprising a rear part, with a rotating shaft coupled to a centre of the rear part, a front part spaced apart from the rear part, with the inlet opening provided at a central portion of the front part, and a sidewall part extending between the rear part and the front part wherein an inner diameter of the sidewall part increases along a direction from the rear part to the front part to allow an internal surface of the sidewall part to be inclined, the sidewall part being connected to the front part along a rounded junction surface, with the drain hole formed on the rounded junction surface.

18. A drum washing machine comprising a water tub to contain water therein and a rotary drum installed in the water tub by use of a rotating shaft and comprising an internal surface of the rotary drum being inclined relative to a rotating axis of the rotary drum so that an inner diameter of the rotary drum increases along a direction from a rear part coupled to the rotating shaft to a front part having an inlet opening, the rotary drum being closed around a sidewall part thereof, and a drain hole being provided on the rotary drum at a position adjacent to the inlet opening.

19. A drum washing machine comprising a water tub to contain water therein, a rotary drum included in the water tub to be inclined so that a front part of the rotary drum having an inlet opening is positioned to be higher than a rear part of the rotary drum coupled to a rotating shaft and comprising an internal surface of the rotary drum being inclined so that an inner diameter of the rotary drum increases along a direction from the rear part to the front part, and a drain hole provided on the rotary drum at a position adjacent to the inlet opening of the front part, a drive unit to drive the rotary drum and a water circulation unit to feed the water from the water tub into the rotary drum.

20. The drum washing machine of claim 16 wherein the drain hole comprising a plurality of drain holes provided on the edge of the sidewall part adjacent to the front part of the rotary drum.

21. The drum washing machine of claim 17 wherein the drain hole comprising a plurality of drain holes provided on the edge of the sidewall part adjacent to the front part of the rotary drum.

22. The drum washing machine of claim 18 wherein the drain hole comprising a plurality of drain holes provided on the edge of the sidewall part adjacent to the front part of the rotary drum.

23. The drum washing machine of claim 19 wherein the drain hole comprising a plurality of drain holes provided on the edge of the sidewall part adjacent to the front part of the rotary drum.

24. The drum washing machine of claim 8 further comprising a detergent supplying unit and a water supplying unit installed in a cabinet above the water to respectively feed each of a detergent and water into the water tub.

25. The drum washing machine of claim 24 wherein the detergent supply unit is placed at a front part of the cabinet to allow the user to feed the detergent into the water tub.

26. The drum washing machine of claim 24 wherein the water supply unit comprising a first water feed pipe which extends from an external water supply pipe to the detergent supply unit, a second water feed pipe which extends from the detergent supply unit to the water tub, and a control valve which is mounted to an intermediate portion of the first water feed pipe to control a flow of the water to be fed into the water tub.

27. The drum washing machine of claim 9 wherein the heater is installed in a heater holding part in which a predetermined amount of water is collected to a level to allow the heater to be submerged into the water.

28. The drum washing machine of claim 27 wherein the heater holding part has a pan-shaped appearance.

29. The drum washing machine of claim 12 wherein the drain pipe comprising a first drain pipe connected to a drain port provided at the lower portion of the water tub, and a second drain pipe which extends from an outlet of the drain pump and allows water to be drained to an outside of a cabinet.

30. A method of washing laundry in a drum washing machine, the method comprising feeding water into a water tub, stopping the water supplied into the water tub after a predetermined amount of water is fed into the water tub, holding the water in a heater holding part provided at a lower portion of a sidewall part of the water tub prior to feeding the water into rotary drum, feeding the water into the rotary drum, overflowing water from the rotary drum into the water tub when a level of the water in the rotary drum exceeds a height of a drain hole in a lowermost position on the rotary drum, circulating the water from the water tub to the rotary drum continuously so that the water tub contains a small amount of water therein, rinsing the laundry and spin-drying the laundry.

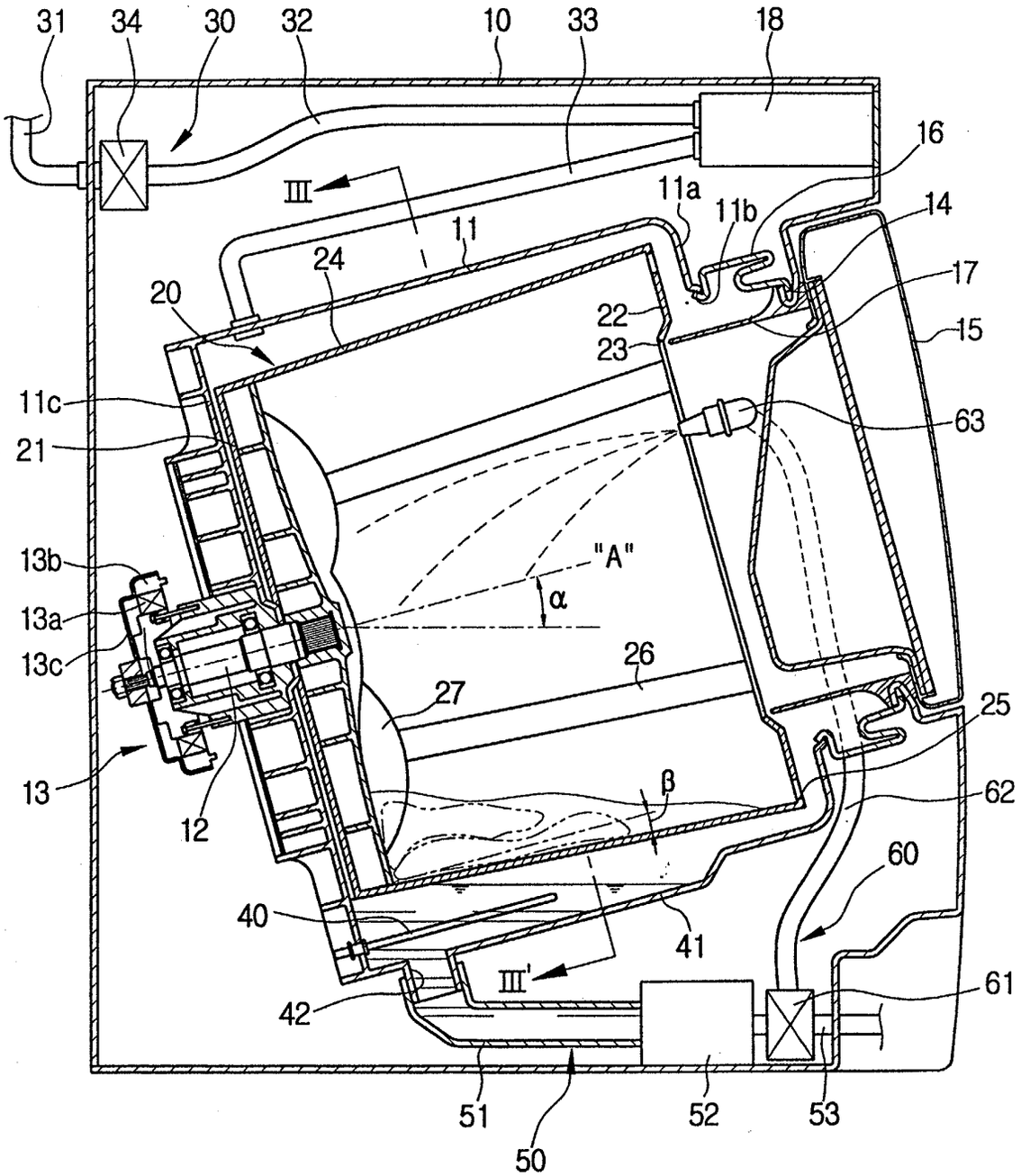
31. The method of claim 30 wherein the feeding water into the water tub comprising supplying water to a detergent supply unit prior to the water reaching the water tub due to coupling of the detergent supply unit and a water supply unit.

32. The method of claim 30 wherein the holding the water in the heater holding part comprising heating the water to a predetermined temperature using a heater.

33. The method of claim 30 wherein the feeding the water into the rotary drum comprising spraying the laundry contained in the rotary drum with water using a spray nozzle while simultaneously rotating the rotary drum at a low speed.

34. The method of claim 30 wherein the rinsing of the laundry comprising spin-drying the laundry wherein the rotary drum is rotated at a high speed and the water is spin-dried out of the laundry in the rotary drum to move radially outward to an internal surface of a sidewall of the rotary drum due to a centrifugal force and is secondarily guided to a plurality of drain holes provided on a front part of a rotary drum and discharged to the outside of the rotary drum through the plurality of drain holes and drained to an outside of a cabinet and supplying new water into the water tub to rinse the laundry.

FIG. 1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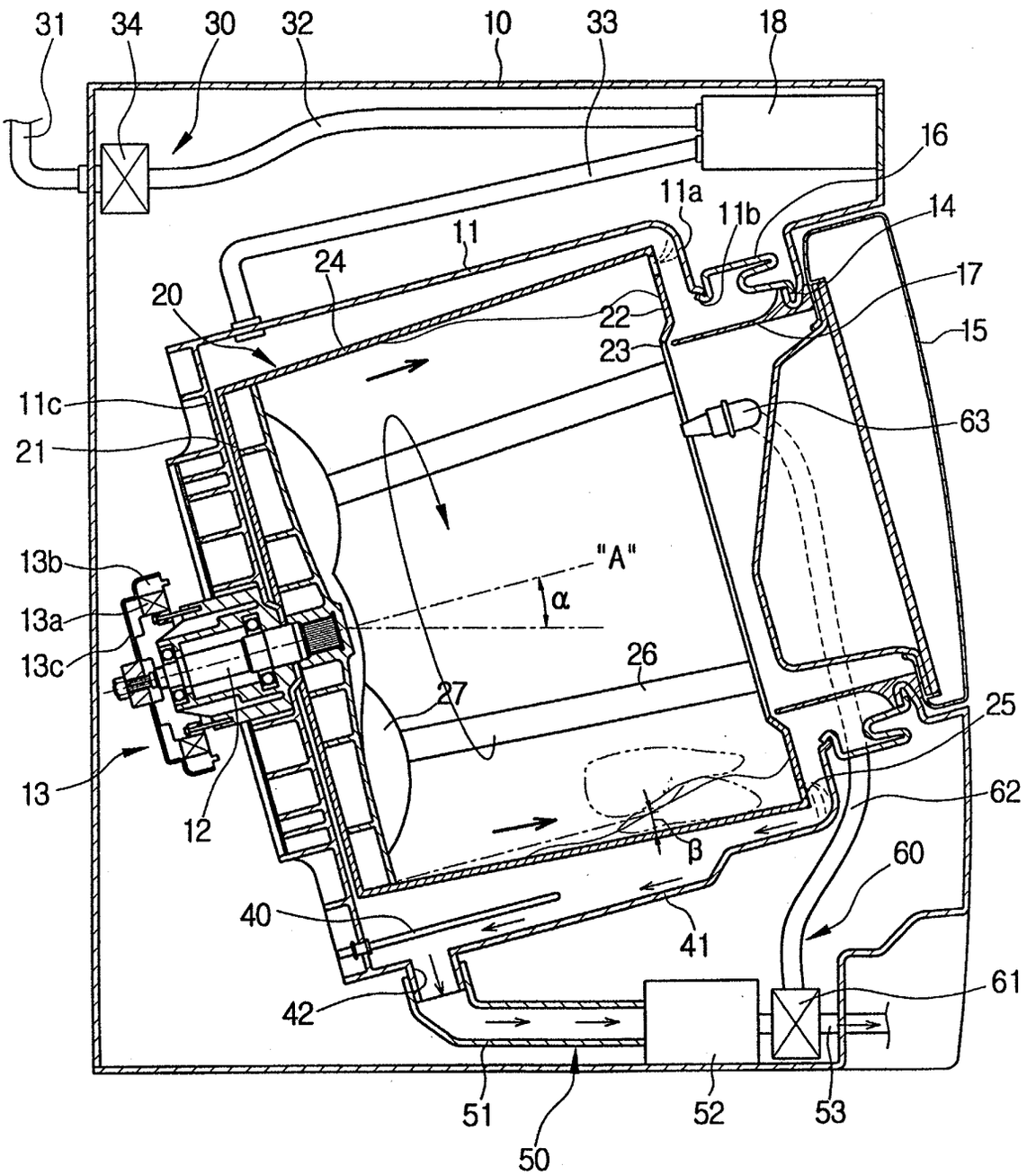
30
32
10
33
18
16
III
11a
11b
14
11
24
17
20
22
15
23
11c
63
21
"A"
13b
α
13a
13c
26
27
25
β
62
13
12
60
40
41
III'
61
42
51
50
52
53

FIG. 2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63
21
"A"
13b
α
13a
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β
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FIG. 3

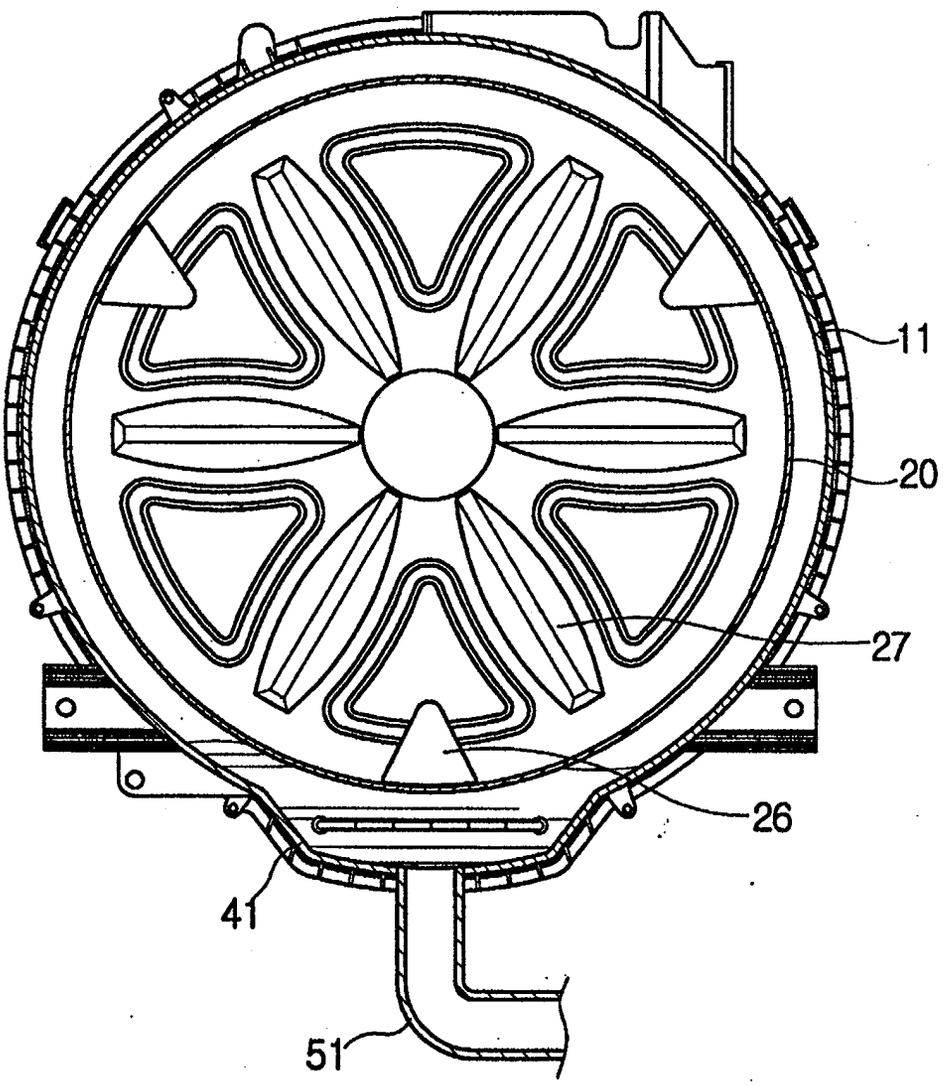

FIG. 4

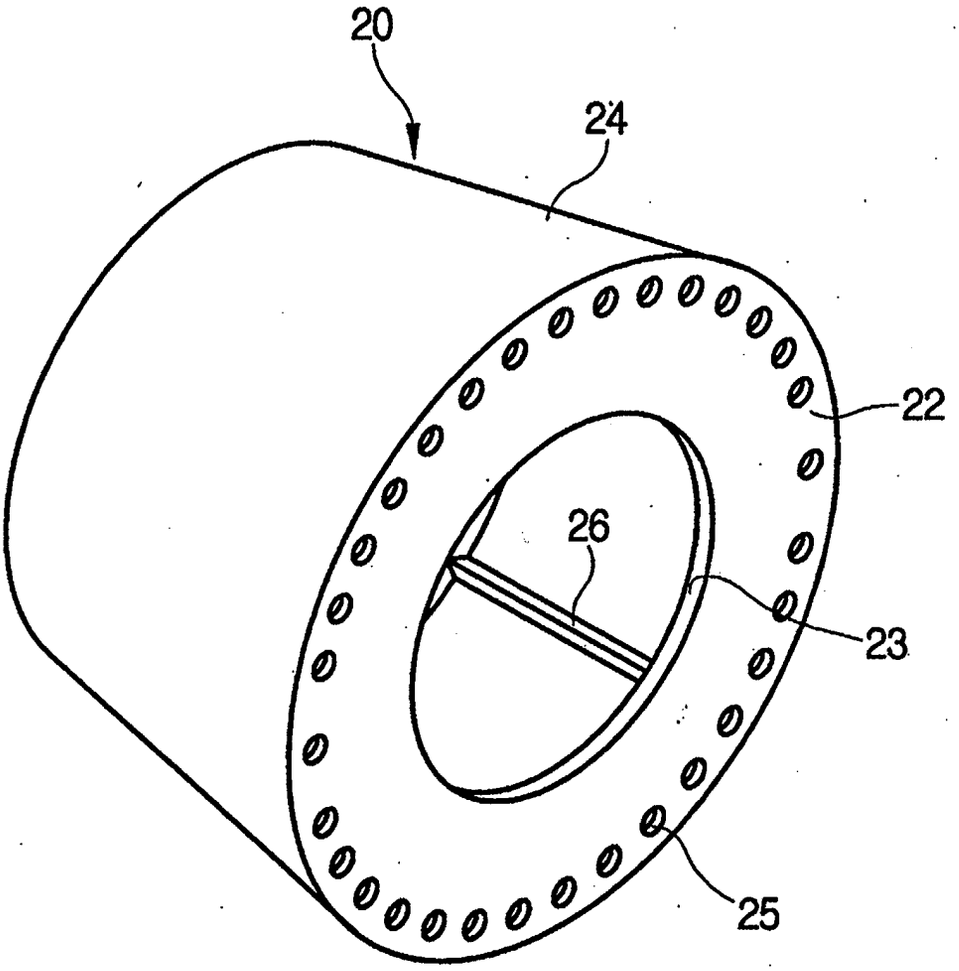

FIG. 5

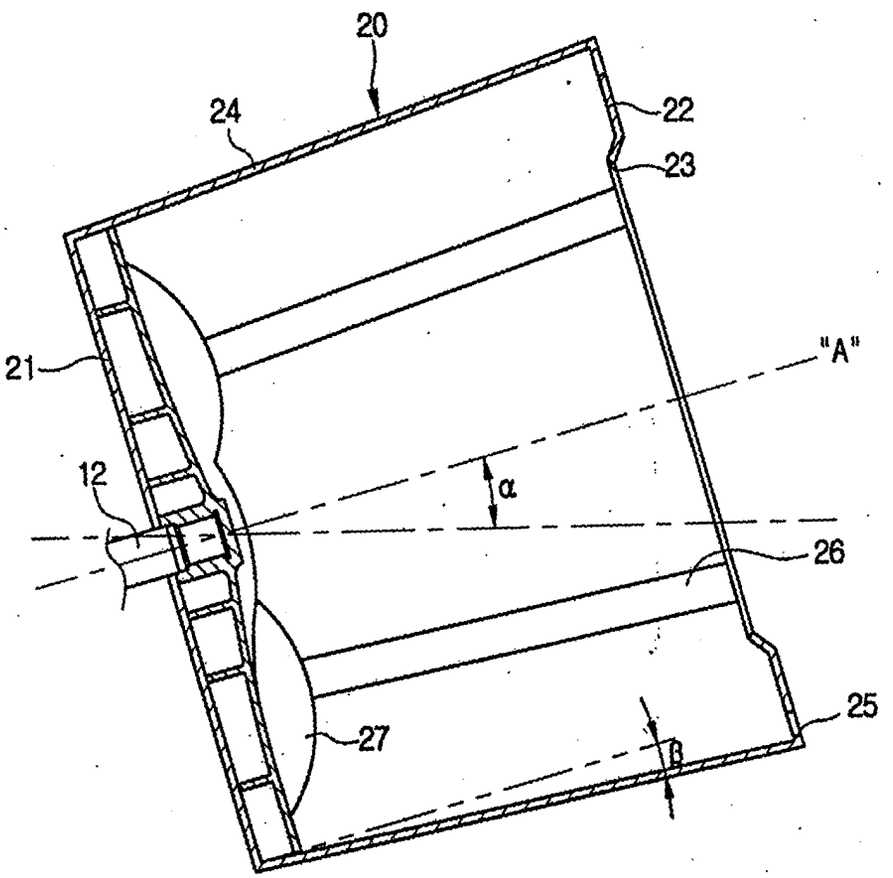

FIG. 6

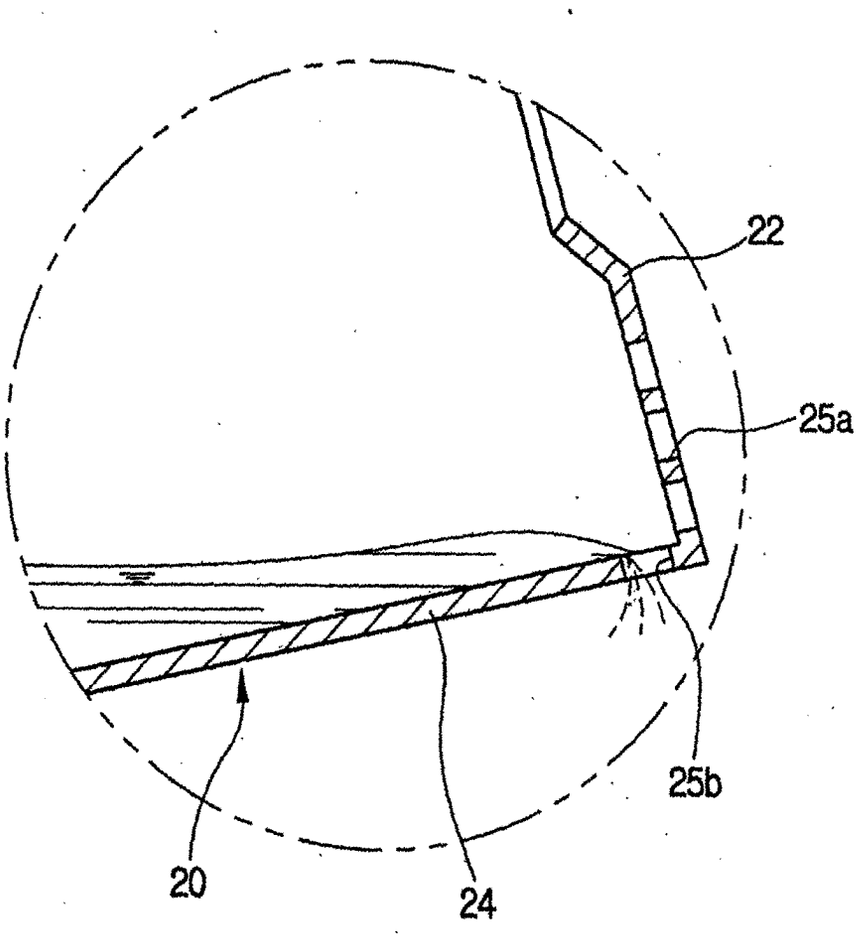

FIG. 7