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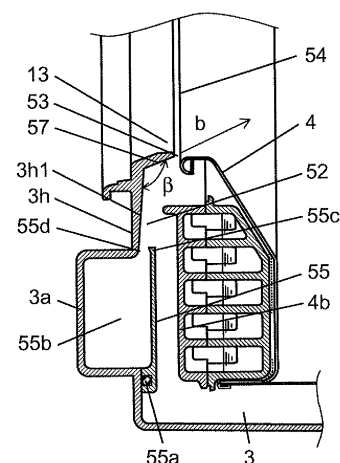
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(54) **DRUM TYPE WASHING MACHINE**

(57) A drum type washing machine of the present invention includes a cylindrical rotary drum with a bottom that has a first opening in the front side, a water tub with a second opening corresponding to the first opening, a motor for rotating the rotary drum, and a water circulating passage for pouring out washing water to a circulating passage connected to the water tub and pouring in the washing water to the rotary drum by a circulating pump so as to circulate the washing water. The rotary drum is installed in the water tub such that its rotating axis direction is set horizontal or tilted downward from the front to the back, which is the bottom part, with respect to the horizontal direction. The water circulating passage includes a headrace where the washing water passes, a nozzle provided in the headrace for discharging the washing water, and a flow path connected to the nozzle for discharging the washing water discharged from the nozzle into the rotary drum. The headrace is configured with a front wall of the water tub and a cover attached to the front wall of the water tub. The nozzle is configured between the cover and the front wall of the water tub.

FIG. 5B



Description**TECHNICAL FIELD**

5 **[0001]** The present invention relates to drum type washing machines that include a cylindrical rotary drum with a bottom that wash the laundry in the rotary drum by rotating the rotary drum. The rotary drum is installed in a water tub such that its rotating axis direction is tilted downward from the front with an opening to the back, which is the bottom, with respect to the horizontal level or horizontal direction.

10 **BACKGROUND ART**

[0002] In this type of washing machine, a drum type washing machine with a circulating function to circulate washing water in a water tub with a circulating pump is disclosed. (For example, PTL 1 and PTL2.)

15 **[0003]** In PTL 1, a circulating means pours the washing water into the rotary drum from the front side toward the center of the rotary drum via multiple jet holes provided at slightly different angles on a nozzle, so as to efficiently wash a large load of laundry.

[0004] In PTL 2, a pump casing of the circulating pump has two nozzles that alternate their discharge from clockwise to counterclockwise according to the direction of rotation of the pump impellers so that direction of poured washing water changes during washing and rinsing corresponding to the clockwise or counterclockwise rotation of the rotary drum.

20 **[0005]** In the water circulation technology disclosed in PTL 1, however, the nozzles are attached to packing on the front face of the drum or between the front door and the drum. This tends to catch the laundry inside the rotary drum, resulting in damages to the laundry.

25 **[0006]** In the water circulation technology disclosed in PTLs 1 and 2, a hose is used as a headrace from the pump discharge to the nozzle. This increases the number of components and materials required to secure reliability against shaking of the rotary drum while rotating, caused by the hose itself or unbalanced laundry during washing, rinsing, and spin-drying. Defects also occur in vibration isolation.

[Citation List]

30 Patent Literature

[0007]

PTL1 Japanese Patent Unexamined Publication H10-127978

35 PTL2 Japanese Patent Unexamined Publication No. 2008-073128

SUMMARY OF THE INVENTION

40 **[0008]** The present invention offers a drum type washing machine with high washing performance that adopts a highly-reliable and simple configuration. When circulating the water in a water tub using a circulating pump, the present invention increases the efficiency of discharge of circulating water from a circulating pump to laundry in a rotary drum via a discharge passage.

45 **[0009]** The drum type washing machine of the present invention includes a cylindrical rotary drum with a bottom and a first opening in the front side, a water tub with a second opening corresponding to the first opening, a motor for rotating the rotary drum, and a water circulating passage. The water circulating passage circulates the washing water in the water tub by making outflow of the washing water to a circulating passage connected to the water tub and thence inflow of the washing water to the rotary drum, driven by the circulating pump. The rotary drum is installed in the water tub such that its rotating axis is set horizontal or tilted downward from the front to the back, which is the bottom part, with respect to the horizontal direction. The water circulating passage includes a headrace through which the water passes,

50 a nozzle provided in the headrace for discharging the washing water, and a flow path connected to the nozzle for discharging the washing water discharged from the nozzle to inside the rotary drum. The headrace is configured with a front wall of the water tub and a cover attached to the front wall of the water tub. The nozzle is positioned between the cover and the front wall of the water tub.

55 **[0010]** The drum type washing machine of the present invention has the nozzle configured with the cover and an inner wall of the water tub. This enables pouring of the washing water to the laundry inside the rotary drum without employing a nozzle with special shape or configuration that risks catching the laundry inside the rotary drum. Accordingly, the laundry can be washed highly efficiently by the jet of washing water without damaging the laundry

BRIEF DESCRIPTION OF DRAWINGS

[0011]

- 5 Fig. 1 is a sectional view of a schematic structure of a drum type washing machine in accordance with a first exemplary embodiment of the present invention.
- Fig. 2A is a sectional view of a circulating pump employed in the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- 10 Fig. 2B is a side view of the circulating pump employed in the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- Fig. 3A is a perspective view of a key part of a water tub of the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- Fig. 3B is a plan view of a front wall of the water tub seen from inside the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- 15 Fig. 4 is a sectional view around a headrace of a water circulating passage of the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- Fig. 5A is a sectional view around a nozzle of the water circulating passage of the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- 20 Fig. 5B is a sectional view around another nozzle of the water circulating passage of the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- Fig. 6 is a front view of the front wall of the water tub seen from inside the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- Fig. 7 is a plan view of the front wall of the water tub seen from inside drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- 25 Fig. 8A is a sectional view around the nozzle of the water circulating passage of the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- Fig. 8B is a sectional view around another nozzle of the water circulating passage of the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- Fig. 9A is a plan view of the front wall of the water tub seen from inside the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- 30 Fig. 9B is a plan view of the front wall of the water tub seen from inside the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- Fig. 10A is a sectional view of the headrace around a flow adjuster of the water circulating passage of the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- 35 Fig. 10B is a sectional view of the headrace and a cover near the flow adjuster and the outlet of the drum type washing machine in accordance with the first exemplary embodiment of the present invention.
- Fig. 11A is a sectional view around a nozzle of a drum type washing machine in accordance with a second exemplary embodiment of the present invention.
- Fig. 11B is a sectional view around another nozzle of a water circulating passage the drum type washing machine in accordance with the second exemplary embodiment of the present invention.
- 40 Fig. 12 is a sectional view near a nozzle of a water circulating passage of a drum type washing machine in accordance with a third exemplary embodiment of the present invention.
- Fig. 13 is a sectional view around a nozzle of a water circulating passage of a drum type washing machine in accordance with a fourth exemplary embodiment of the present invention.
- 45 Fig. 14A is a magnified sectional view around a nozzle of a water circulating passage of a drum type washing machine in accordance with a fifth exemplary embodiment of the present invention.
- Fig. 14B is a magnified sectional view around another nozzle of the water circulating passage of a drum type washing machine in accordance with the fifth exemplary embodiment of the present invention.
- 50 Fig. 15 is a sectional view near a nozzle of a water circulating passage of a drum type washing machine in accordance with a six exemplary embodiment of the present invention.
- Fig. 16 is a sectional view near a headrace of a water circulating passage of a drum type washing machine in accordance with a seventh exemplary embodiment of the present invention.
- Fig. 17 is a sectional view around a headrace of a water circulating passage of a drum type washing machine in accordance with an eighth exemplary embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0012] Exemplary embodiments of the present invention are described below with reference to drawings. However,

a scope of the present invention is not limited to the description below.

(FIRST EXEMPLARY EMBODIMENT)

[0013] Fig. 1 is a sectional view of a schematic configuration of a drum type washing machine in the first exemplary embodiment of the present invention. Fig. 2A is a sectional view of a circulating pump employed in the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 2B is a side view of the circulating pump employed in the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 3A is a perspective view of a key part of a water tub of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 3B is a plan view, seen from inside, of a front wall of the water tub of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 4 is a sectional view around a headrace of a water circulating passage of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 5A is a sectional view around a nozzle of the water circulating passage of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 5B is a sectional view around another nozzle of the water circulating passage of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 6 is a front view of illustrating a pouring state of washing water in the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 7 is a plan view, seen from inside, of the front wall of the water tub of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 8A is a sectional view around the nozzle of the water circulating passage of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 8B is a sectional view around another nozzle of the water circulating passage of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 9A is a plan view, seen from inside, of the front wall of the water tub of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 9B is a plan view, seen from inside, of the front wall of the water tub of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 10A is a sectional view of the headrace near a flow adjuster of the water circulating passage of the drum type washing machine in the first exemplary embodiment of the present invention. Fig. 10B is a sectional view of the flow adjuster, and the headrace and a cover around the nozzle of the drum type washing machine in the first exemplary embodiment of the present invention.

[0014] The drum type washing machine in this exemplary embodiment is a drum type washer and dryer that automatically controls motor 6, supply system 7, drain system 8, and drying system 9 shown in Fig. 1 according to mode setting and control programs; and at least includes functions for executing a washing step, rinsing step, spin-drying step, and drying step. However, drying system 9 can be omitted. This exemplary embodiment also includes functions for encouraging early dissolution or preventing imbalanced dissolution of detergent, and improving washing and rinsing performance by circulating the washing water in water tub 3 using water circulating passage 16.

[0015] Water supply system 7 supplies water as appropriate indicated by an arrow in solid line by opening and closing a solenoid valve (not illustrated). Detergent in a detergent case (not illustrated) can also be provided to water tub 3 as appropriate by using water supply. Drain system 8 can drain water in water tub 3 as indicated by an arrow in dotted line by opening and closing drain valve 19 when required such as when the washing step or rinsing step is completed. Water circulating passage 16 repeats vacuuming up the washing water in water tub 3 and returning the washing water into water tub 3 via discharge passage 16b using circulating pump 20.

[0016] Modes such as operation courses and functions are selected by input to control panel 21 provided on the front top face of body 2. Control system 22 controls a display on control panel 21 based on information input to control panel 21, and provides information to the user by a range of indications. If an operation start is set using an input setting part of control panel 21, a water detector for detecting a water level in water tub 3 outputs data to control system 22, and driving starts. Then, control system 22 controls the operation typically of the drain valve and supply valve, and execute operations such as washing, spin-drying, and drying.

[0017] Main opening 2b is provided on the front side (left side in Fig. 1) of body 2. Laundry can be loaded into and taken out from rotary drum 4 through second opening 13 provided on the front side of water tub 3 and first opening 54 provided on the front side of rotary drum. Openable door 5 is provided on main opening 2b. Second opening 13 of water tub 3 can be tightly sealed or opened by opening and closing this openable door 5 via sealing material 14 attached to a rim of second opening 13.

[0018] Driving modes of rotary drum 4 include a forward reverse arc rotary drive mode and a forward reverse continuous rotary drive mode. The forward reverse arc rotary drive mode is a mode that alternately repeats fast forward arc rotation and fast reverse arc rotation of rotary drum 4 at a rotating angle between 90° and 180°. The forward reverse continuous rotary drive mode is a mode that alternately repeats forward and reverse continuous rotations of rotary drum 4 at a rotating speed exceeding the centrifugal force developed by the rotation of rotary drum 4 acting on own weight of laundry tossed up by the rotation of rotary drum 4.

[0019] In the washing step, or washing step and rinsing step, the forward reverse arc rotary drive mode and the forward reverse continuous rotary drive mode are executed alternately. During the forward reverse arc rotary drive mode, fast-

speed arc rotation in a rotating-angle range between 90° and 180° and sudden breaking are applied to rotary drum 4. This enables lifting of the laundry at a rotating angle over 90° up to 180°. In addition, by sudden breaking at the last stage of lifting laundry, the laundry is reliably removed from the inner face of rotary drum 4 by its inertia and own weight, and dropped to the side horizontally opposite to the lifted side. Accordingly, a particularly high disentanglement effect can be applied to the laundry that is fully swollen by containing the washing water, and also loosened and slippery. Still more, a mechanical force that can be applied to the laundry increases the washing performance. Still more, the lifting position and dropping position of laundry can be switched horizontally every time during arc rotary drive by alternately repeating the fast forward arc rotation in the forward direction and the fast reverse arc rotation in the reverse direction. This can further increase the disentanglement effect while further preventing entangling of the laundry. In addition, the number of times of mechanical force applied to the laundry can be increased, improving the washing performance. Furthermore, a high disentanglement effect suppresses entangling of clothes that may occur in the course of washing and rinsing steps. Accordingly, effective beat-wash is continuously executed in the forward reverse arc rotary drive mode, so as to increase the washing effect and rinsing effect.

[0020] However, although entangling, twisting, and wrinkling of laundry can be reduced, vertical positions of laundry hardly change if only the forward reverse arc rotary drive mode is executed. Laundry at the bottom of rotary drum 4 does not move so much. This tends to cause uneven washing of laundry, but it can be improved by also executing the forward reverse continuous rotary drive mode. In other words, the forward reverse continuous rotary drive mode can change vertical positions of laundry and reduce entangling, twisting, and wrinkling of laundry. This mode can also reduce imbalanced application of mechanical force to the laundry that may occur in the forward reverse arc rotary drive mode. In other words, by using both forward reverse arc rotary drive mode and forward reverse continuous rotary drive mode, two different behaviors can be given to the laundry during washing and rinsing. More specifically, the forward reverse arc rotary drive mode reduces entangling, twisting, and wrinkling of laundry and also gives firm hand-washing behavior to the laundry. On the other hand, the forward reverse continuous rotary drive mode reduces imbalanced washing by continuously and broadly moving the laundry during washing to give a washing behavior effective for heavily and evenly soiled clothes.

[0021] Circulating pump 20 is fixed on base plate 2a. Discharge passage 16b from circulating pump 20 in water circulating passage 16 extends toward the front of body 2 where second opening 13 of water tub 3 exists. More specifically, as shown in Figs. 2A and 2B, impeller 20a is housed in resin pump casing 20b in circulating pump 20. An open side of pump casing 20b is attached to bearing wall 20d1 at the front end of motor casing 20d of circulating motor 20c, and thus pump casing 20b is integrated with motor casing 20d. This directly connects impeller 20a to motor shaft 20e. Circulating pump 20 as formed above is tightened to resin attachment seat 35.

[0022] Water circulating passage 16 includes headrace 55b where the washing water passes, nozzle 55d provided in the headrace for discharging the washing water, and flow path 52 connected to nozzle 55d for discharging the washing water discharged from nozzle 55d into the rotary drum. As shown in Figs. 3A and 3B, substantially Y-shaped expanded portion 3a protruding toward the front (outward, to the front in Fig. 3A) of the body is formed at a lower half part of front wall 3h of water tub 3. Cover 55 that has substantially the same outer shape as expanded portion 3a is attached from inside of expanded portion 3a to an inner face of front wall 3h typically by screwing with packing 55a in between. Expanded portion 3a and cover 55 thus forms headrace 55b. Accordingly, headrace 55b is disposed extending horizontally (to the left and right direction when seen from the front of the body) toward first opening 54 of rotary drum 4.

[0023] The lower end of expanded portion 3a is connected to one end of connecting part 51 extending horizontally. The other end of connecting part 51 is connected to discharge passage 16b of water circulating passage 16. The washing water can thus run from discharge passage 16b to headrace 55b.

[0024] Cover 55 also covers connecting space 51a of connecting part 51 between pipe (discharge passage 16b) from circulating pump 20 and headrace 55b. Since cover 55 also covers connecting space 51a of connecting part 51, restrictions on position or structure of connecting part 51, due to design factors or mold structure, can be easily solved.

[0025] Notch 55c without sealing structure is formed at left and right of an upper end of substantially Y-shaped cover 55, respectively. This forms nozzle 55d with opening extending in the circumferential direction between notch 55c and a corresponding rear face (inner face) of front wall 3h of water tub 3. Nozzles 55d are provided in an end part to the left and right of headrace 55b, respectively, with respect to a line passing the center of first opening 54 of rotary drum 4 that is perpendicular to an installation face.

[0026] The washing water pressurized by circulating pump 20 reaches headrace 55b from connecting part 51 via discharge passage 16b of water circulating passage 16. The washing water reaching headrace 55b is poured from nozzle 55b to between the rear face (inner face) of front wall 3h of water tub 3 and a corresponding outer face of front wall 4b of rotary drum 4. The washing water is then discharged into rotary drum 4 through flow path 52 formed by the rear face (inner face) of front wall 3h of water tub 3 and the outer face of front wall 4b of rotary drum 4.

[0027] Nozzle 55d is opened in a direction of a central rotating axis of rotary drum 4, as shown in Fig. 5A. More particularly, nozzle 55d is opened toward ring jet hole 53 in flow path 52. Accordingly, the washing water poured from nozzle 55d is efficiently discharged toward the central rotating axis of rotary drum 4, i.e., toward jet hole 53, from flow

path 52 to an inner rotation area of rotary drum 4 in a radial direction. The washing water can thus be efficiently supplied regardless of the volume of laundry.

[0028] Front wall 3h also includes tilt face 3h1 tilted to the back of body 2 toward the inner circumferential direction of the washing machine from a position corresponding to nozzle 55d. Furthermore, guide face 52 extends in tilted manner from an end of this tilt face 3h1 at inside the washing machine (right side in Fig. 5A) toward first opening 54 of rotary drum 4. As shown in Fig. 5A, this enables the washing water poured into flow path 52 to pass along tilt face 3ha and guide face 56, and then discharged from jet hole 53 to the back of rotary drum 4 via first opening 54 of rotary drum 4. Accordingly, an efficiency of the washing water supplied to laundry can be increased.

[0029] As shown in Figs. 5A and 5B, guide faces 56 and 57 with different tilt angles are provided in multiple nozzles, respectively. For example, as shown in Fig. 5A, a tilt angle of guide face 56 corresponding to nozzle 55d to the left when seen from the front of branched headrace 55b (right side in Fig. 3B) is set to α . As shown in Fig. 5B, a tilt angle of guide face 57 corresponding to nozzle 55d to the right when seen from the front of headrace 55b (left side in Fig. 3B) is set to β , and $\alpha > \beta$. Here, the tilt angle is an angle between tilt face 3h1 and guide face 56 or guide face 57. This configuration makes the washing water from jet hole 53 to the left when seen from the front (arrow a in Fig. 5A) poured relatively upward in shower form A. On the other hand, the washing water from jet hole 53 to the right when seen from the front (arrow b in Fig. 5B) poured in shower form B that is lower than shower form A. In other words, the washing water poured from each of nozzles 55d pass along guide faces 56 and 57 with different tilt angles, and is poured into rotary drum 4 from jet hole 53 via first opening 54. Therefore, the washing water can be poured at different jet angles with respect to the central rotating axis of rotary drum 4.

[0030] The tilt angle described above also affects how poured washing water spreads in rotary drum 4. If the tilt angle is small, (e.g., the case of configuration shown in Fig. 5B), the washing water that passes along tilt face 3h1 sharply changes its angle on guide face 57 around an area where the angle changes from tilt face 3h1 to guide face 57. Therefore, the washing water hits against guide face 57. This condition generates a stream of water along a tilt direction of guide face 57 (e.g., flow in arrow a direction in Fig. 5A) and also a stream of water spreading in a circumferential direction (direction along flow path 52). This makes the washing water poured spreading in the circumferential direction in the washing machine. In other words, as shown in Fig. 6, the washing water in shower form B from jet hole 53 to the right with tilt angle β (in the relationship of $\alpha > \beta$ as described above) is poured broader in the circumferential direction than that of the washing water in shower form A from jet hole 53 to the left with tilt angle α . Based on inventors' test results, the washing water spreads broader up to close to the tilt angle of 120° , and then the washing water spreads narrower at the tilt angle of 130° or greater.

[0031] In addition, as shown in Fig. 7, a jet width or volume of the washing water discharged from each nozzle 55d can be changed by changing an opening width of nozzle 55d. In Fig. 7, nozzle 55d to the left of the body (left side in Fig. 7) has opening width D1, and nozzle 55d to the right (right side in Fig. 7) has opening width D2. ($D1, > D2$)

[0032] However, the opening width of nozzle 55d is not limited to above D1 or D2. Any width can be set as appropriate.

[0033] The above configuration enables pouring of water from nozzles 55d in different widths and volumes, and the washing water is discharged toward the back (bottom side of rotary drum) of rotary drum 4 along guide face 56, and through jet hole 53 and first opening 54 of rotary drum 4. Accordingly, the flow volume and spreading angle of the washing water can be set optimally in response to a capacity of laundry. The washing effect can thus be increased, and also the washing water can be efficiently supplied to the laundry to achieve water conservation.

[0034] Still more, as shown in Figs. 8A and 8B, nozzle 55d is opened in a predetermined circumferential range toward the central rotating axis of rotary drum 4. An opening width of nozzle 55d in the rotating axis direction (e.g., D3 in Fig. 8A and D4 in Fig. 8B, $D3 < D4$) determines the waterjet volume. Therefore, by setting two or more types of width in the rotating axis direction for the opening of nozzle 55d, the washing water can be poured in different flow volumes from each of jet holes 53.

[0035] Furthermore, as shown in Fig. 9A, the opening direction (arrow c) of nozzle 55d1 to the right of the body (right side in Fig. 9A) is shifted upward for predetermined angle ξ with respect to central rotating axis o of rotary drum 4. The washing water is thus discharged from nozzle 55d1 with its center (arrow c) shifted for predetermined angle ξ with respect to central rotating axis o of rotary drum 4. Therefore, the washing water is poured from jet hole 53 with the jet center (arrow c) with predetermined angle ξ with respect to rotating center o of rotary drum 4. Guide face 56 is configured annularly centering on rotating center o of rotary drum 4. Accordingly, a stream of water becomes gentle as the opening direction of nozzle 55d1 is more shifted from rotating center o of rotary drum 4, although a cross-sectional shapes of guide faces 56 where the washing water poured from nozzles 55d1 are the same. This encourages spreading of the washing water in the circumferential direction, and thus the washing water can be poured at a large spreading angle.

[0036] The center of discharge (arrow d) of nozzle 55d to the left of the body (left side in Fig. 9A) is opened toward central rotating axis o of rotary drum 4. This configuration achieves pouring of the washing water with different spreading jet forms from nozzles 55d and 55d1 to the left and right, respectively.

[0037] Furthermore, as shown in Fig. 9B, nozzle 55d2 to the left of the body (left side in Fig. 9B) may have guide portion 65 for shifting upward the opening direction (arrow e) of discharge 55d2 for predetermined angle σ with respect

to central rotating axis o of rotary drum 4. This makes the washing water discharged from nozzle 55d2 with its discharge center (arrow e) shifted for predetermined angle σ with respect to central rotating axis o of rotary drum 4. Accordingly, the washing water is poured from jet hole 53 to the jet center (arrow e) shifted for predetermined angle σ with respect to central rotating axis o of rotary drum 4. Guide face 57 is configured annularly centering on central rotating axis o of rotary drum 4. A stream of water becomes gentle as the jet center is shifted greater from rotating center o of rotary drum 4, although cross-sectional shapes of guide faces 57 where the washing water poured from nozzles 55d2 pass are the same with respect to the central rotating axis. This encourages spreading of the washing water in the circumferential direction, and thus the washing water can be poured at a large spreading angle.

[0038] Furthermore, as shown in Figs. 9A, 9B, 10A, and 10B, rib 66 that overlaps with nozzle 55d in the flow direction of the washing water is provided in cover 55 near a downstream side of at least one of nozzles 55d in headrace 55b. Normally, if rib 66 is not provided, the washing water passing along headrace 55b tends to be discharged with an angle in a long-hand direction of headrace 55b with respect to the opening direction of discharge 55d and guide portion 65 due to an influence of a velocity component in the long-hand direction of headrace 55b when the washing water is discharged from nozzle 55d. In the first exemplary embodiment, as described above, rib 66 overlapped with nozzle 55d in the washing water flow direction is provided near nozzle 55d (upstream of nozzle 55d) in headrace. Accordingly, the velocity component of the washing water in the long-hand direction of headrace 55b discharged from nozzle 55d is suppressed because the washing water passing along headrace 55b hits against rib 66. The washing water can thus be discharged from nozzle 55d at a predetermined angle in the opening direction. The washing water can be reliably poured at a large predetermined spreading angle.

[0039] The above configuration enables pouring of the washing water from multiple jet holes 53 at different jet angles with respect to the central rotating axis of rotary drum 4, and also at different spreading angles for the washing water from each jet hole 53. Accordingly, an optimal jet angle of washing water can be set depending on low or high laundry load.

[0040] For example, let's say the laundry not soaked with the washing water at starting washing is voluminous and is covering jet hole 53 to the left shown in Fig. 6 in the circumferential direction. Also in this case, jet hole 53 to the right of the body pours the washing water greatly spread toward near first opening 54 of rotary drum, so as to reduce the volume of laundry near jet hole 53 quickly and solve closure of jet hole 53 to the left by the laundry.

[0041] In addition, the washing water is poured from jet hole 53 to the left in Fig. 6 in the central axis direction of rotary drum 4 at a narrower angle toward the back of rotary drum 4, so as to quickly soak the laundry at the back where it is difficult to soak by pouring the water from jet hole 53 to the right with broader jet angle. This increases the effect of the washing water, and also reduces the volume of laundry by making more washing water penetrate the laundry at the back behind the center. Accordingly, the laundry in rotary drum 4 becomes easily movable quickly, and thus the beat-wash effect also improves. In addition, the washing water can be poured to the entire laundry through spaces created by reducing the laundry volume. This synergistically increases the washing effect.

[0042] By the above effects, detergent can effectively act on the laundry in rotary drum 4, regardless of laundry volume. Since nozzle 55d is disposed at a position not making contact with the laundry in rotary drum 4, disturbance of movement needed for washing or rinsing by catching the laundry, or damaging or tearing the laundry can be prevented. In addition, good appearance will not be degraded. The jet effect of the washing water increases by combination of vertical shuffling of laundry in the forward reverse continuous rotary drive mode and horizontal shuffling of laundry in the forward reverse arc rotary drive mode.

[0043] In the first exemplary embodiment, nozzles 55d are provided at two points to the left and right. However, it is apparent that the same effect is applicable when nozzles 55d are provided at three or more positions.

[0044] In this exemplary embodiment, one headrace 55b is provided, but multiple headraces are also acceptable.

[0045] The present invention may also include multiple headraces 55b and nozzles 55d, and those branched from circulating pump 20 may be connected to connecting part 51 of each headrace 55.

(SECOND EXEMPLARY EMBODIMENT)

[0046] Fig. 11A is a sectional view around a nozzle of a water circulating passage of a drum type washing machine in the second exemplary embodiment of the present invention. Fig. 11B is a sectional view around another nozzle of the water circulating passage of the drum type washing machine in the second exemplary embodiment. Components same as those of the first exemplary embodiment are given the same reference marks to omit their description.

[0047] As shown in Figs. 11A and 11B, guide faces 58 and 59 are curved, and they have different curving radii against left and right nozzles 55d. For example, as shown in Fig. 11A, a curving radius of guide face 58 corresponding to nozzle 55d to the left when seen from the front of branched headrace 55b (right side in Fig. 3B) is set to γ . As shown in Fig. 11B, a curving radius of guide face 59 corresponding to nozzle 55d to the right when seen from the front of headrace 55b (left side in Fig. 3B) is set to δ , and $\gamma > \delta$. As shown in Fig. 6, the washing water from jet hole 53 to the left when seen from the front (arrow f in Fig. 11A) is poured relatively upward in shower form A. On the other hand, the washing water from jet hole 53 to the right when seen from the front (arrow g in Fig. 11B) is poured in shower form B

that is downward compared to shower form A. In other words, the washing water sprayed from each of nozzles 55d passes along guide faces 58 and 59 with different curving radiuses, and is poured into rotary drum 4 via jet hole 53 and then first opening 54. Therefore, the washing water can be poured at different angles with respect to the rotating axis of rotary drum 4.

[0048] The curving radius also affects spreading of spray. If the curving radius is small, a stream of washing water along tilt face 3h1 sharply changes its angle at curving of guide face 59 in an area changing from tilt face 3h1 to guide face 59. Therefore, the washing water hits against guide face 59. This condition generates a stream of water along guide face 59 and also a stream of water spreading in the circumferential direction, and thus the washing water spreads. In other words, as shown in Fig. 6, the washing water poured from jet hole 53 to the right in shower form B, which has tilt angle δ spreads more than the washing water poured from jet hole 53 to the left in shower form A with curving radius γ (in a aforementioned relationship of $\gamma > \delta$).

[0049] Accordingly, the second exemplary embodiment has an effect equivalent to that of the first exemplary embodiment.

THIRD EXEMPLARY EMBODIMENT

[0050] Fig. 12A is a sectional view around a nozzle of a water circulating passage of a drum type washing machine in the third exemplary embodiment of the present invention. Components same as those of the first exemplary embodiment are given the same reference marks to omit their description.

[0051] As shown in Fig. 12, curved face 60 connects tilt face 3h1 and guide face 61 with different tilt angles. With this configuration, the washing water discharged from nozzle 55d smoothly passes to guide face 61 with different tilt angle from tilt face 3h1 via curved face 60, and thus the washing water is more reliably poured from jet hole 53.

[0052] The jet angle for pouring the washing water with respect to the rotating axis of rotary drum 4 is determined by the tilt angle of guide face 61. The jet spreading angle can be determined by the curving radius of curved face 60. Therefore, the jet angle with respect to the central rotating axis and the jet spreading angle can be separately adjusted. Accordingly, the jet angle can be raised while broadening the spray spreading angle, or the jet angle can be laid while suppressing the spray spreading angle. By providing two or more shapes for curved face 60 and guide face 61, the washing water can be sprayed from each jet hole in different jet angle against the rotating axis of the rotary drum or at different spray spreading angle.

FOURTH EXEMPLARY EMBODIMENT

[0053] Fig. 13 is a sectional view around a nozzle of a water circulating passage of a drum type washing machine in the fourth exemplary embodiment of the present invention. Components same as those in the first exemplary embodiment are given same reference marks to omit their description.

[0054] As shown in Fig. 13, a guide face is configured with faces with multiple tilt angles in the fourth exemplary embodiment.

[0055] In Fig. 13, guide face 62 is configured with face 62a that has tilt angle ϵ against tilt face 3h1 and face 62b that has tilt angle ξ against tilt face 3h1. First, tilt face 3h1 is connected to face 62a with tilt angle ϵ via curved face 60. In this way, area changing from tilt face 3h1 to guide face 62 has small tilt angle ϵ to suddenly change the angle of the washing water passing along tilt face 3h1 at guide face 62, so as to spread the stream of washing water by making the washing water hit against guide face 62. Face 62a is connected to face 62b that has tilt angle ζ larger than tilt angle ϵ . This face 62b realizes waterjet with large jet angle with respect to the rotating axis of rotary drum 4. If the stream of washing water against face 62b is detached, and discharge becomes unstable, due to a large difference between tilt angle ϵ and tilt angle ζ , another face with an intermediate tilt angle may be added between face 62a and face 62b. These shapes can also suppress uneven thickness around faces 62a and 62b. The guide face may be configured with faces with multiple tilt angles so as to discharge water with a large jet angle and in wide stream with respect to the rotating axis of rotary drum 3.

FIFTH EXEMPLARY EMBODIMENT

[0056] Fig. 14A is a magnified sectional view around a nozzle of a water circulating passage of a drum type washing machine in the fifth exemplary embodiment of the present invention. Fig. 14B is a magnified sectional view around another nozzle of a water circulating passage of the drum type washing machine in the fifth exemplary embodiment of the present invention.

Components same as those of the first exemplary embodiment are given same reference marks to omit their description.

[0057] As shown in Fig. 14A, the jet angle of the washing water with respect to the rotating axis of rotary drum 4 is determined by an extension line or tangential direction of guide face 62 near first opening 54. Therefore, the jet angle

may be changed by providing chamfered shape 67 with a predetermined angle to an edge of face 62b of guide face 62. Chamfered shape 67 also has an effect of preventing damage or breakage of the laundry. In the same way, chamfered shape 67 may be round shape 68, as shown in Fig. 14B.

SIXTH EXEMPLARY EMBODIMENT

[0058] Fig. 15 is a sectional view around a nozzle of a water circulating passage of a drum type washing machine in the sixth exemplary embodiment of the present invention. Components same as those in the first exemplary embodiment are given same reference marks to omit their description.

[0059] As shown in Fig. 15, a guide face may be configured by gradually changing tilt faces 64 and 64a with multiple tilt angles; curved faces 60, 60a, 60b, and 60c; and edge taking into account spreading of waterjet, jet angle, waterjet stability, damage to laundry, breakage, and uneven thickness. In other words, intended discharge of washing water can be achieved and damage to laundry can be prevented by combining guide faces or curved faces with multiple tilt angles and edge shape described in each of aforementioned exemplary embodiments.

SEVENTH EXEMPLARY EMBODIMENT

[0060] Fig. 16 is a sectional view around a headrace of a water circulating passage of a drum type washing machine in the seventh exemplary embodiment of the present invention. Components same as those in the first exemplary embodiment are given same reference marks to omit their description.

[0061] As shown in Fig. 16, expanded portion 55f protruding toward rotary drum 4 is provided in cover 55 in headrace 55e. This expanded portion 55f enables to make a cross-sectional area of headrace 55e larger than a cross-sectional area of headrace 55b in the first exemplary embodiment. If the cross-sectional area of headrace 55e is the same as that of headrace 55b, an expanded volume of expanded portion 3a to the front of water tub 3 can be suppressed by providing expanded portion 55f. Accordingly, more compact water circulating passage 16 with less pressure drop is achievable.

EIGHTH EXEMPLARY EMBODIMENT

[0062] Fig. 17 is a sectional view around a headrace of a water circulating passage of a drum type washing machine in the eighth exemplary embodiment of the present invention. Components same as those in the first exemplary embodiment are given same reference marks to omit their description.

[0063] As shown in Fig. 17, headrace 55h is configured via welded portion 55g made by vibration welding or ultrasonic welding between cover 55 and the inner wall of water tub 3. This configuration eliminates fixing typically by sealing material or screw. A simple structure achieves efficient pouring of the washing water pressurized by the circulating pump without any leakage. Accordingly, highly efficient washing is achieved at low costs.

INDUSTRIAL APPLICABILITY

[0064] The drum type washing machine of the present invention circulates water in the water tub by the circulating pump, and discharges the water without adopting a special shape or configuration for a jet hole that may catch laundry inside the rotary drum. The washing effect can be increased by increasing the discharge efficiency of circulating water toward the laundry in the rotary drum without damaging the laundry. Accordingly, the present invention is effectively applicable typically to drum type washing machines for washing laundry in the rotary drum by rotating the cylindrical rotary drum with a bottom installed in the water tub such that its rotating axis direction is tilted downward from the front with opening to the back, which the bottom, with respect to the horizontal level or horizontal direction.

REFERENCE MARKS IN THE DRAWINGS

[0065]

2	Body
2a	Base plate
3	Water tub
3a	Expanded portion
3h	Front wall
3h1	Tilt face
4	Rotary drum
4b	Front wall

5	Openable door
6	Motor
7	Water supply system
8	Drain system
5 9	Drying system
13	Second opening
14	Sealing material
16	Water circulating passage
16b	Discharge passage
10 19	Drain valve
20	Circulating pump
20a	Impeller
20b	Pump casing
20c	Circulating motor
15 20d	Motor casing
20d1	Bearing rib
20e	Motor shaft
21	Control panel
22	Control system
20 35	Attachment seat
51	Connecting part
51a	Connecting space
52	Flow path
53	Jet hole
25 54	First opening
55	Cover
55b, 55e, 55h	Headrace
55c	Notch
55d, 5d1, 5d2	Nozzle
30 55f	Expanded portion
55g	Welded portion
60, 60a, 60b, 60c	Curved face
56, 57, 58, 59, 61, 62	Guide face
62a, 62b	Face
35 64, 64a	Tilt face
65	Guide portion
66	Rib
67	Chamfered shape
68	Round shape
40	

Claims

1. A drum type washing machine comprising:

- 45 a cylindrical rotary drum with a bottom and a first opening in a front side;
a water tub with a second opening corresponding to the first opening, the rotary drum being installed in the water tub such that a rotating axis direction is set horizontal or tilted downward from front to back, which is a bottom part, with respect to the horizontal level and a horizontal direction;
50 a motor for rotating the rotary drum; and
a water circulating passage for circulating washing water in the water tub by pouring out the washing water to a circulating passage connected to the water tub and pouring in the washing water to the rotary drum using a circulating pump, the water circulating passage including:
- 55 a headrace where the washing water passes;
a nozzle provided in the headrace for discharging the washing water;
and a flow path connected to the nozzle for discharging the washing water discharged from the nozzle into the rotary drum,

wherein
the headrace is configured with a front wall of the water tub and a cover attached to the front wall of the water tub, and
the nozzle is configured between the cover and the front wall of the water tub.

- 5
2. The drum type washing machine of claim 1,
wherein
the nozzle is opened to the flow path in a predetermined circumferential range, so as to discharge the washing water toward a central rotating axis direction of the rotary drum.
- 10
3. The washing machine of claim 1,
wherein
the nozzle guides the washing water from the flow path to a jet hole for pouring the washing water into the rotary drum.
- 15
4. The drum type washing machine of claim 3,
wherein
the jet hole is formed between an outer face of a front wall of the rotary drum and an inner face of the front wall of the water tub, the jet hole pouring the washing water into the rotary drum toward a back side and a central axis direction of the rotary drum.
- 20
5. The drum type washing machine of claim 1,
wherein
an inner face of the front wall of the water tub forming the flow path has a curved face that is curved toward the rotary drum.
- 25
6. The drum type washing machine of claim 1,
wherein
an inner face of the front wall of the water tub forming the flow path has a tilt face that is tilted toward the rotary drum.
- 30
7. The drum type washing machine of claim 1,
wherein
the nozzle is one of a plurality of nozzles provided in the headrace.
- 35
8. The drum type washing machine of claim 7,
wherein
at least one of the plurality of nozzles is provided in each of the left side and the right side of the headrace with respect to a line passing the center of the opening of the rotary drum, the line being perpendicular to an installation face.
- 40
9. The drum type washing machine of claim 1, wherein the headrace and the nozzle are respective ones of a plurality of headraces and a plurality of nozzles.
- 45
10. The drum type washing machine of claim 9,
wherein
the plurality of nozzles are disposed at the left and right ends of the headrace with respect to a line passing the center of the opening of the rotary drum, the line being perpendicular to an installation face.
- 50
11. The drum type washing machine of one of claims 8 and 10,
wherein
the plurality of nozzles have at least two types of positional angles, respectively, with respect to a line passing the center of the opening of the rotary drum, the line being perpendicular to an installation face.
- 55
12. The drum type washing machine of claim 1,
wherein
a rear face of the front wall of the water tub near a plurality of nozzles is configured with at least two types of shapes.
13. The drum type washing machine of claim 1,
wherein

an expanded portion is provided on the front wall of the water tub configuring the headrace, the expanded portion protruding outward from the washing machine.

14. The drum type washing machine of claim 1,

wherein

an expanded portion is provided on the cover configuring the headrace, the expanded portion protruding inward to the washing machine.

15. The drum type washing machine of claim 1,

wherein

the headrace is disposed in a circumferential direction with respect to the center of a circle formed by the opening of the rotary drum.

16. The drum type washing machine of claim 15,

wherein

the headrace is disposed extending in a left and right direction, as viewed toward the opening of the rotary drum.

17. The drum type washing machine of claim 1,

wherein

the cover covers a connecting space of a connecting part between a pipe from the circulating pump to the headrace and the headrace.

18. The drum type washing machine of claim 1,

wherein

the headrace is configured with the cover and an inner face of the front wall of the water tub, and a sealing material in between.

19. The drum type washing machine of claim 1,

wherein

the headrace is configured by welding the cover and an inner face of the front wall of the water tub.

FIG. 1

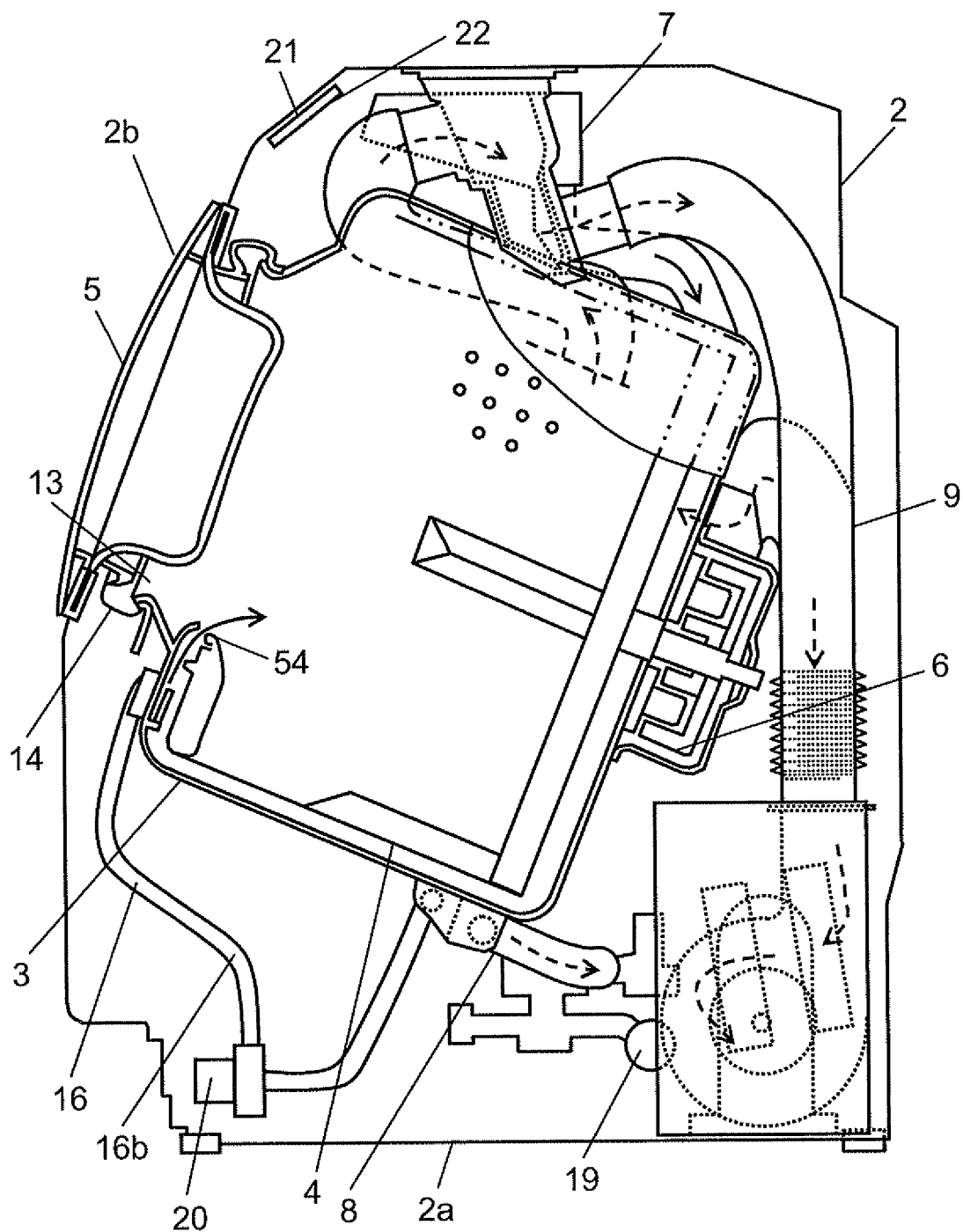


FIG. 2A

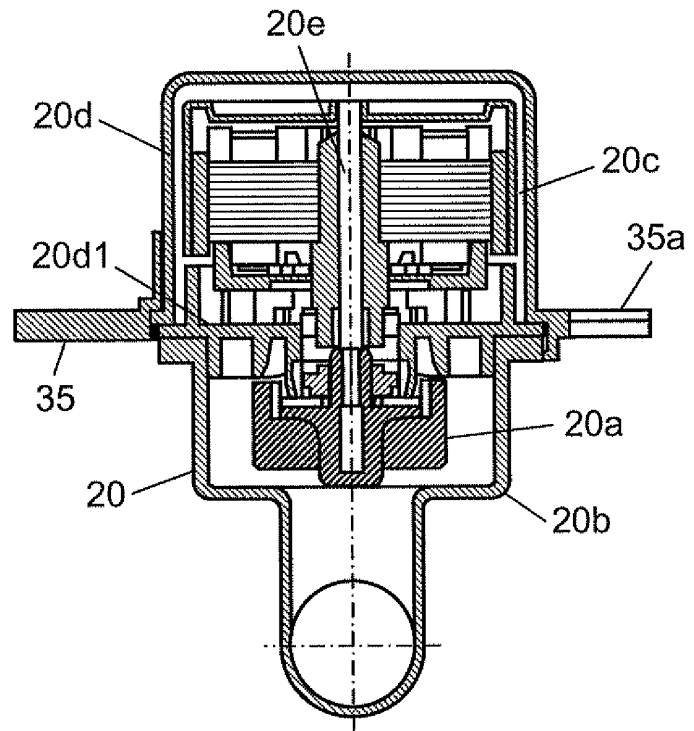


FIG. 2B

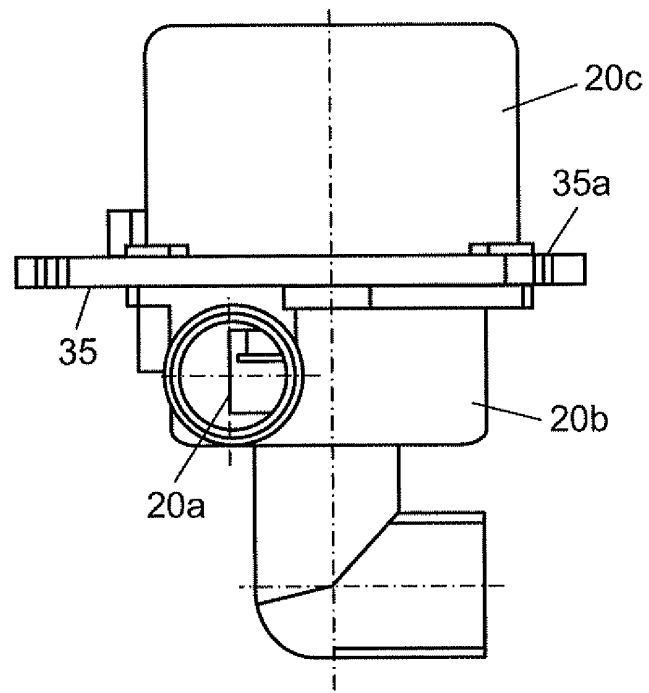


FIG. 3A

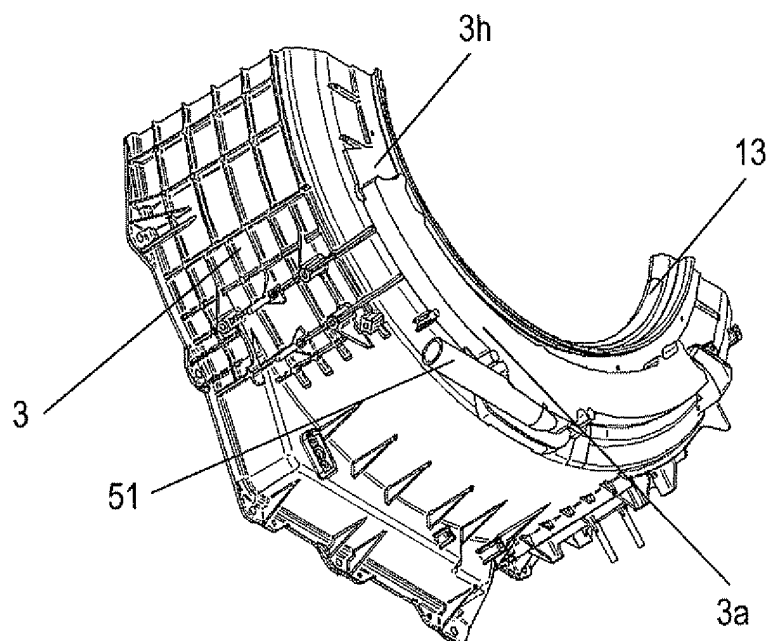


FIG. 3B

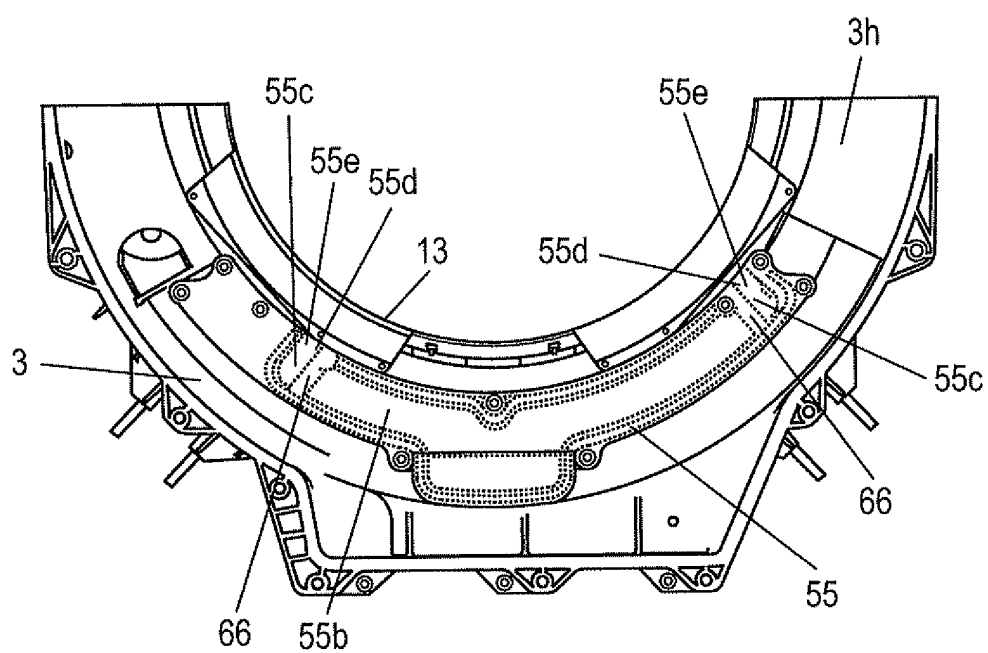


FIG. 4

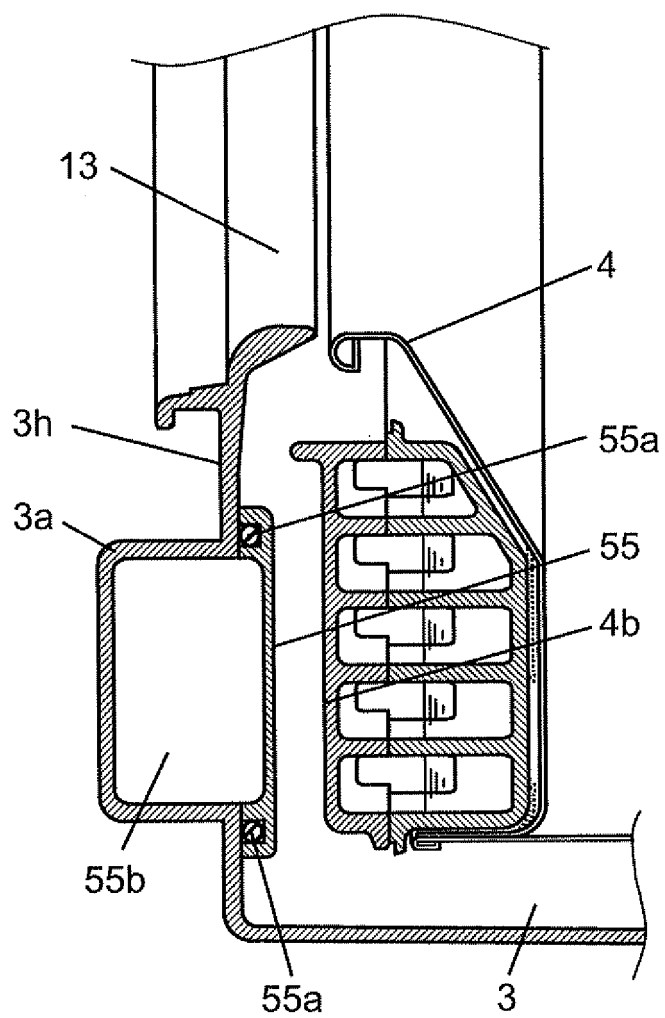


FIG. 5A

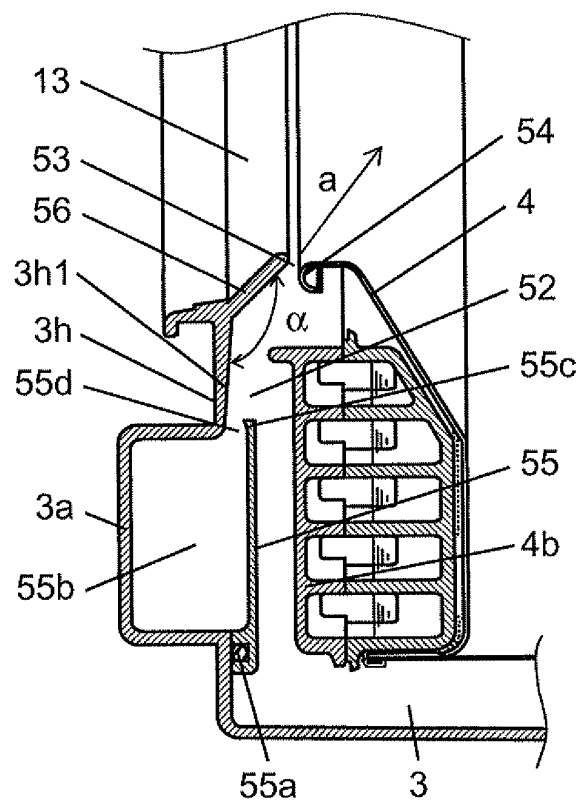


FIG. 5B

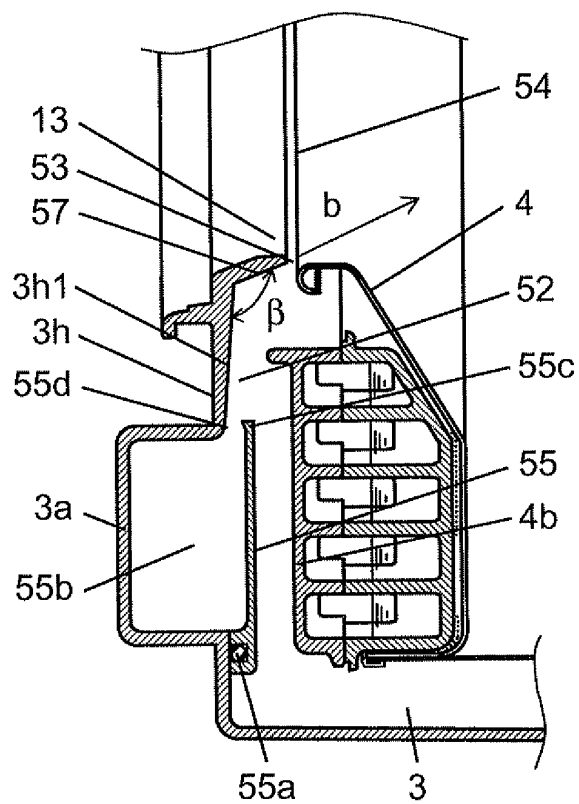


FIG. 6

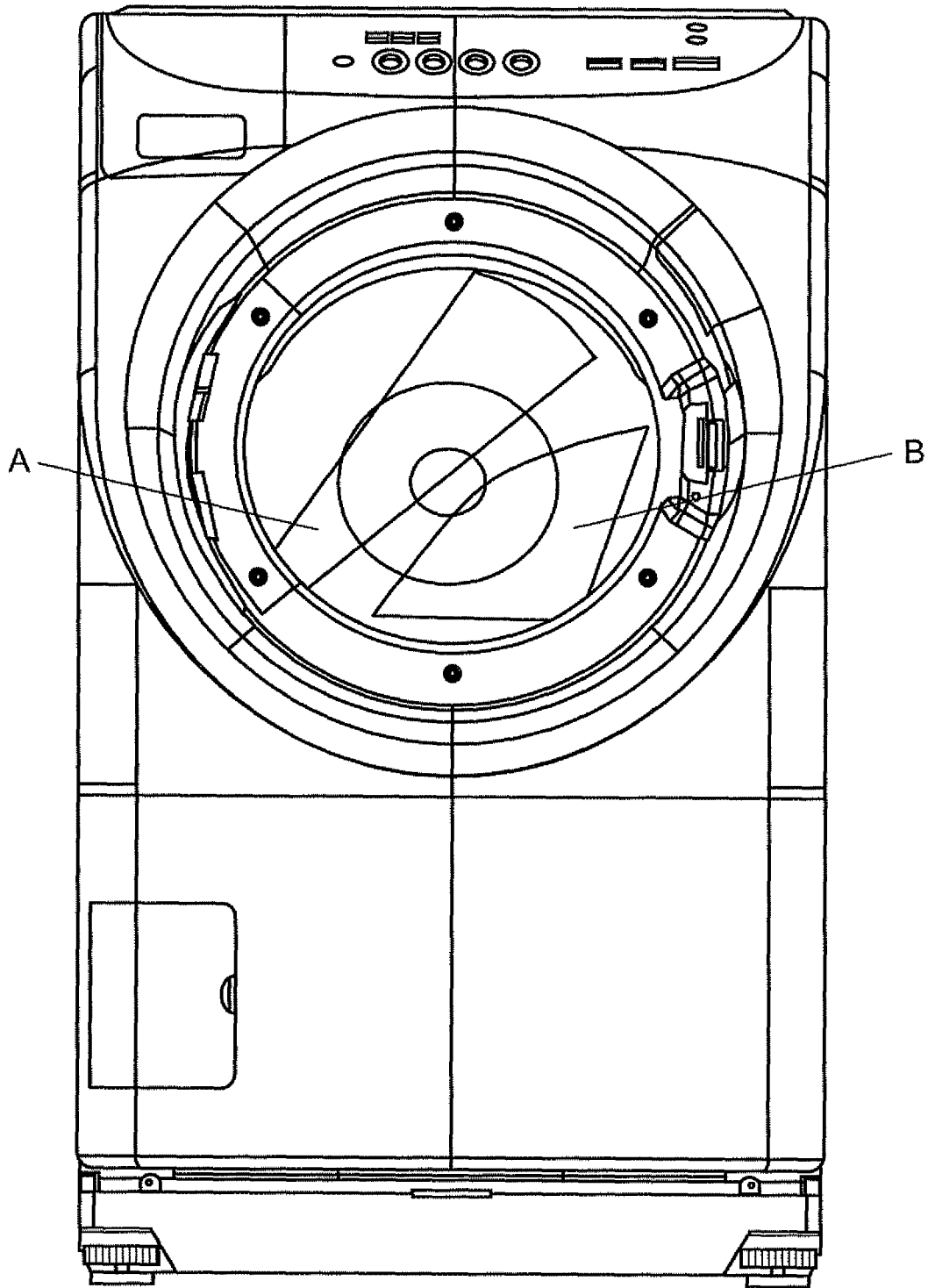


FIG. 7

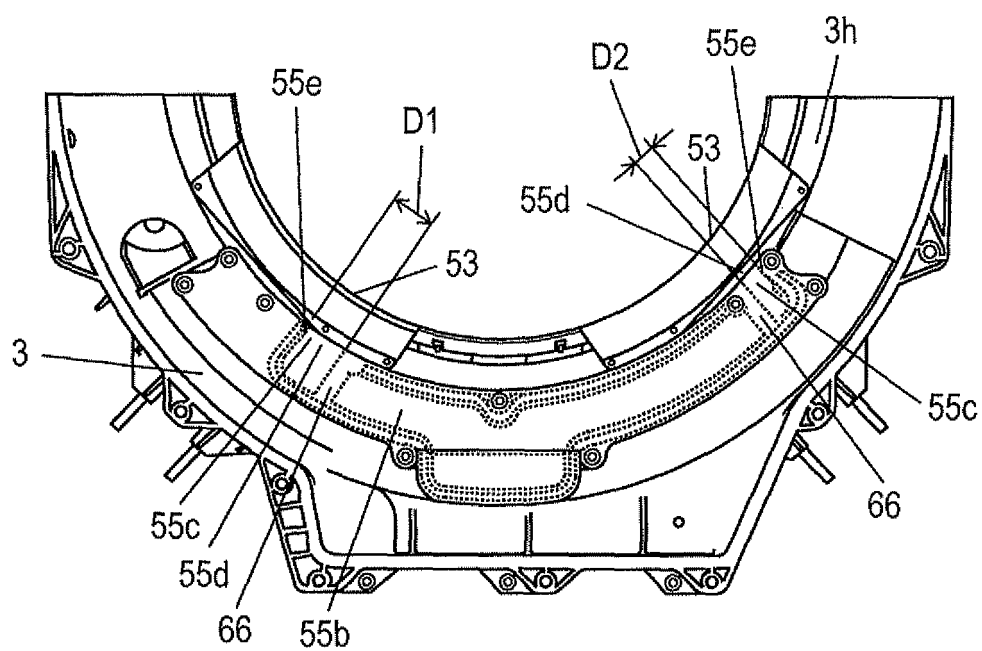


FIG. 8A

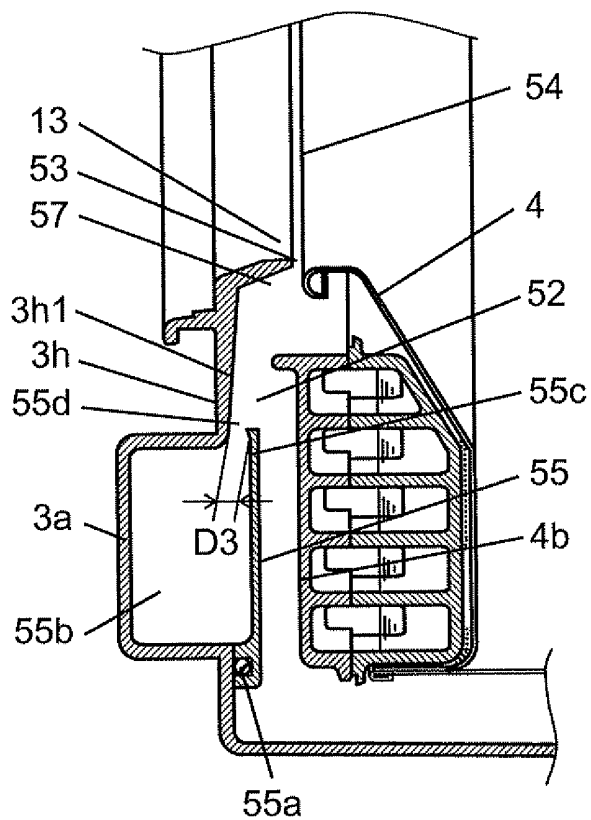


FIG. 8B

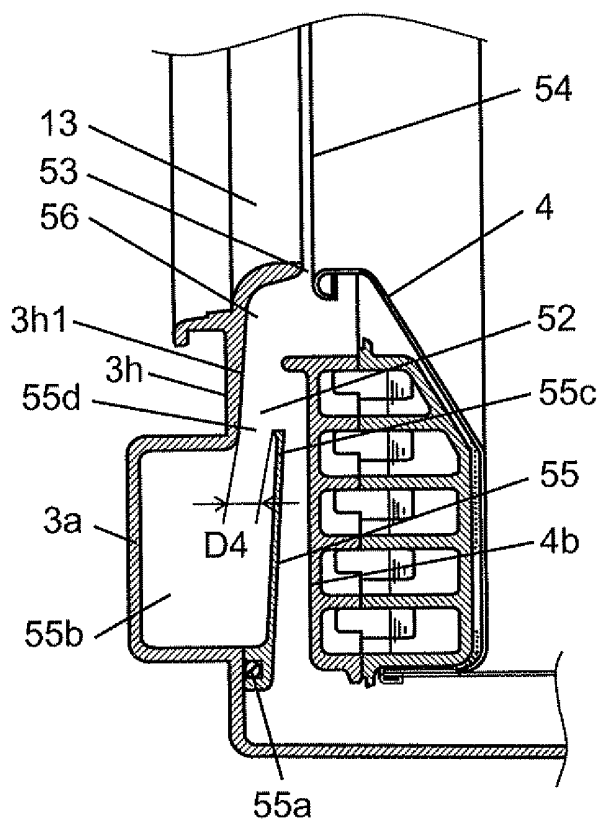


FIG. 9A

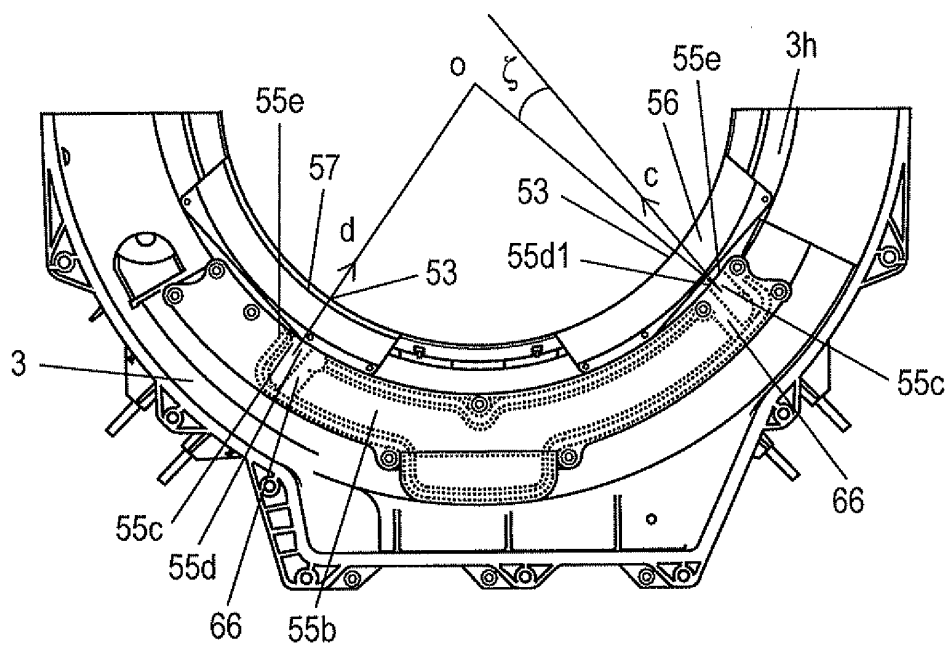


FIG. 9B

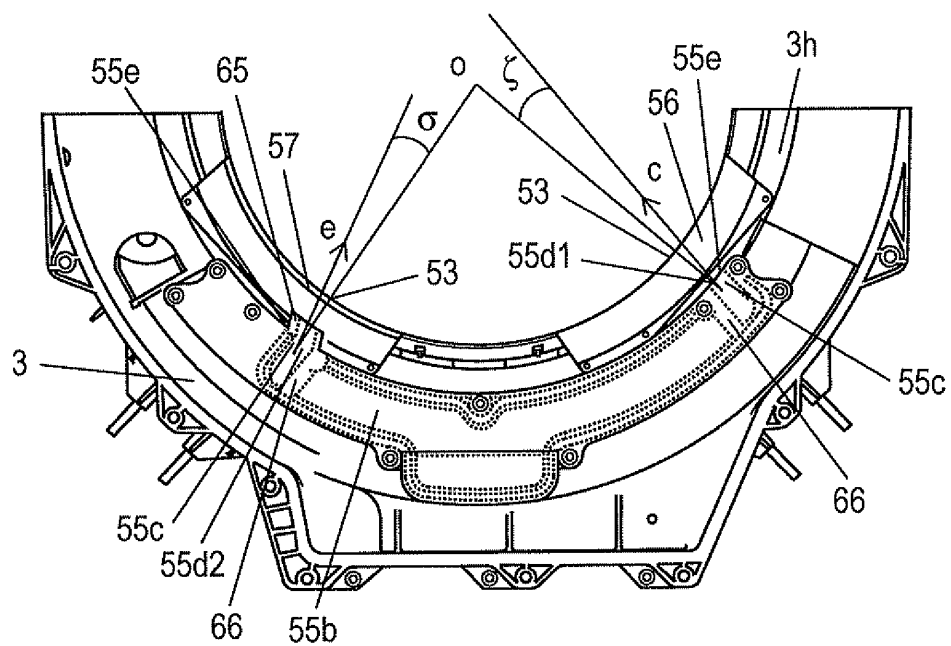


FIG. 10A

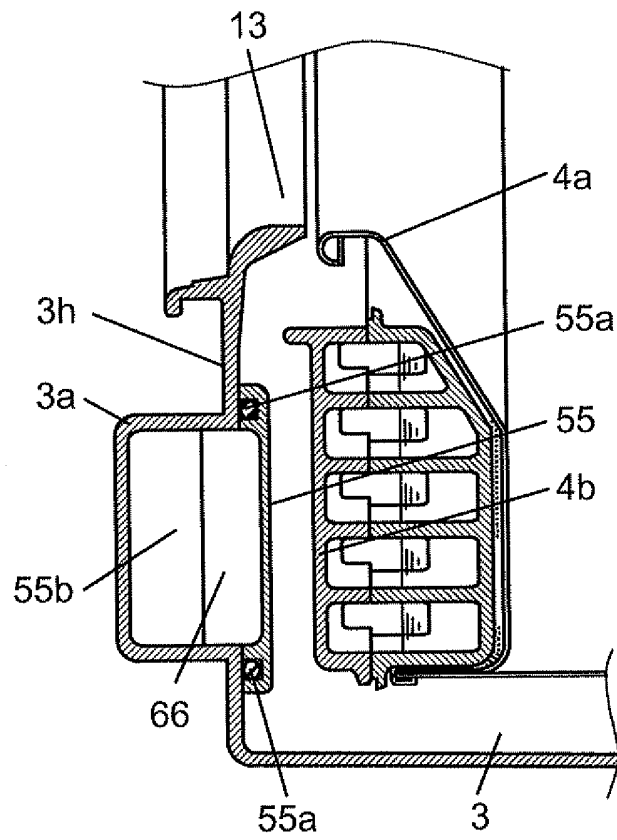


FIG. 10B

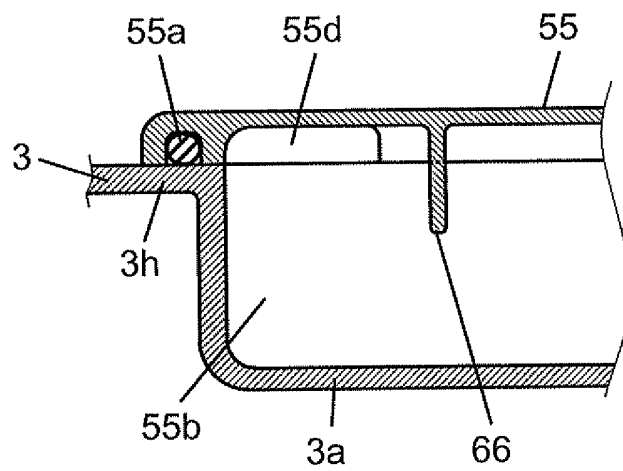


FIG. 11A

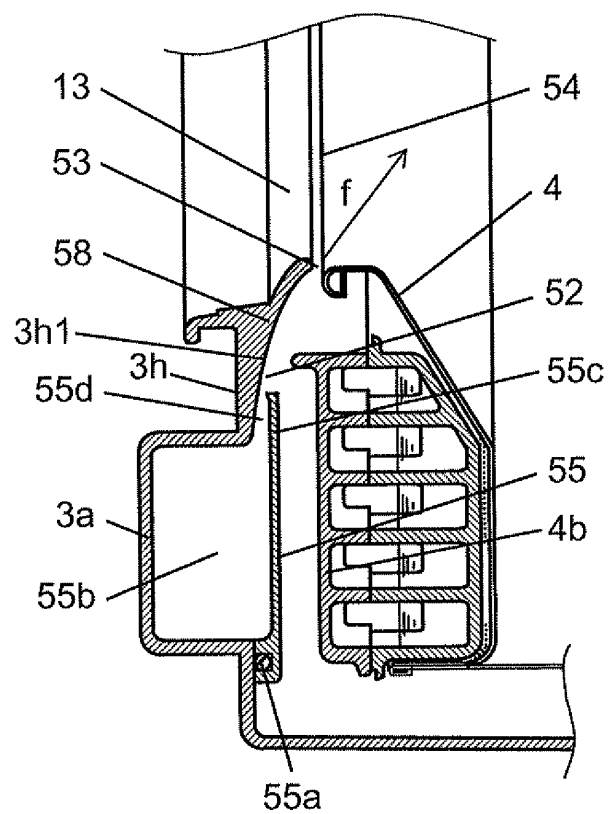


FIG. 11B

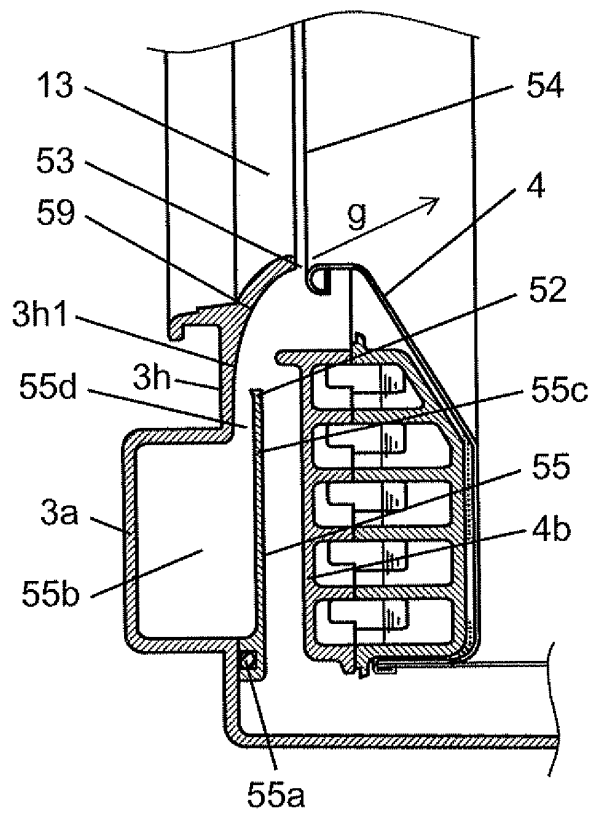


FIG. 12

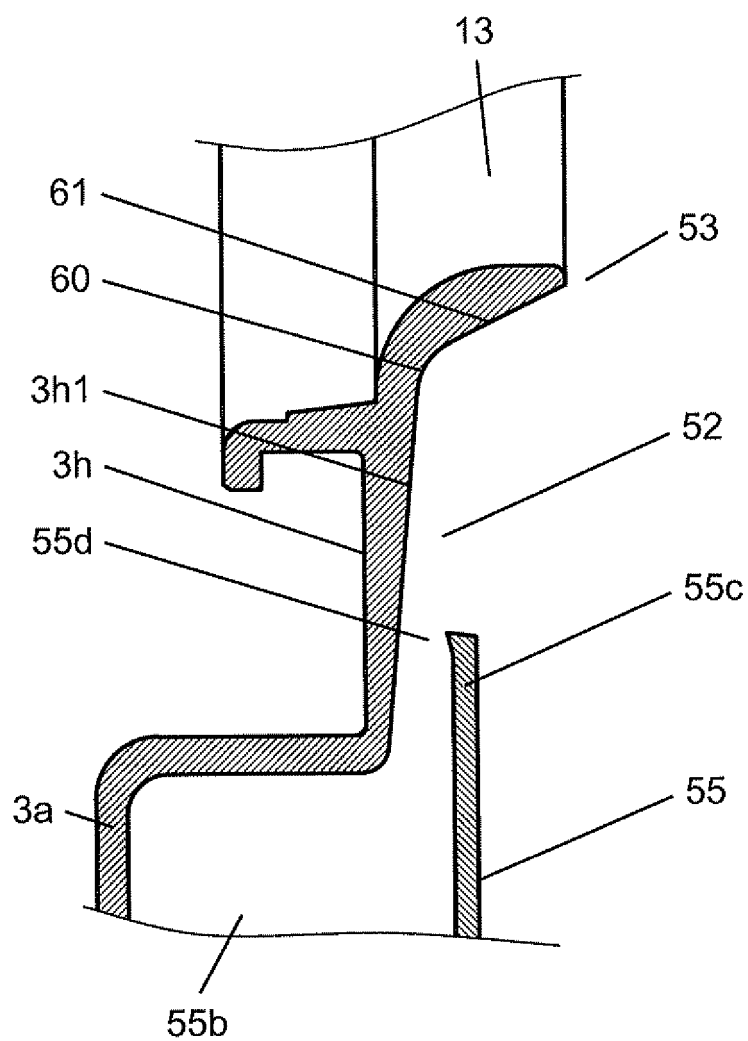


FIG. 13

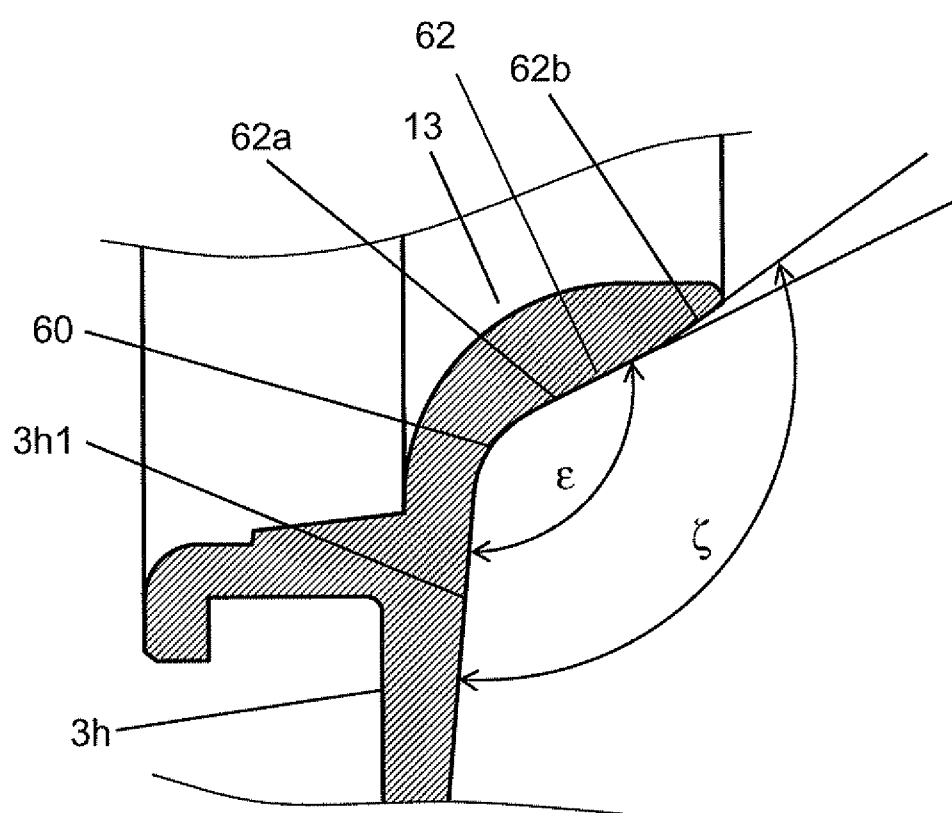


FIG. 14A

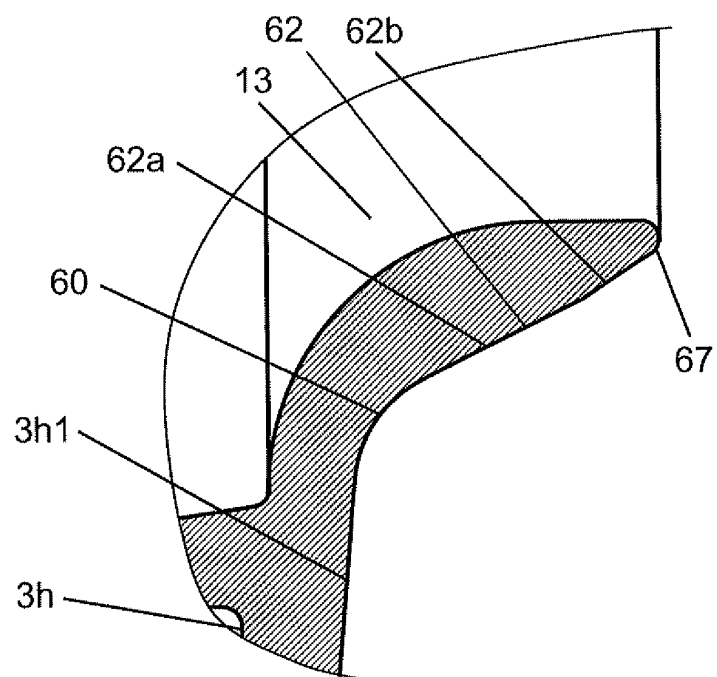


FIG. 14B

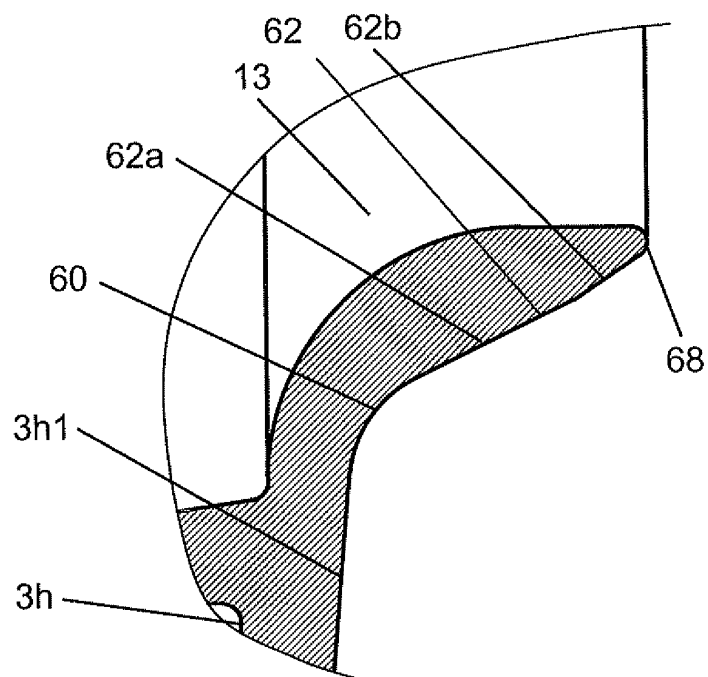


FIG. 15

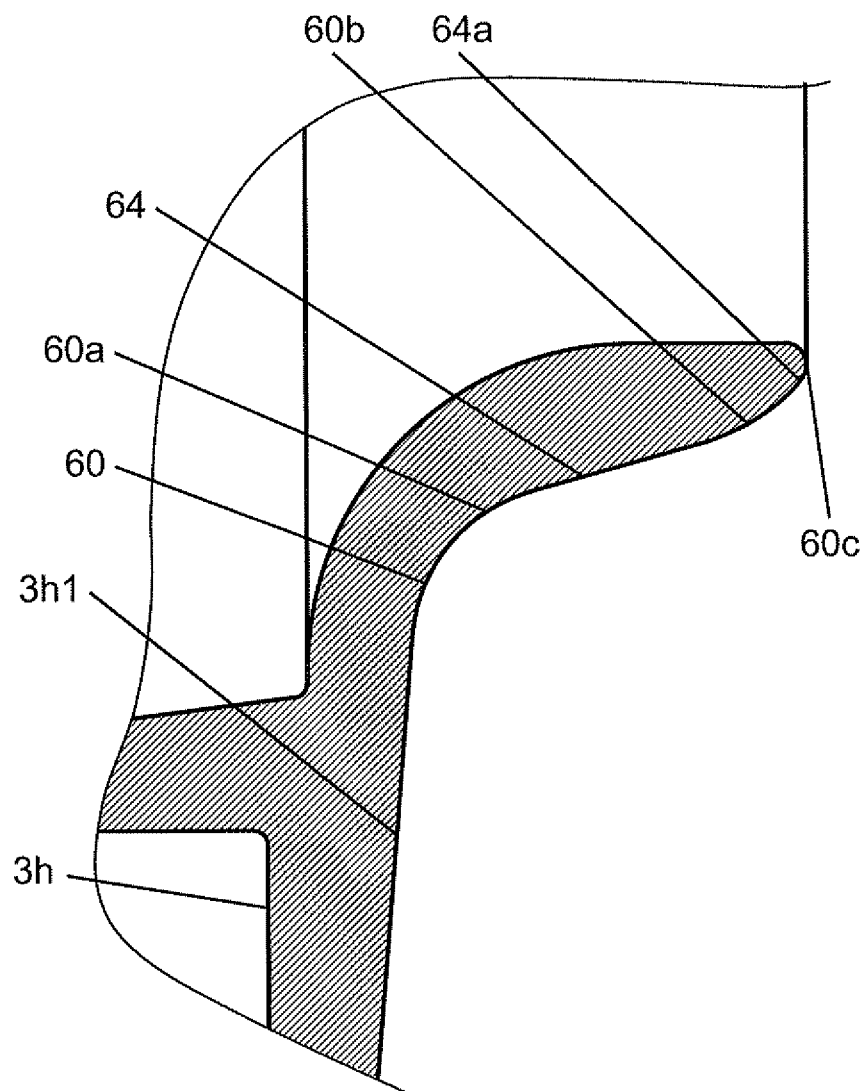


FIG. 16

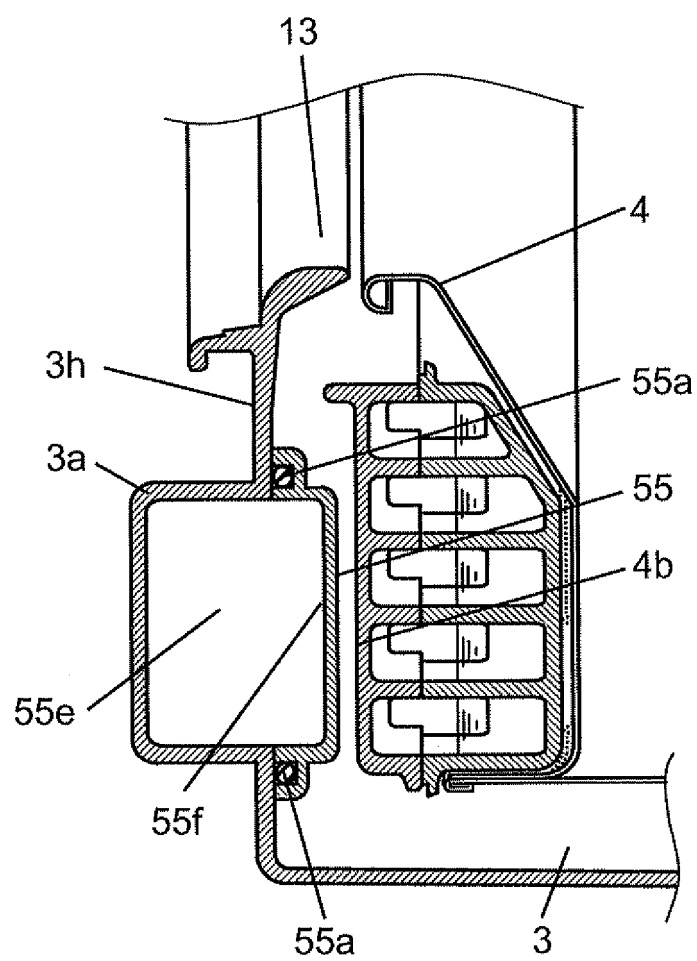
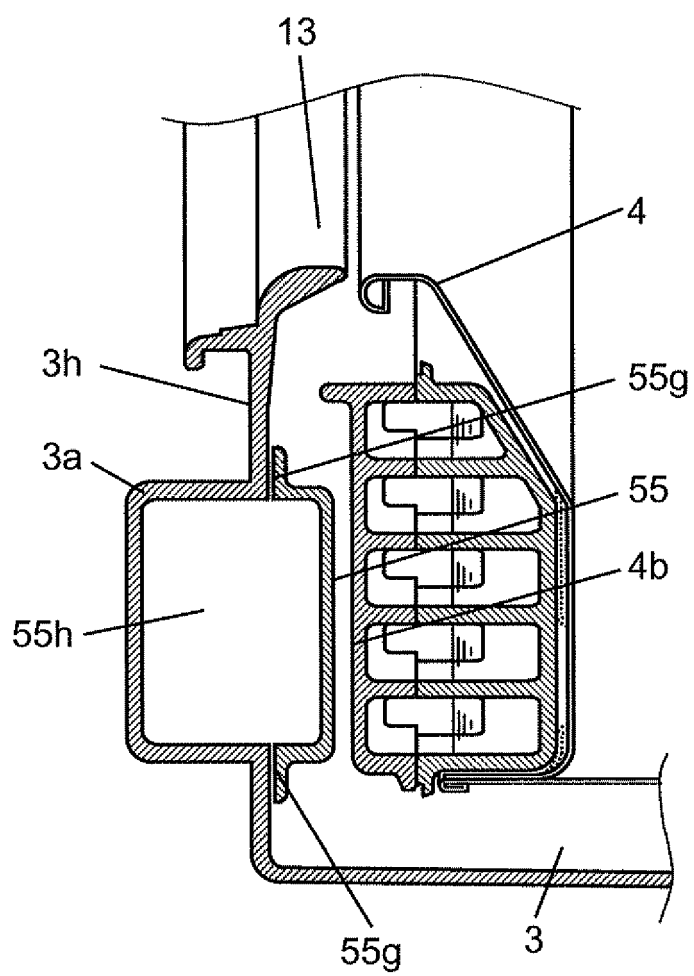


FIG. 17



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/005497

A. CLASSIFICATION OF SUBJECT MATTER

D06F39/08 (2006.01) i, D06F37/04 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F39/08, D06F37/04

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2010

Kokai Jitsuyo Shinan Koho 1971-2010 Toroku Jitsuyo Shinan Koho 1994-2010

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 4325734 B1 (Panasonic Corp.), 19 June 2009 (19.06.2009), entire text; all drawings & EP 2169105 A1 & CN 101713136 A	1-19
Y	JP 2007-111161 A (Matsushita Electric Industrial Co., Ltd.), 10 May 2007 (10.05.2007), entire text; all drawings (Family: none)	1-19



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

27 October, 2010 (27.10.10)

Date of mailing of the international search report

09 November, 2010 (09.11.10)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

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