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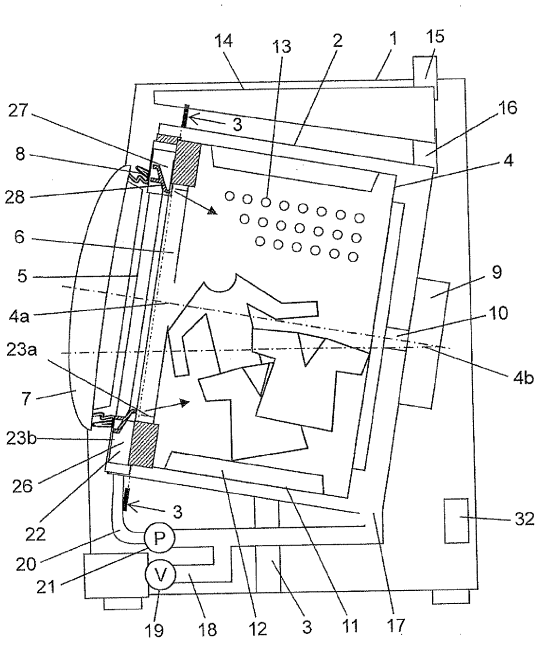
(54) Washing machine

(57) A drum-type washing machine includes a water tub (2) for storing wash water, a rotary drum (4) placed rotatably in the water tub and having an opening at the front (5), a motor (9) for driving the rotary drum, a water circulating path (20) for circulating the wash water stored in the water tub to the drum, a pump (21) for conveying the wash water stored in the water tub to the water circulating path, multiple nozzles (26) for jetting the wash water, conveyed to the nozzle water path by the pump, into the rotary drum, and a nozzle water path (22) formed around a front face of the water tub for conveying the wash water from the water circulating path to the nozzles.

FIG. 1



EP 2 631 349 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to drum-type washing machines that wash clothes and others.

BACKGROUND OF THE INVENTION

[0002] A conventional drum-type washing machine is disclosed in, e.g. Unexamined Japanese Patent Application Publication No. H10-127978 (Patent Literature 1). This washing machine includes a pump for supplying wash water stored in a water tub into a water circulating path and a nozzle having multiple holes through which the wash water jets from this side of a rotating drum toward an inner part of the drum. The nozzle is placed in front of the drum and the multiple holes are formed at slightly different angles from each other, so that clothes loaded in the drum can get wet fast. The rpm of the drum is controlled to prevent the wet clothes from tangling with non-wet clothes or clustering between the wet clothes. The foregoing structure allows improving the tumbling effect produced by the spin of the drum, and as a result, a washing time can be shortened and the performance of wash and rinse can be improved.

[0003] The drum-type washing machine disclosed in Patent Literature 1 is detailed hereinafter. Fig. 18 is a lateral cross section schematically illustrating a method for jetting wash water of the drum-type washing machine. Fig. 19 is a perspective view of nozzle 26 in part.

[0004] As shown in Fig. 18, the drum-type washing machine is formed of: housing 1, water tub 2, rotary drum 4, motor 44, pump 21, water shut off valve 6, drain valve 19, water circulating path 20, feed valve 15, vents 13, drain path 18, drain port 17, door 7, motor pulley 40, driving belt 41, driving pulley 42, tank 43, and nozzle 26. The dotted lines in Fig. 18 indicate the jets of wash water.

[0005] Nozzle 26 shown in Fig. 19 includes inlet 24 through which the wash water to be jetted is supplied, and multiple nozzle holes 31 having openings at different positions.

[0006] The operation of the foregoing conventional drum-type washing machine is described hereinafter. First, supply water through feed valve 15 in an appropriate amount to the clothes loaded in drum 4, then drive motor 44 for rotating drum 4 at an rpm which allows tumbling the clothes in drum 4. Spin of the driving shaft of motor 44 drives motor pulley 40 coupled to the driving shaft, thereby transmitting power to driving pulley 42 coupled to drum 4 via driving belt 41. Driving pulley 42 and drum 4 thus rotate. After a lapse of a given time, shut drain valve 41 and open water shut-off valve 6.

[0007] Next, drive pump 21 to jet, via water circulating path 20, the wash water in which detergent is solved from nozzle 26 to the laundry in drum 4. The wash water is jetted from multiple holes 31 of which openings are formed at different positions from each other, where the wash water jets from door 7 toward the inner part of drum 4. The structure discussed above allows the wash water jetted for wetting the laundry within a short time and in a wide area, so that the shorter wash time and the better performance of wash and rinse can be expected.

[0008] The foregoing conventional drum-type washing machine jets the wash water from the door side toward the inner part of drum 4 through nozzle 26 placed above drum 4 at the door side, thereby wetting the laundry for washing. This method, however, fails to practically wet the laundry when a small volume of laundry is loaded in drum 4 because the water jetted in parts fail to hit the laundry but hit the drum directly. To the contrary, when a large volume of laundry is loaded, the wash water jetted in parts only hit the laundry near to the nozzles or nozzle holes, so that nozzle 26 also fails to wet the laundry uniformly or in a wider area. In these cases, wash performance for the entire laundry cannot be improved.

[0009] Since the nozzle has multiple nozzle-holes, greater pressure loss is incurred during the water supply from the circulating path to the individual holes. As a result, a smaller amount of wash water is jetted from each one of the nozzle holes, so that it is difficult to wet the clothes quickly and uniformly.

[0010] To overcome the foregoing problems, a nozzle greater in size is used, and multiple nozzles are provided in the water tub for jetting the wash water over the greater area. However, these measures cause the laundry rotating in the rotary drum to tangle with the nozzles.

SUMMARY OF THE INVENTION

[0011] A drum-type washing machine of the present invention comprises the following structural elements:

- a water tub for storing wash water;
- a rotary drum disposed rotatably in the water tub and having an opening at the front;
- a motor for driving the rotary drum;
- a water circulating path for circulating the wash water stored in the water tub to the drum;
- a pump for conveying the wash water stored in the water tub to the water circulating path;
- multiple nozzles for jetting the wash water, transmitted thereto by the pump, into the rotary drum; and
- a nozzle water path formed around a front face of the water tub for conveying the wash water from the water circulating path to the nozzles.

[0012] The structure discussed above allows the wash water conveyed by the pump into the water tub to jet over a greater area, thereby exposing the laundry agitated in the rotary drum to the wash water more frequently. As a result, the wash water can be supplied all over the laundry in the drum, thereby wetting the laundry uniformly, and improving the performance of wash and rinse.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is a sectional view of a drum-type washing machine in accordance with a first embodiment of the present invention.

Fig. 2 is a sectional view of an essential part of the drum-type washing machine in accordance with the first embodiment.

Fig. 3 is fragmentary view taken along arrows 3 - 3 of Fig. 1 for illustrating the first embodiment.

Fig. 4 is a sectional view of a nozzle of the drum-type washing machine in accordance with the first embodiment.

Fig. 5 is a sectional view illustrating an essential part of a nozzle generally used in drum-type washing machines.

Fig. 6 is a fragmentary view taken along arrows 3 - 3 of Fig. 1 for illustrating a second embodiment of the present invention.

Fig. 7 is a fragmentary view taken along arrows 3 - 3 of Fig. 1 for illustrating a third embodiment of the present invention.

Fig. 8 is a fragmentary view taken along arrows 3 - 3 of Fig. 1 for illustrating a fourth embodiment of the present invention.

Fig. 9 is a fragmentary view taken along arrows 3 - 3 of Fig. 1 for illustrating a fifth embodiment of the present invention.

Fig. 10 is a sectional view of a nozzle of a drum-type washing machine in accordance with a sixth embodiment of the present invention.

Fig. 11 is a sectional view of a nozzle of a drum-type washing machine in accordance with a seventh embodiment of the present invention.

Fig. 12 is a sectional view of a nozzle of a drum-type washing machine in accordance with an eighth embodiment of the present invention.

Fig. 13 is a sectional view taken along line 13 - 13 of Fig. 6 for illustrating a ninth embodiment of the present invention.

Fig. 14 is a sectional view taken along line 14 - 14 of Fig. 6 for illustrating the ninth embodiment of the present invention.

Fig. 15 is a sectional view taken along line 15 - 15 of Fig. 6 for illustrating the ninth embodiment of the present invention.

Fig. 16 is a fragmentary view taken along arrows 3 - 3 of Fig. 1 for illustrating a tenth embodiment of the present invention.

Fig. 17 illustrates a way of jetting wash water from multiple nozzles 26.

Fig. 18 is a lateral sectional view schematically illustrating a way of jetting wash water of a drum-type washing machine disclosed in Patent Literature 1.

Fig. 19 is a perspective view in part of nozzle 26 of the drum-type washing machine disclosed in Patent Literature 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0014] Exemplary embodiments of the present invention are demonstrated hereinafter with reference to the accompanying drawings. Structural elements similar to those of the conventional model or those of an antecedent embodiment have the same reference signs and the detailed descriptions thereof are omitted. The present invention is not limited by the following embodiments. In the embodiments, the opening side of the rotary drum of the drum-type washing machine is referred to as a front, a front side, a front section, or a front face, and the opposite side to the opening side is referred to as a rear, a rear side, a rear section or a rear face.

Exemplary Embodiment 1.

[0015] Fig. 1 is a sectional view of a drum-type washing machine in accordance with the first embodiment of the present invention. This drum-type washing machine, as shown in Fig. 1, comprises the following elements: housing 1, water tub 2, suspension 3, rotary drum 4, openings 5 and 6, door 7, motor 9, protrusion 12, feed valve 15, drain valve 19, water circulating path 20, pump 21, nozzle water path 22, nozzle 26. The washing machine further comprises controller 32 mounted on a rear bottom in housing 1 for controlling motor 9, feed valve 15, drain valve 19, and pump 21 as well as controlling the steps of wash, rinse, and spin-dry based on a given program.

[0016] Water tub 2 shaped like a cylinder having a bottom is resiliently supported by suspension 3 in housing 1. Rotary drum 4 shaped like a cylinder having a bottom is placed rotatably in water tub 2. Rotary axis 4a of drum 4 substantially agrees with the center line on which rotary drum 4 rotates, and also substantially agrees with the center line on which water tub 2 rotates. Tub 2 and drum 4 have circular openings 5 and 6 respectively, on the front, i.e. the place where door 7 is mounted. Rotary axis 4a tilts rearward (front-up and rear-down) by, e.g. 1.0 - 20 degrees relative to the horizontal 4b, so that water tub 2 can be situated in housing 1.

[0017] Confronting openings 5 and 6, door 7 is placed on the front of housing 1 for loading or unloading the laundry into or from drum 4. Bellows 8 made of elastic material such as rubber is placed around opening 5 of water tub 2, so that shut of door 7 bites a rim of bellows 8 at inner face of door 7 for sealing door 7 shut.

[0018] Motor 9 is mounted at the opposite end (rear face of water tub 2) to opening 5 of water tub 2 for driving drum 4. The rotor of motor 9 is connected to drum 4 via rotary shaft 10 which transmits the spin of motor 9 to drum 4. Cylindrical wall 11 of drum 4 has multiple projections 12 projected toward rotary axis 4a. The laundry is caught on projections 12 and lifted, and then falls from a height to the bottom. This action is repeated during the

rotation of drum 4. On top of that, numerous vents 13 are formed all over cylindrical wall 11, so that when wash water is stored in water tub 2 up to a given level, the wash water enters into drum 4 through vents 13.

[0019] Detergent container 14 is placed above water tub 2, and connected to feed valve 15 which connects with a tap of a water supply. Open or close of feed valve 15 supplies the tap water or halts the supply to detergent container 14. Water-feed path 16 is connected to the underside of detergent container 14 so that the detergent is supplied to water sub 2 together with the water entered container 14.

[0020] Drain port 17 is formed on the underside of water tub 2 for discharging the wash water stored in tub 2, and drain path 18 is connected to drain port 17 for conveying the wash water to the outside of housing 1. Drain valve 19 is placed somewhere in path 18 for closing path 18.

[0021] Circulating path 20 connected to drain port 17 branches off from drain path 18 so that the wash water discharged from tub 2 can circulate via rotary drum 4 into water tub 2 again. Circulating path 20 is laid under water tub 2 such that it extends from the rear to the front and lies almost horizontally. Driving pump 21 placed somewhere in circulating path 20 draws the wash water stored in water tub 2 from drain port 17 into path 20, and pressurizes the wash water flowing in path 20 for conveying it into drum 4. This mechanism allows the wash water stored in water tub 2 to run through path 20 and circulate to tub 2.

[0022] Nozzle water path 22 is formed inside the front face of water tub 2, to be more specific, on the inner face of opening 5 viewed from opening 6 of drum 4 and outside of rim 23a of circular opening 6 of drum 4. Nozzle water path 22 is shaped like a circle, which is approx. concentric (including concentric) with opening 5 of tub 2 and opening 6 of drum 4. Inner rim 23a of path 22 is placed outside rim 23a of opening 6 in the radial direction.

[0023] Next, a structure around nozzle 26 in accordance with the first embodiment is demonstrated with reference to Fig. 2 which shows a sectional view of an essential part of the drum-type washing machine in accordance with the first embodiment.

[0024] As shown in Fig. 2, flow-in port 25 is formed at an upper section of circulating path 20 such that port 25 communicates with path 20. Nozzles 26 are provided at an upper section of nozzle water path 22 which is formed circularly outside rim 23a of opening 6. Space 27 is provided between nozzle 26 and rim 23 a. Reflector 28 is provided in space 27 for the wash water jetted into space 27 to reflect thereon toward opening 6. The jetted wash water can be thus guided to opening 6 and then into drum 4.

[0025] Reflector 28 is formed annularly around opening 5 and confronts the front of rotary drum 4. Reflector 28 includes hit-face 28a tilting relative to the jet stream from nozzle 26. This tilt avoids scattering the wash water in all directions and allows the jet stream of wash water to land stably on hit-face 28a, thereby diffusing the wash water along hit-face 28a. As a result, the wash water can be sprayed over the laundry in drum 4 in a stable manner.

[0026] A smaller tilt angle of hit-face 28a relative to the jet direction from nozzle 26 allows the jet stream to land more stably on hit-face 28a and diffuse over a greater area. However, if reflector 28 is formed of only hit-face 28a, a small tilt angle of hit-face 28a fails to guide the jet stream into the inner part of drum 4, and the wash water is sprayed onto only the clothes located at the front part of drum 4.

[0027] To avoid the foregoing possible problem, guide-face 28b is formed on the inner rim of reflector 28, and the tilt angle of reflector 28 relative to the jet direction is set smaller than that of guide-face 28b. This structure allows setting the tilt angle of hit-face 28a gently relative to the jet direction from nozzle 26, whereby the jet stream of the wash water can land at hit-face 28a more steadily and diffuse over a wider area regardless of the direction which guides the jet stream into drum 4. The jet stream is guided by guide-face 28b along the direction toward inside drum 4, so that the wash water can be sprayed over the laundry in drum 4 in a steady diffusing manner.

[0028] The length of guide-face 28b is set shorter than that of hit-face 28a because it is necessary for hit-face 28a to have a greater contacting area than a hitting area of the jet stream so that the jet stream can stably land on hit-face 28a and diffuse. Since guide-face 28b functions only as changing the jet stream direction, a smaller contacting area of guide-face 28b than that of hit-face 28a works good. This structure allows minimizing the reduction in the flow velocity at guide-face 28b, thereby spraying the wash water more strongly over the laundry. As a result, the performance of wash and rinse can be improved.

[0029] As discussed above, the jet stream from nozzle 26 should run to reflector 28, so that a water-guide wall, which is regularly used in a conventional washing machine, is omitted from Fig. 2. Omission of the water-guide wall allows the jet stream from nozzle 26 to flow into space 27, and then hit the hit-face 28a, and diffuse into drum 4 through opening 6 with the aid of guide-face 28b. The mechanism allows nozzle 26 to be located away from the rim of opening 6 of drum 4 while the jet stream from nozzle 26 can be guided into rotary drum 4 free from adverse resistance from the wall. As a result, this structure allows minimizing the reduction in the flow velocity, thereby spraying the wash water more strongly over the laundry in drum 4.

[0030] Nozzle 26 is not necessarily shaped like a flat tube which is required for running along the water guide wall, but its cross-sectional area should equal to that of the flat one, so that the cross section of nozzle 26 is shaped like, e.g. a round hole because this shape invites the least pressure loss. This shape allows minimizing the reduction in volumetric flow of the wash water jetted from nozzle 26, so that a sufficient quantity of the wash water can be supplied to the laundry in drum 4.

[0031] Reflector 28 diffuses the bar-shaped jet stream, so that the wash water can be sprayed in a wide area over the laundry in rotary drum 4. As a result, the performance of wash and rinse can be improved.

[0032] Next, a structure of the drum-type washing machine in accordance with the first embodiment is described hereinafter with reference to Fig. 3, which is a fragmentary view taken along arrows 3 - 3 of the drum-type washing machine shown in Fig. 1. Fig. 3 shows the structure viewed from opening 6 of rotary drum 4.

[0033] As shown in Fig. 3, nozzle water path 22 is provided with flow-in port 25 at the lower a section. Nozzle water path 22 runs along the shape of water tub 2, so that path 22 shapes approx. annularly (including a circle), and it branches off at port 25 to both sides and the two branched paths extend to end parts 22a respectively. The water flowing in path 22 is split into two streams which run long and approx. annularly (including a circle) such that the streams surround opening 5. This split makes each one of the streams short, which reduces the pressure loss in nozzle water path 22. This structure allows applying sufficient pressures to each one of nozzles 26a - 26g (detailed later) so that the velocity of jet stream from nozzle 26 can be appropriately maintained, and therefore, the wash water can be sprayed all over the laundry in drum 4. Nozzle water path 22 is not necessarily provided with end parts 22a, so that path 22 can be formed seamlessly. In this case, since the water flow is also split into two directions at flow-in port 25, an advantage similar to what is discussed above is obtainable.

[0034] The wash water flows into nozzle water path 22 from flow-in port 25 along the direction toward rotary axis 4a (direction indicated by arrow C in Fig. 3). This structure allows the streams to branch off smoothly in two directions, thereby applying sufficient pressures onto respective nozzles 26a - 26g. As a result, this structure can increase the velocity of the jet streams.

[0035] If the wash water pumped out to nozzle water path 22 dashes against each other at port 25, jet force is lowered, so that path 22 is preferably structured to avoid this possible problem. For instance, a path running clockwise and another path running counterclockwise are prepared so that the wash water cannot dash against each other at port 25.

[0036] As shown in Fig. 3, multiple nozzles 26a - 26g provided in nozzle water path 22 are supposed to jet the wash water toward rotary axis 4a (e.g. nozzle 26c is supposed to jet the wash water along the alternate long and short dash line); however, the jet direction is shifted from the alternate long and short dash line to the arrow line by angle [theta]1. Respective nozzles 26a - 26g are thus shifted toward the same direction by the same angle [theta]1 (shift angle). This structure allows enlarging the area over which the wash water can be sprayed, so that the wash water can be supplied all over the laundry in an efficient manner.

[0037] In this case, if the shift angle is too great, the wash water cannot be sprayed around rotary axis 4a. To avoid this possible problem, shift angle [theta]1 is set to be an approx. half of angle [theta]2 (e.g. 10 - 30 degrees) which defines the spread of the wash water diffusing along the rotary direction of drum 4, so that shift angle [theta]1 should be set at, e.g. 5 - 15 degrees.

[0038] Multiple nozzles 26 (26a - 26g) are formed at locations distant from rim 23a of opening 6 of rotary drum 4 as shown in Fig. 2. This structure allows nozzles 26 to spray the diffusing wash water over the laundry in drum 4 without exposing nozzles 26 to opening 6 of drum 4. As a result, the laundry can be loaded or unloaded into/from drum 4 free from being caught on opening 6 and being torn. On top of that, the laundry can be loaded or unloaded with ease, so that better usability can be expected.

[0039] It is preferable to form bulge section 29 by swelling out a part of nozzle water path 22 toward rotary axis 4a. An advantage of nozzle 26 formed at bulge section 29 is demonstrated hereinafter with reference to Figs. 4 and 5. Fig. 4 is a sectional view of the nozzle of the drum-type washing machine in accordance with the first embodiment.

[0040] As shown in Fig. 4, bulge section 29 is provided to a part of nozzle water path 22, and nozzle hole 31 shaped like, e.g. a circle, is formed on flat part 30 of bulge section 29. Thickness (depth) "L" of nozzle hole 31 is set not greater than diameter "d" thereof. An extension of flat part 30 runs across the direction of the wash water jetted from nozzle hole 31 at right angles, and as shown in Fig. 3, tilts by the shift angle [theta]1 of nozzle 26.

[0041] The wash water at bulge section 29 is isolated from the main stream (indicated by dotted line with arrow in Fig. 4) which flows in nozzle water path 22 to end part 22a, so that the main stream does not so much affect multiple nozzles 26a - 26g shown in Fig. 3. This mechanism thus prevents the streams jetted from multiple nozzles 26a - 26g from being disarranged, and makes the jet direction steadily. The jet streams can be contracted, whereby the velocities of the streams can be increased. Stronger jet stream thus can be expected.

[0042] The foregoing mechanism is detailed hereinafter with reference to Fig. 5 that is a sectional view illustrating a structure of an essential part of a nozzle widely used in drum-type washing machines.

[0043] As shown in Fig. 5, in general, inner wall 103 of nozzle water path 102 slants gently and smoothly toward nozzle hole 101, thereby narrowing nozzle hole 101, in order to minimize pressure-loss. This structure keeps preventing the water flowing through path 102 from separating from inner wall 103 until just before the flow is jetted from nozzle hole 101, otherwise this separation would incur turbulence. Nozzle 100 inviting smaller pressure loss is thus obtainable. In this case, under the condition of the same quantity of flow, the velocity of the jet stream from nozzle hole 101 is determined by the cross sectional area of hole 101, so that a greater quantity of flow or a smaller cross sectional area of hole 101 is needed to increase the velocity of the jet stream.

[0044] Increment in the circulation flow running through circulating path 20 which supplies the wash water to nozzle water path 22 lowers the water level in water tub 2, thereby inviting air with ease to enter pump 21, which then falls into "air-biting" state, and the circulation flow decreases contrary to the expectation. The increment in the quantity of flow in circulating path 20 is thus limited when a washing is done with a small amount of water stored in water tub 2. At this time, waste thread produced from the laundry will clog path 20, and to avoid such a reliability problem, there should be a limitation on reducing the cross sectional area of nozzle hole 31.

[0045] As shown in Fig. 4, bulge section 29 swelling out toward rotary axis 4a of drum 4 is thus formed, and flat part 30 formed approx. vertically (including vertical) relative to the extending direction of nozzle hole 31 is also provided around hole 31. The flow around inner wall face 22b, formed by bulge section 29, of nozzle water path 22 tries to flow along inner wall face 22b due to its viscosity; however, the stream jetted from hole 31 is separated from the inside wall of nozzle hole 31 because inner wall face 22b sharply bends by approx. 90 degrees.

[0046] The cross sectional area "B" of the jet stream thus becomes smaller than the cross sectional area "A" of nozzle 31, namely, the stream is contracted. Nozzle 26 in accordance with this first embodiment achieves a greater velocity of flow and a stronger jet stream than a conventional nozzle under the condition where nozzle 26 has the same cross sectional area as the conventional one and both of the subject nozzles and the conventional ones are used in the same quantity of flow.

[0047] The sectional view of nozzle hole 31 cut along line 4 - 4 of Fig. 4 is, e.g. a circle, and this structure allows contracting the jet stream uniformly, preventing the jet stream from being disarranged, and jetting the wash water along a given direction for spraying the wash water over the laundry. Circular nozzle hole 31 has no projections therein, so that the waste thread produced from the laundry is hardly caught in hole 31, which can be thus prevented from being clogged by the waste thread.

[0048] Thickness "L" of nozzle hole 31 is set not greater than diameter "d" thereof, because if the length of hole 31 along the jet direction is too long, the contracted flow separated from the inside wall of hole 31 flares gradually before the flow is jetted, which cancels the advantage of increasing the velocity of flow. This is the reason why thickness "L" of nozzle hole 31 is preferably set not greater than diameter "d" thereof.

[0049] The structure discussed above allows increasing the velocity of the stream jetted from nozzle hole 31, and increasing the strength of the wash water jet stream.

[0050] Starting operation of the foregoing drum-type washing machine is demonstrated hereinafter, and other operations, e.g. rinse, dehydration, spin-dry, stay the same as those of the conventional washing machine.

[0051] First, open door 7 for loading laundry, e.g. clothes, into rotary drum 4 before driving the machine, which then senses an amount of the laundry. Next, open feed valve 15 for wash water to dissolve detergent stored in container 14, and this wash water enters water tub 2 via water-feed path 16.

[0052] Then sense a water level of the wash water stored in water tub 2 with a water level sensor (not shown). To be more specific, the water level sensor senses the amount of water determined in response to an amount of the laundry. Then halt the water supply before starting the washing. Motor 9 rotates drum 4 forward or backward, and the laundry accommodated in drum 4 is lifted along the rotating direction with projections 12 provided on cylindrical wall 11 of drum 4, and then the laundry falls. The lift & fall action, referred to as "tumbling", washes the laundry.

[0053] At this time, the water level of the wash water is preferably set appropriately to obtain effective tumbling (beat wash). However, when the water in tub 2 stays at a low level, the wash water cannot permeate throughout the laundry, so that the wash water in tub 2 is drawn by pump 21 into circulating path 20 via drain port 17 provided at the bottom of tub 2, and the wash water is then jetted over the laundry in drum 4.

[0054] To be more specific, as shown in Fig. 1, pump 21 pumps the wash water into water tub 2, and the wash water then runs through circulating path 20, passes through flow-in port 25 provided at nozzle water path 22, and flows into nozzle water path 22. The wash water is then branched off to both sides and runs through annularly formed long path 22 to end parts 22a. The wash water is then guided to multiple nozzles 26 (e.g. seven nozzles 26a - 26g are available in Fig. 3). At least three nozzles 26 are needed. The wash water is jetted from nozzles 26a - 26g in a bar-like shape into space 27 formed at rotary axis 4a side.

[0055] As shown in Fig. 2, the wash water jetted into space 27 hits against hit-face 28a of reflector 28, and reflects toward opening 6 of rotary drum 4. The wash water then diffuses along the rotating direction of drum 4, and the wash water is jetted from around rim 23 a of opening 6 into drum 4 with the aid of guide-face 28b.

[0056] In this embodiment, jet directions "a" (indicated in a solid line with arrow in Fig. 3) of respective nozzles 26a - 26g are shifted by angle [theta]1 from the directions (indicated in an alternate long and short dash line in Fig. 3) directed to rotary axis 4a. This structure allows jetting the wash water uniformly in a wider area, so that the laundry agitated in drum 4 is more frequently exposed to the wash water. As a result, the wash water can be sprayed all over the laundry, and the performance of wash and rinse can be improved.

[0057] The jet directions of wash water from multiple nozzles 26 (26a-26g) can be shifted from the direction to rotary axis 4a by different angles although they are shifted in unison as discussed previously. This structure also allows jetting the wash water uniformly in a wider area, so that the laundry agitated in drum 4 is more frequently exposed to the wash water. As a result, the wash water can be sprayed all over the laundry, and the per-

formance of wash and rinse can be improved.

[0058] At least one nozzle, e.g. nozzle 26g, among multiple nozzles 26 is preferably placed close to the upper end of rim 23a of opening 6 so that nozzle 26g can jet the wash water into drum 4. This structure allows spraying the wash water from around the upper most point to the laundry, and the wash water jetted over the laundry flows downward due to gravitation, thereby wetting the laundry covered with the other laundry.

[0059] The starting operation is discussed above, and this operation can be used at the rinse, so that pump 21 works even at the rinse, and rinse water can be sprayed uniformly all over the laundry. As a result, the laundry can be rinsed efficiently within a shorter time.

[0060] When a given number of rinses is completed, open drain port 19 for discharging the rinse water, and spin rotary drum 4 for dewatering the rinse water contained in the laundry. The dewatering step is done for a given time before the operation ends. A drying device can be added for carrying out a drying step following the dewatering step.

Exemplary Embodiment 2

[0061] Fig. 6 is a fragmentary view taken along arrows 3 - 3 of a drum-type washing machine shown in Fig. 1 in accordance with the second embodiment. The second embodiment differs from the first one in placing nozzle water path 22 at any place except just under (along the perpendicular direction from) rotary axis 4a. Other structures remain unchanged from those of the first embodiment, so that detailed descriptions thereof are borrowed from the first one.

[0062] The wash water usually gathers at a lower section of drum 4, so that the laundry lying in the lower part is always supplied with the wash water. The wash water jetted from nozzle 26 may be sprayed over the laundry from under rotary axis 4a upward along the perpendicular direction. However, since the laundry lying in the lower part of drum 4 is usually supplied with the wash water, this upward jet stream produces poor effect. Nozzle water path 22 is thus placed at any place other than the place just under (along perpendicular direction from) rotary axis 4a. This structure allows supplying the wash water efficiently and uniformly all over the laundry, so that the performance of wash and rinse can be improved.

[0063] In this second embodiment, as shown in Fig. 6, three nozzles 26 (26a - 26c) are provided for instance, and nozzle 26a is apart from nozzle 26c by less than 180 degrees. No nozzle water path 22 exists between nozzle 26a and nozzle 26c. To be more specific, nozzle water path 22 is shaped like an arc including approx. 240 degrees and surrounding rotary axis 4a. Respective nozzles 26a - 26c are equidistantly placed, i.e. at equal intervals of 120 degrees.

[0064] To be more specific, nozzle 26a is placed at left lower side viewed from the opening of the rotary drum and relative to rotary axis 4a, and nozzle 26c is placed at right lower side, and nozzle 26b is placed at upper side. In other words, at least one nozzle is provided at each place, i.e. the upper, lower, right and left sides relative to rotary axis 4a. This structure allows multiple nozzles 26a - 26c to jet the wash water along upward, downward, leftward, and rightward directions to the laundry in drum 4 while the jet streams diffuse along the rotating direction. The laundry rotated following the rotation of drum 4 can be exposed to the wash water more frequently regardless of the location of the laundry in drum 4, so that the wash water can be sprayed uniformly all over the laundry.

[0065] Flow-in port 25, through which the wash water flows into nozzle water path 22, is formed at a place other than around the upper end of nozzle water path 22. The reason of this limited location is this: When pump 21 pumps out the wash water to nozzle water path 22 through flow-in port 25, the air initially trapped in path 22 is exhausted from nozzles 26a - 26c, and then path 22 is filled with the wash water. Usually the air tends to gather around the upper end of path 22, so that a supply of the wash water from the upper end of path 22 will stir the air gathered, and then the air disperses in path 22 if nozzle water path 22 is long.

[0066] At the beginning, streams of water mixed with air are jetted from nozzles 26, so that the streams are disarranged and louder noises are produced at the jet. Flow-in port 25 is thus placed at the place in order to avoid the foregoing problems, namely, at the place other than around the upper end of path 22, thereby preventing the air from being stirred and preventing the jet water stream from being mixed with air. The disarrangement of the jet streams and the loud noise at the jet thus can be prevented.

[0067] In this second embodiment, nozzle water path 22 should not be laid just under rotary axis 4a (along the perpendicular direction); however, path 22 can be laid just under axis 4a while nozzles 26 should not be placed there. This structure allows spraying the wash water efficiently and uniformly all over the laundry, and the performance of wash and rinse can be improved.

Exemplary Embodiment 3

[0068] Fig. 7 is a fragmentary view taken along arrows 3 - 3 of the drum-type washing machine shown in Fig. 1 for illustrating the third embodiment of the present invention. The third embodiment employs nozzles 26a - 26f that jet the wash water along directions other than the perpendicular direction to rotary axis 4a. The other structures remain unchanged from those of the first embodiment, so that the detailed descriptions thereof are borrowed from the first one.

[0069] Since the wash water stays at a lower section of rotary drum 4, the laundry there is supplied with the wash water. Nozzles 26a - 26f thus jet the wash water along the directions other than the perpendicular direction which is directed to just under rotary axis 4a. This

structure allows spraying the wash water efficiently and uniformly all over the laundry, and the performance of wash and rinse can be improved.

Exemplary Embodiment 4

[0070] Fig. 8 is a fragmentary view taken along arrows 3 - 3 of the drum-type washing machine shown in Fig. 1 for illustrating the fourth embodiment of the present invention. The fourth embodiment employs nozzles 26a - 26g that are equidistantly apart from each other with intervals of angle [theta]3 therebetween. The other structures remain unchanged from those of the first embodiment, so that the detailed descriptions thereof are borrowed from the first one.

[0071] As shown in Fig. 8, nozzle water path 22 is laid approx. annularly (including a circle) to surround almost entire circumference around rotary axis 4a. The number of multiple nozzles 26 is determined in response to the length of path 22. For instance, seven nozzles 26a - 26f are equidistantly placed in path 22 with approx. the same intervals (including the same intervals) of angle [theta]3 therebetween, i.e. in this case angle [theta]3 is 360/7 degrees.

[0072] This structure allows nozzles 26a - 26f to jet the wash water uniformly into drum 4. As a result, the laundry can be exposed more frequently to the wash water, and the wash water can be supplied more uniformly to the laundry.

[0073] In this fourth embodiment, the wash water is jetted toward rotary axis 4a, i.e. the wash water to be supplied to the laundry is jetted toward the center of drum 4. This structure allows the wash water to resist flowing out through vents 13 formed on cylindrical wall 11 to the outside of drum 4. As a result, the laundry can be wetted efficiently.

Exemplary Embodiment 5

[0074] Fig. 9 is a fragmentary view taken along arrows 3 - 3 of the drum-type washing machine shown in Fig. 1 for illustrating the fifth embodiment of the present invention. The fifth embodiment employs nozzles 26a - 26g of which at least one jet direction is different from the other jet directions. This is the different point from the first embodiment. To be more specific, a jet direction from, e.g. nozzle 26c and a direction toward rotary axis 4a from nozzle 26c viewed from the opening of drum 4 includes an angle. The other nozzles also form angles between their jet direction and the directions toward axis 4a. In this fifth embodiment, at least one of the foregoing angles is formed differently from the other angles. The other structures remain unchanged from those of the first embodiment, so that the detailed descriptions thereof are borrowed from the first one.

[0075] As shown in Fig. 9, angle [theta]4 formed by nozzle 26c differs from angle [theta]5 formed by nozzle 26d such that angle [theta]5 is greater than angle [theta] 4. In a case where a large amount of laundry is loaded into drum 4, the laundry moves a little in drum 4 such that it rotates together with drum 4. The structure discussed above allows the jet streams from nozzles 26a - 26g over the laundry to change their directions following the rotation of drum 4. As a result, the wash water can be supplied efficiently and uniformly all over the laundry.

Exemplary Embodiment 6

[0076] Fig. 10 is a sectional view of a nozzle of a drum-type washing machine in accordance with the sixth embodiment of the present invention. In this sixth embodiment, nozzle hole 31 is tapered, i.e. the diameter of hole 31 at the flow-in side of the wash water is smaller than the diameter at the flow-out side thereof. The other structures remain unchanged from those of the first embodiment, so that the detailed descriptions thereof are borrowed from the first one.

[0077] To be more specific, as shown in Fig. 10, nozzle hole 31 of nozzle 26 is tapered and its diameter at the flow-out side is "d1" and the one at the flow-in side is "d2", and d1 > d2 is established.

[0078] The flow around inner wall 22b of nozzle water path 22 tries to flow as close as possible to inner wall 22b due to the viscosity; however, the tapered hole 31 bends sharply inner wall 22b by well over 90 degrees at the place where the wash water is jetted from hole 31. The flow of wash water thus separates at a greater distance than the conventional one from the inside wall of hole 31, so that the flow is contracted. The structure discussed above thus contracts the jet stream of wash water for increasing the velocity thereof. As a result, stronger jet streams can be expected, and the performance of wash and rinse can be improved.

Exemplary Embodiment 7

[0079] Fig. 11 is a sectional view of a nozzle of a drum-type washing machine in accordance with the seventh embodiment of the present invention. In this seventh embodiment, flat part 30 where nozzle hole 31 is formed is swelled toward the flow-in side. The other structures remain unchanged from those of the first embodiment, so that the detailed descriptions thereof are borrowed from the first one.

[0080] To be more specific, as shown in Fig. 11, on flat part 30, nozzle hole 31 forms an uphill slope toward the flow-in side, thereby increasing the height by "H" at hole 31, in other words, the location of hole 31 swells up toward the flow-in side by height "H". The swell of flat part 30 can form either a slope or an arc.

[0081] In general, the flow around inner wall 22b of nozzle water path 22 tries to flow close to inner wall 22b due to the viscosity; however, the structure discussed above bends sharply inner wall 22b by well over 90 degrees at the place where the wash water is jetted from hole 31. The flow of wash water thus separates at a great-

er distance than the conventional one from the inner wall of hole 31, so that the flow is contracted. The structure discussed above thus contracts the jet stream of wash water for increasing the velocity thereof. As a result, stronger jet streams can be expected, and the performance of wash and rinse can be improved.

Exemplary Embodiment 8

[0082] Fig. 12 is a sectional view of a nozzle of a drum-type washing machine in accordance with the eighth embodiment of the present invention. In this eighth embodiment, cylindrical rib is formed in a protruding manner on flat part 30 at the flow-in side of nozzle hole 31. The other structures remain unchanged from those of the first embodiment, so that the detailed descriptions thereof are borrowed from the first one.

[0083] In general, the flow around inner wall 22b of nozzle water path 22 tries to close to inner wall 22b due to the viscosity; however, cylindrical rib 22c protruding from hole 31 toward the flow-in side sharply bends inner wall 22b by approx. 180 degrees, so that the flow is separated distantly from the inside wall of hole 31 and the flow can be thus more contracted. As a result of this greater contraction, the velocity of flow increases, and stronger jet streams can be expected, and the performance of wash and rinse can be improved.

Exemplary Embodiment 9

[0084] Fig. 13 - Fig. 15 are sectional views of a nozzle of the drum-type washing machine in accordance with the ninth embodiment. Fig. 13 is a sectional view taken along line 13 - 13 in Fig. 6, Fig. 14 is a sectional view taken along line 14 - 14 in Fig. 6, and Fig. 15 is a sectional view taken along line 15 - 15 in Fig. 6.

[0085] Guide-face 28b is formed on reflector 28 which leads the wash water jetted from each one of multiple nozzles 26a - 26c into rotary drum 4. Guide-face 28b includes a slope, of which angular part opposite to each one of nozzles 26a - 26c, tilts differently from another angular part thereof. There are at least two different tilt angles. This is a different point from the first embodiment. The other structures remain unchanged from those of the first embodiment, so that the detailed descriptions thereof are borrowed from the first one.

[0086] To be more specific, hit-faces 28a, against which the wash water jetted from nozzles 26a - 26c hit, of nozzles 26a - 26c tilt at the same angle; however, guide-faces 28b, which guide the wash water hit against hit-faces 28a to opening 6 of drum 4, tilts differently among nozzles 26a - 26c. As shown in Fig. 13, the wash water jetted from nozzle 26a hits against hit-face 28a and flows along the arrow to guide-face 28b, of which function is to guide the wash water hit against hit-face 28a to opening 6, and guide-face 28b greatly tilts toward opening 6 relative to the jet stream of wash water. The wash water thus jets along direction S1.

[0087] As shown in Fig. 14, guide-face 28b of nozzle 26b tilts smaller than that of nozzle 26a, then the wash water jets along direction S2. As shown in Fig. 15, guide-face 28b of nozzle 26c tilts smaller than other two guides 26b, then the wash water jets along direction S3.

[0088] The structure discussed above allows nozzle 26a to jet the wash water into drum 4 at the inside-front of drum 4, while nozzles 26b and 26c jet the wash water into drum 4 at inner-deep (bottom of drum 4), because each one of guides 26b tilt at different angles. In other words, the wash water jetted from multiple nozzles 26a - 26c hits against respective hit-faces 28a, which tilt at the same angle, so that each wash-water diffuses in the same manner, and each guide-face 28b changes a direction along which the each diffusing water is supplied to the laundry.

[0089] In the case where a large amount of laundry is loaded in drum 4 and the laundry rotates together with drum 4, the direction of supplying the wash water can be changed in response to the rotation of drum 4, so that the wash water can be supplied efficiently and uniformly to all over the laundry.

Exemplary Embodiment 10

[0090] Fig. 16 is a fragmentary view taken along arrows 3 - 3 of Fig. 1 for illustrating the tenth embodiment of the present invention. Fig. 17 illustrates a way of jetting the wash water from multiple nozzles 26. The left drawing of Fig. 17 is a front sectional view of rotary drum 4 viewed from the front, i.e. from the opening, and the right drawing of Fig. 17 is a lateral sectional view of rotary drum 4.

[0091] As shown in the right drawing of Fig. 17, upper nozzle 26a jets the wash water at jet angle "[alpha]" relative to rotary axis 4a and lower nozzle 26b jets the wash water at jet angle "[beta]" relative to rotary axis 4a. Jet angle "[alpha]," is preferably different from jet angle "[beta]".

[0092] The foregoing structure allows reducing the hit areas between the streams of wash water jetted from nozzle 26a and nozzle 26b, although the streams run across with each other. This structure thus prevents the kinetic energy, produced when the wash water is jetted, from being lowered. As a result, the performance of wash increases, because the wash water having great kinetic energy can strip dirt off from the laundry, and can increase the force that allows the wash water to permeate into fibers more in depth.

[0093] Since jet angle "[alpha]" is set different from jet angle "[beta]", the streams of wash water lands at different places with respect to the depth direction of rotary drum 4. The wash water thus can be sprayed all over the laundry even when the laundry spreads over in drum 4, so that the laundry can be wetted fast.

[0094] In the embodiments previously discussed, each one of nozzle holes of nozzles 26 has the same jetting area (diameter of hole); however, the present invention is not limited to these embodiments. The wash water

pumped out by pump 21 is conveyed to the upper side while its flow velocity in part is converted into potential energy, or the flow velocity is lowered due to resistance in a long nozzle water path 22. An amount of circulation flow is thus gradually reduced. To overcome this problem, the jetting areas of nozzle holes of nozzles 26 are preferably changed in response to the locations of nozzles 26.

[0095] For instance, as shown in Fig. 17, in the case where flow-in port 25 is formed at a lower part of rotary drum 4, jetting areas of nozzles 26a laid at the upper front section of drum 4 are set greater than those of nozzles 26b laid closer to flow-in port 25 (e.g. at the lower front of drum 4). This structure can prevent from reducing an amount of wash water jetted from nozzle 26a laid at an upper half of drum 4 even when the water pressure lowers, and can maintain the amount of wash water jetted from nozzle 26a at approx. the same amount jetted from nozzle 26b.

[0096] For instance, as shown in Fig. 16, flow-in port 25 formed at an upper section of drum 4 invites no loss in the flow velocity, where the loss is caused by the conversion into potential energy, so that there is no need to vary the jetting area for both of nozzles 26a and 26b.

[0097] The structure described in one of the embodiments discussed previously can be combined with the other embodiments, or combined with a part of the other embodiments.

The following examples listed below are directed to advantageous embodiments which may represent separate and independent inventions:

A. A drum-type washing machine comprising:

(a) water tub for storing wash water;
(b) a rotary drum disposed rotatably in the water tub and having an opening at a front face of the rotary drum;
(c) a motor for driving the rotary drum;
(d) a water circulating path for circulating the wash water stored in the water tub to the rotary drum;
(e) a pump for conveying the wash water stored in the water tub to the water circulating path;
(f) a plurality of nozzles for jetting the wash water, transmitted thereto by the pump, into the rotary drum; and
(g) a nozzle water path formed around a front face of the water tub for conveying the wash water from the water circulating path to the plurality of nozzles.

B. The drum-type washing machine of embodiment A, wherein the plurality of nozzles jets the wash water along directions shifted by an angle equal to each other from a direction starting from each one of the nozzles, viewed from the opening side of the rotary drum, toward the rotary axis. tilts by the shift angle [theta]1 of nozzle 26.

C. The drum-type washing machine of embodiment A, wherein at least one nozzle of the plurality of nozzles jets the wash water along different directions from each other, viewed from the opening side of the rotary drum, toward a rotary axis of the rotary drum.

D. The drum-type washing machine as defined in any one of embodiment A to embodiment C, wherein at least one nozzle of the plurality of nozzles jets the wash water along different directions from each other, viewed from a lateral side of the drum, toward the rotary axis of the drum.

E. The drum-type washing machine as defined in any one of embodiment A to embodiment C, wherein the nozzle water path is disposed generally annularly outside a rim of the opening.

F. The drum-type washing machine as defined in any one of embodiment A to embodiment C, wherein the plurality of nozzles is disposed at any place other than a place directed along a perpendicular direction from the rotary axis of the drum.

G. The drum-type washing machine as defined in any one of embodiment A to embodiment C, wherein the plurality of nozzles is disposed such that the nozzles jet the wash water in any direction other than a perpendicular direction from the rotary axis of the rotary drum.

H. The drum-type washing machine as defined in any one of embodiment A to embodiment C, wherein the plurality of nozzles is disposed surrounding the rotary axis as a center, viewed from the opening side of the rotary drum, and at intervals of approx. an equal angle to each other.

I. The drum-type washing machine as defined in any one of embodiment A to embodiment C , wherein the plurality of nozzles is disposed at approx. equal intervals to each other in an upper section or a lower section of the water tub at a front circumference of the tub.

J. The drum-type washing machine as defined in any one of embodiment A to embodiment C, wherein the plurality of nozzles jets approx. equal amount of the wash water to each other.

K. The drum-type washing machine as defined in any one of embodiment A to embodiment C, wherein each one of the nozzles disposed on an upper section of front circumference of the water tub has a greater opening area than each one of the nozzles disposed on a lower section of the front circumfer-

ence of the water tub.

L. The drum-type washing machine as defined in any one of embodiment A to embodiment C, wherein the plurality of nozzles has a nozzle hole through which the wash water is jetted, and the nozzle hole is tapered such that a diameter of the nozzle hole is greater at a flow-out side of the wash water than a diameter of the nozzle hole at a flow-in side of the wash water.

M. The drun-type washing machine as defined in any one of embodiment A to embodiment C, wherein the plurality of nozzles has a nozzle hole through which the wash water is jetted and a flat part which is provided with the nozzle hole, and the flat part swells toward a flow-in side of the wash water.

N. The drum-type washing machine as defined in any one of embodiment A to embodiment C, wherein the plurality of nozzles has a nozzle hole through which the wash water is jetted, and the nozzle hole is provided with a cylindrical rib at a flow-in side of the wash water.

O. The drum-type washing machine as defined in any one of embodiment A to embodiment C, wherein the nozzle water path is provided with a reflector and a guide for guiding the wash water jetted from the plurality of nozzles into the rotary drum, the reflector has a hit-face for hitting the wash water jetted from the plurality of nozzles and a guide-face for guiding the wash water hit the hit-face into the rotary drum.

Claims

1. A drum-type washing machine comprising:

(a) water tub for storing wash water;
(b) a rotary drum disposed rotatably in the water tub and having an opening at a front face of the rotary drum;
(c) a motor for driving the rotary drum;
(d) a water circulating path for circulating the wash water stored in the water tub to the rotary drum;
(e) a pump for conveying the wash water stored in the water tub to the water circulating path;
(f) a plurality of nozzles for jetting the wash water, transmitted thereto by the pump, into the rotary drum; and
(g) a nozzle water path formed around a front face of the water tub for conveying the wash water from the water circulating path to the plurality of nozzles,

wherein at least one nozzle of the plurality of nozzles jets the wash water along different directions from each other, viewed from a lateral side of the drum, toward the rotary axis of the drum .

2. The drum-type washing machine as defined in claim 1, wherein the nozzle water path is disposed generally annularly outside a rim of the opening.

3. The drum-type washing machine as defined in claim 1, wherein the plurality of nozzles is disposed at any place other than a place directed along a perpendicular direction from the rotary axis of the drum.

4. The drum-type washing machine as defined in claim 1, wherein the plurality of nozzles is disposed such that the nozzles jet the wash water in any direction other than a perpendicular direction from the rotary axis of the rotary drum.

5. The drum-type washing machine as defined in claim 1, wherein the plurality of nozzles is disposed surrounding the rotary axis as a center, viewed from the opening side of the rotary drum, and at intervals of approx. an equal angle to each other.

6. The drum-type washing machine as defined in claim 1, wherein the plurality of nozzles is disposed at approx. equal intervals to each other in an upper section or a lower section of the water tub at a front circumference of the tub.

7. The drum-type washing machine as defined in claim 1, wherein the plurality of nozzles jets approx. equal amount of the wash water to each other.

8. The drum-type washing machine as defined in claim 1, wherein each one of the nozzles disposed on an upper section of front circumference of the water tub has a greater opening area than each one of the nozzles disposed on a lower section of the front, circumference of the water tub.

9. The drum-type washing machine as defined in claim 1, wherein the plurality of nozzles has a nozzle hole through which the wash water is jetted, and the nozzle hole is tapered such that a diameter of the nozzle hole is greater at a flow-out side of the wash water than a diameter of the nozzle hole at a flow-in side of the wash water.

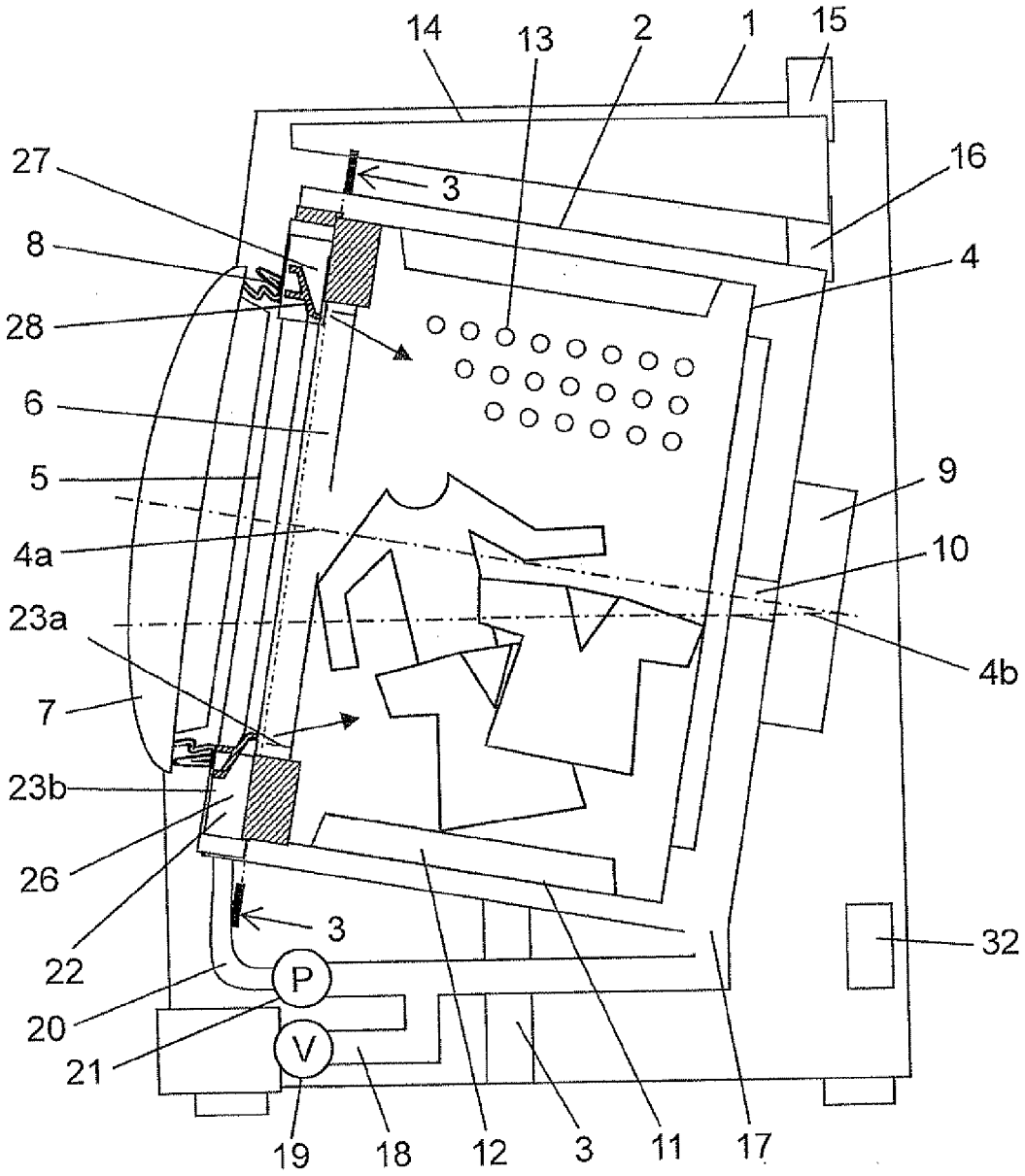
10. The drum-type washing machine as defined in claim 1, wherein the plurality of nozzles has a nozzle hole through which the wash water is jetted and a flat part which is provided with the nozzle hole, and the flat part swells toward a flow-in side of the wash water.

11. The drum-type washing machine as defined in claim 1, wherein the plurality of nozzles has a nozzle hole through which the wash water is jetted, and the noz-

zle hole is provided with a cylindrical rib at a flow-in side of the wash water.

12. The drum-type washing machine as defined in claim 1, wherein the nozzle water path is provided with a reflector and a guide for guiding the wash water jetted from the plurality of nozzles into the rotary drum, the reflector has a hit-face for hitting the wash water jetted from the plurality of nozzles and a guide-face for guiding the wash water hit the hit-face into the rotary drum.

FIG. 1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10
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11
17

FIG. 2

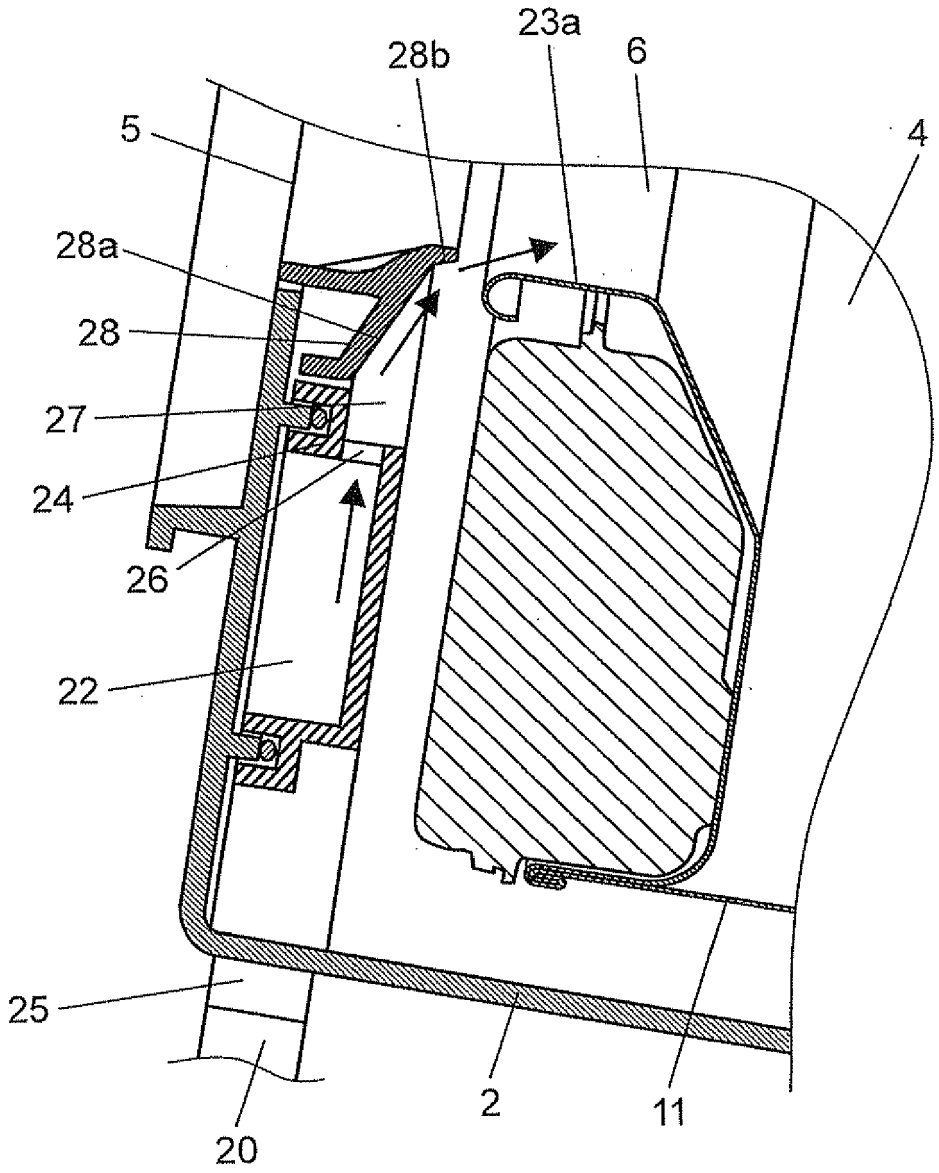


FIG. 3

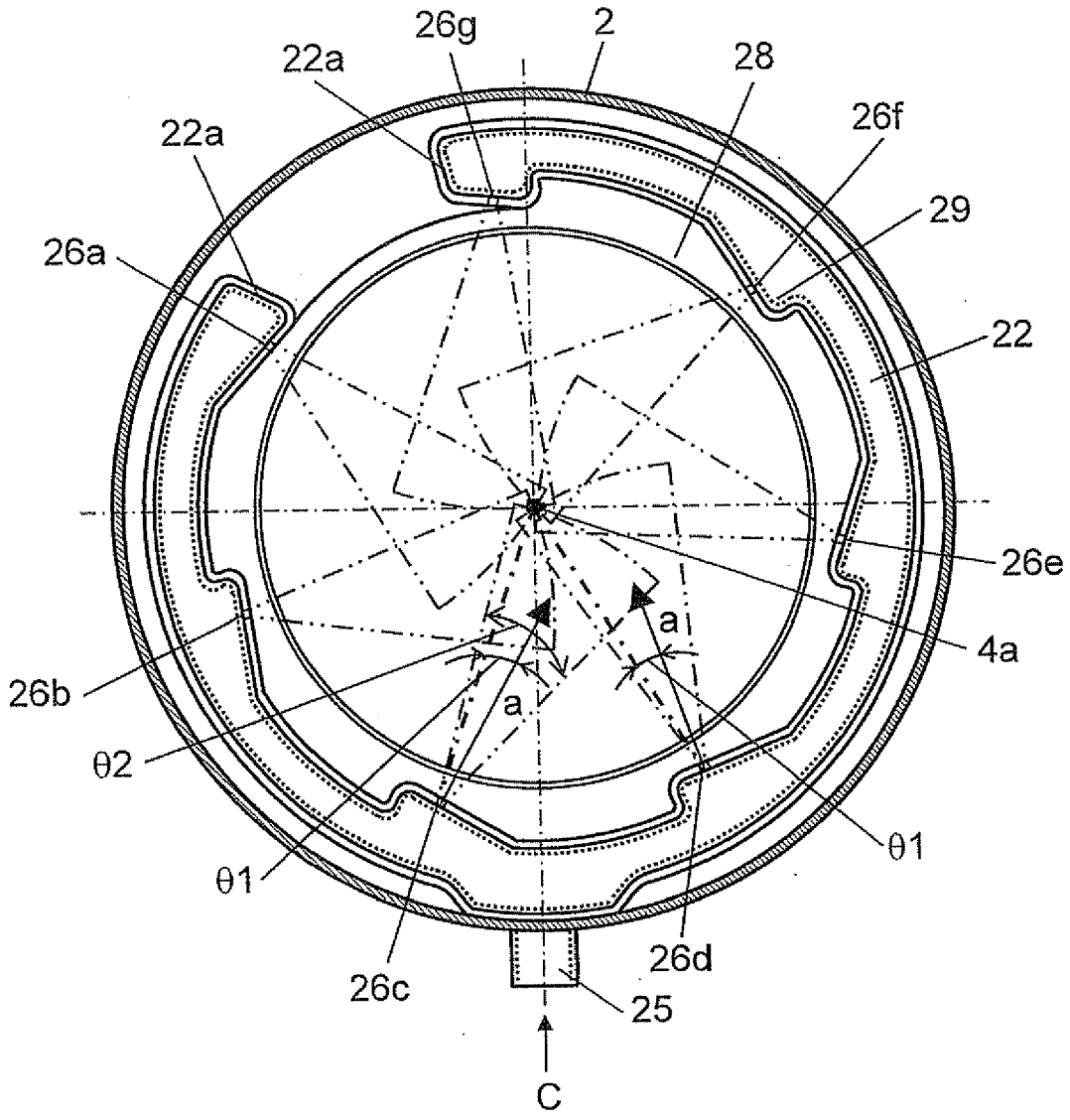


FIG. 4

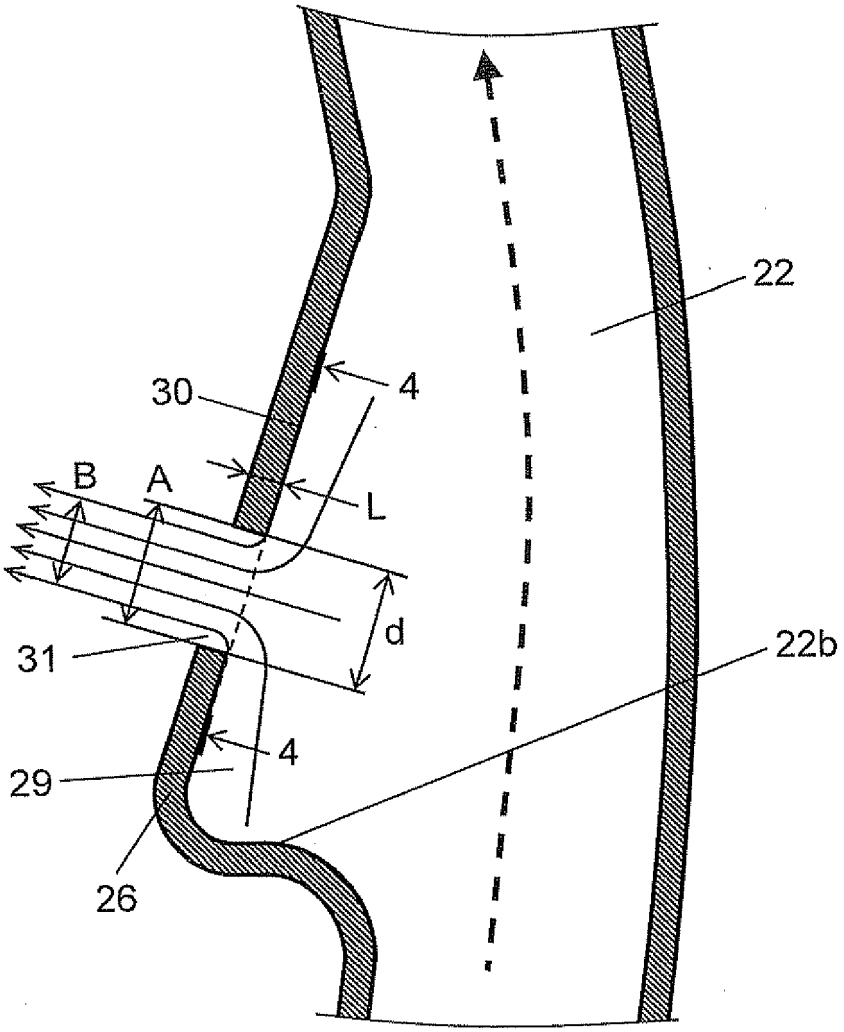


FIG. 5

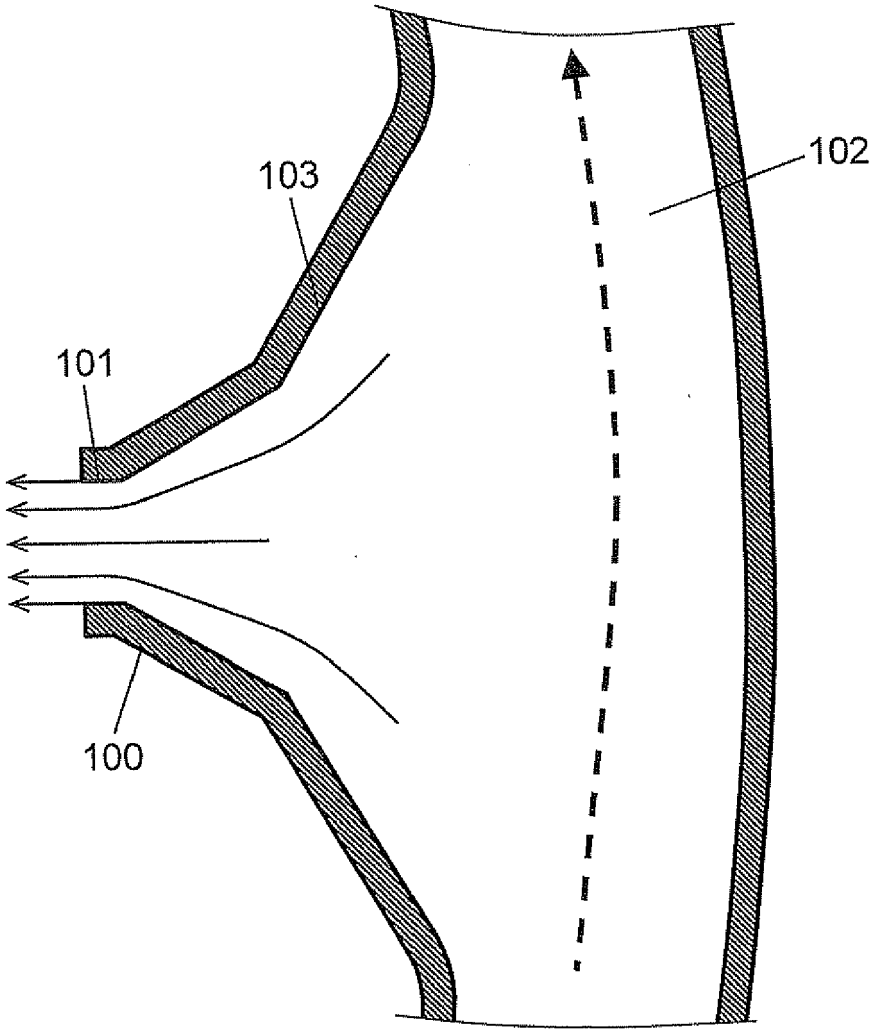


FIG. 6

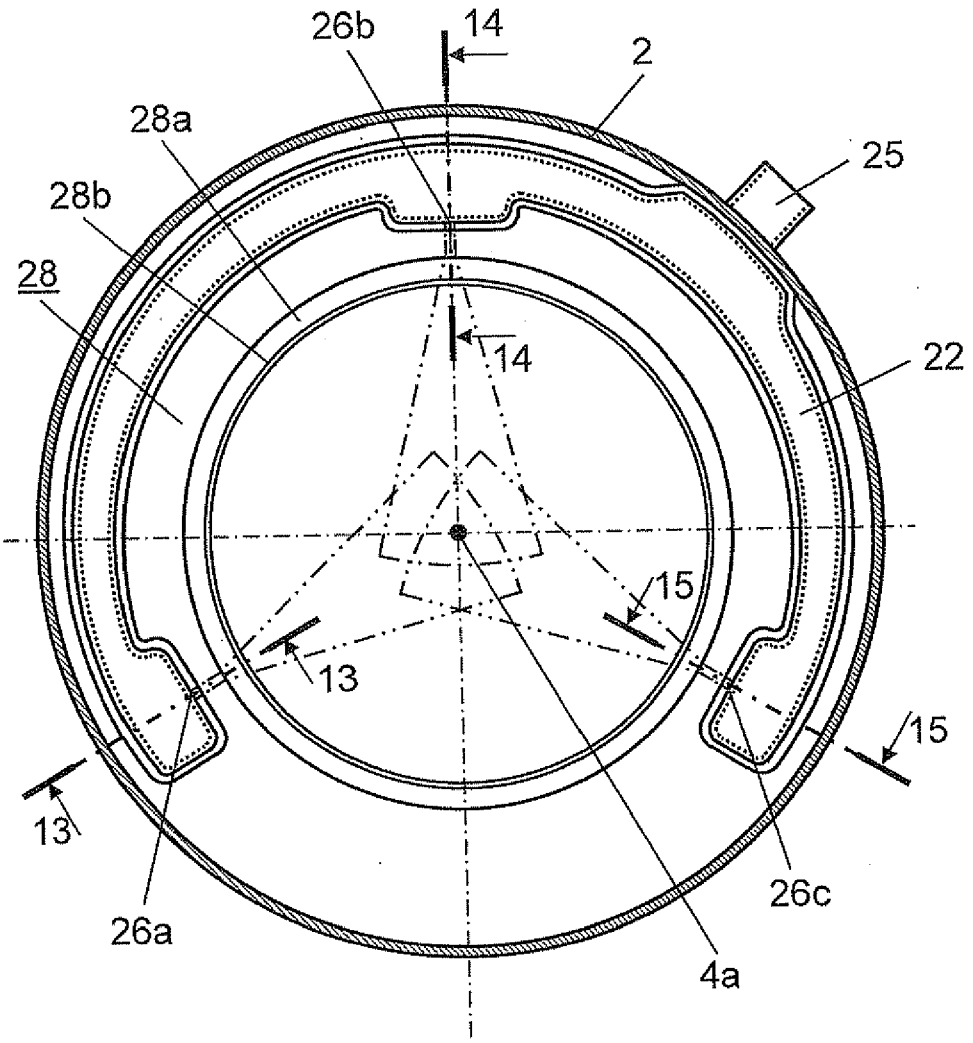


FIG. 7

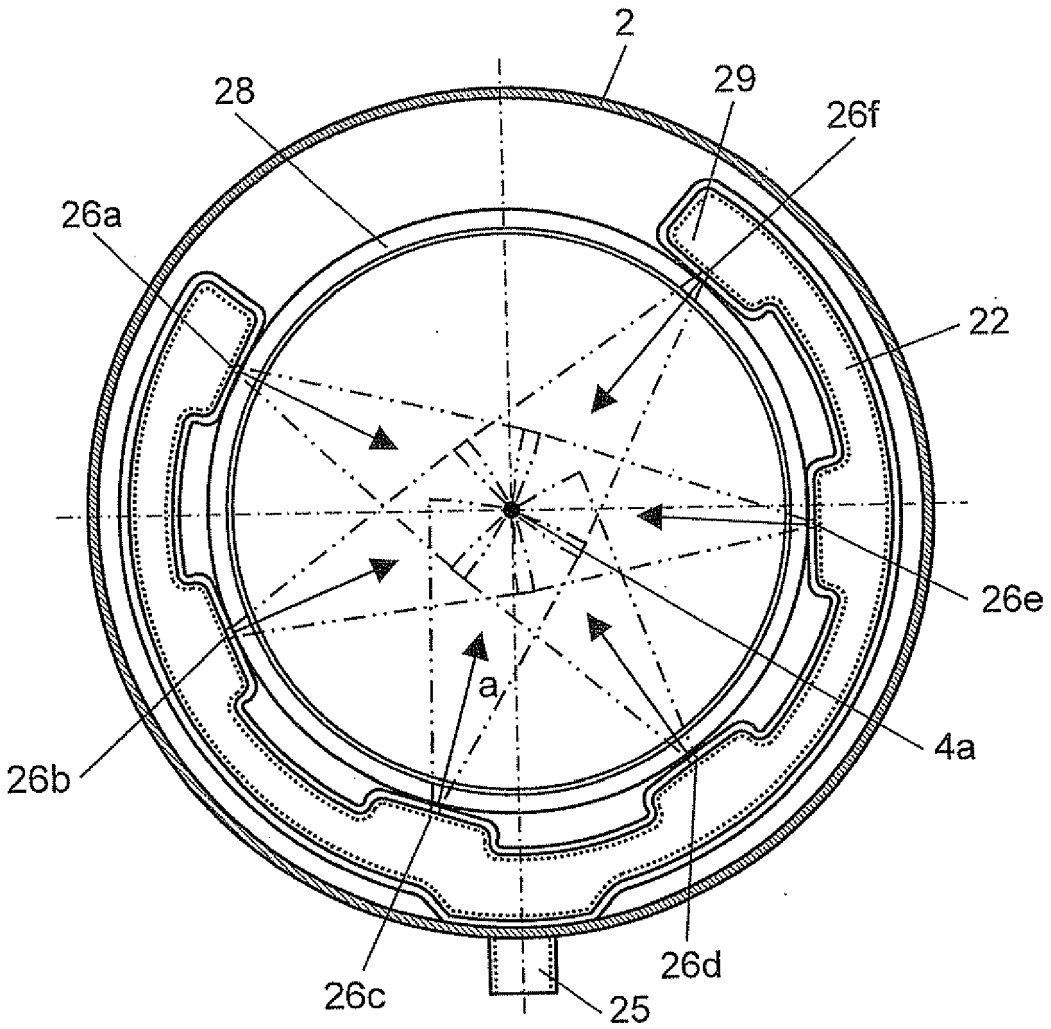


FIG. 8

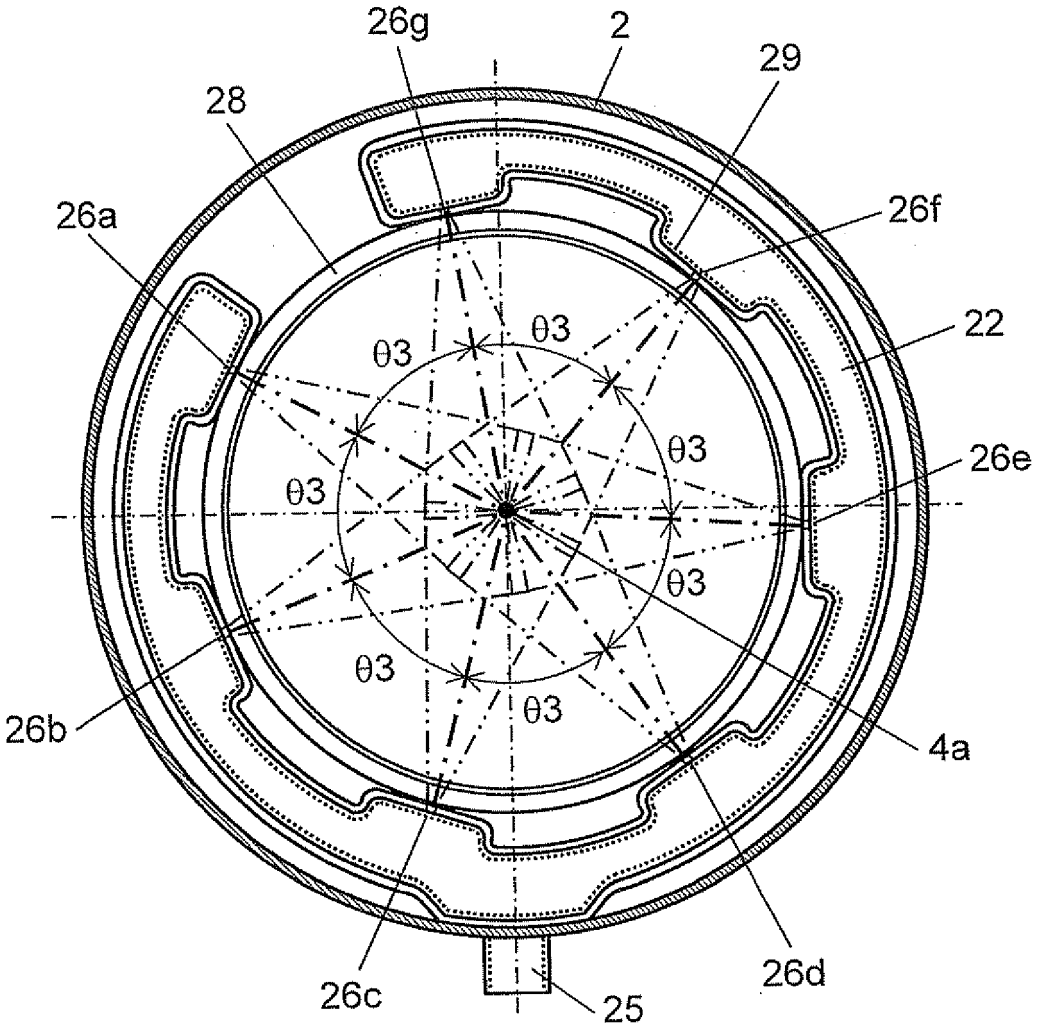


FIG. 9

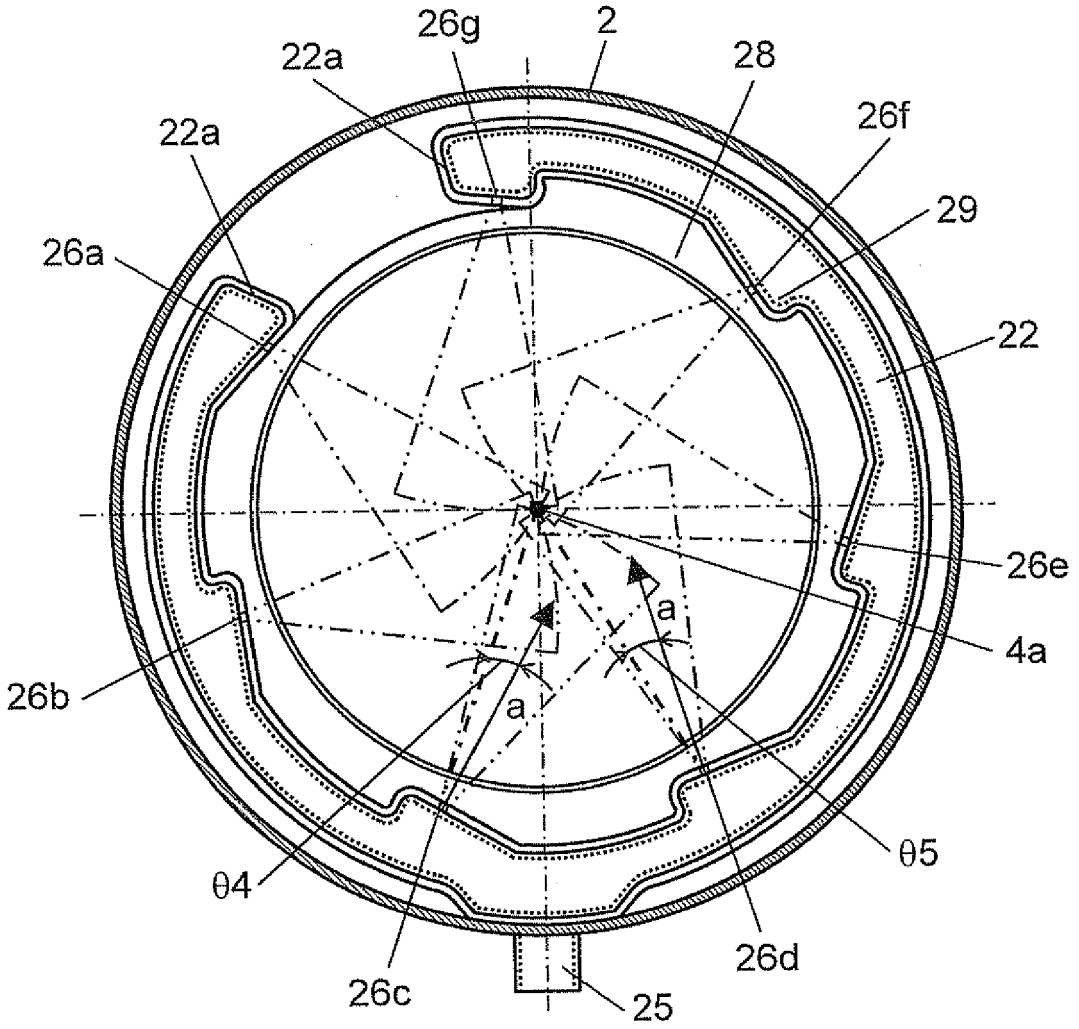


FIG. 10

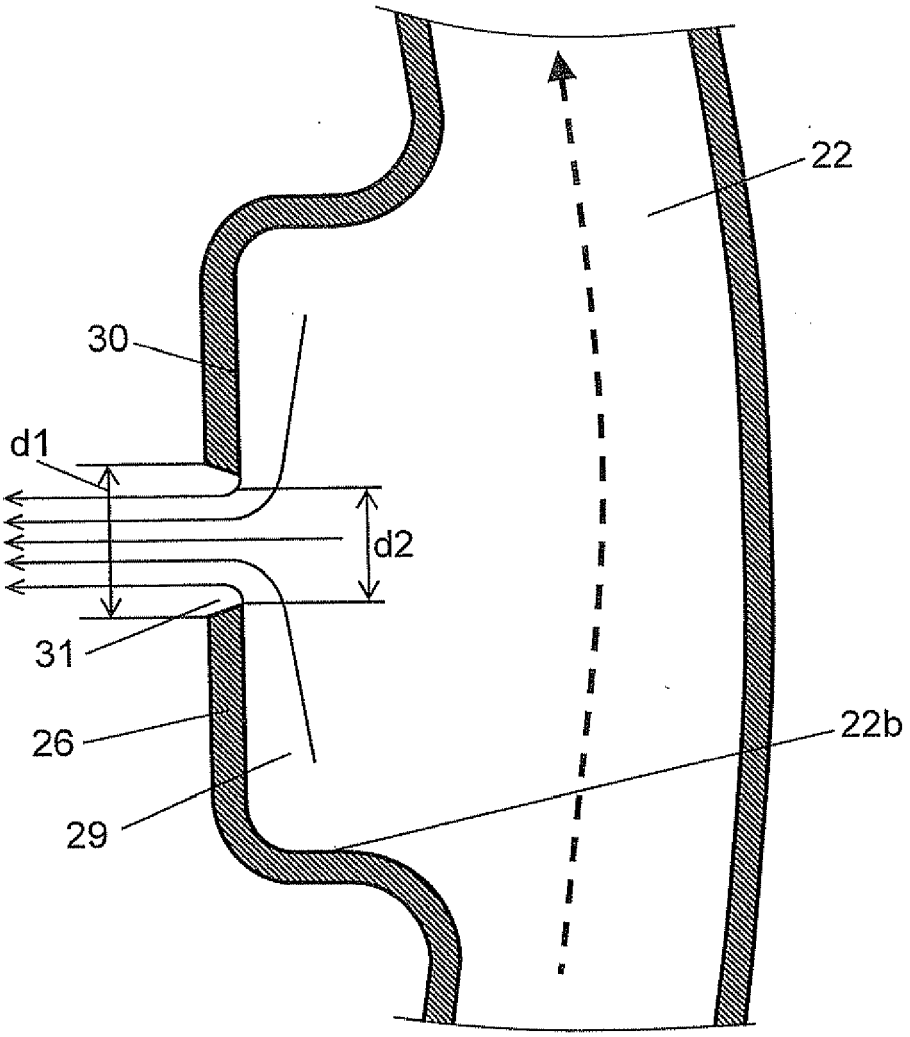


FIG. 11

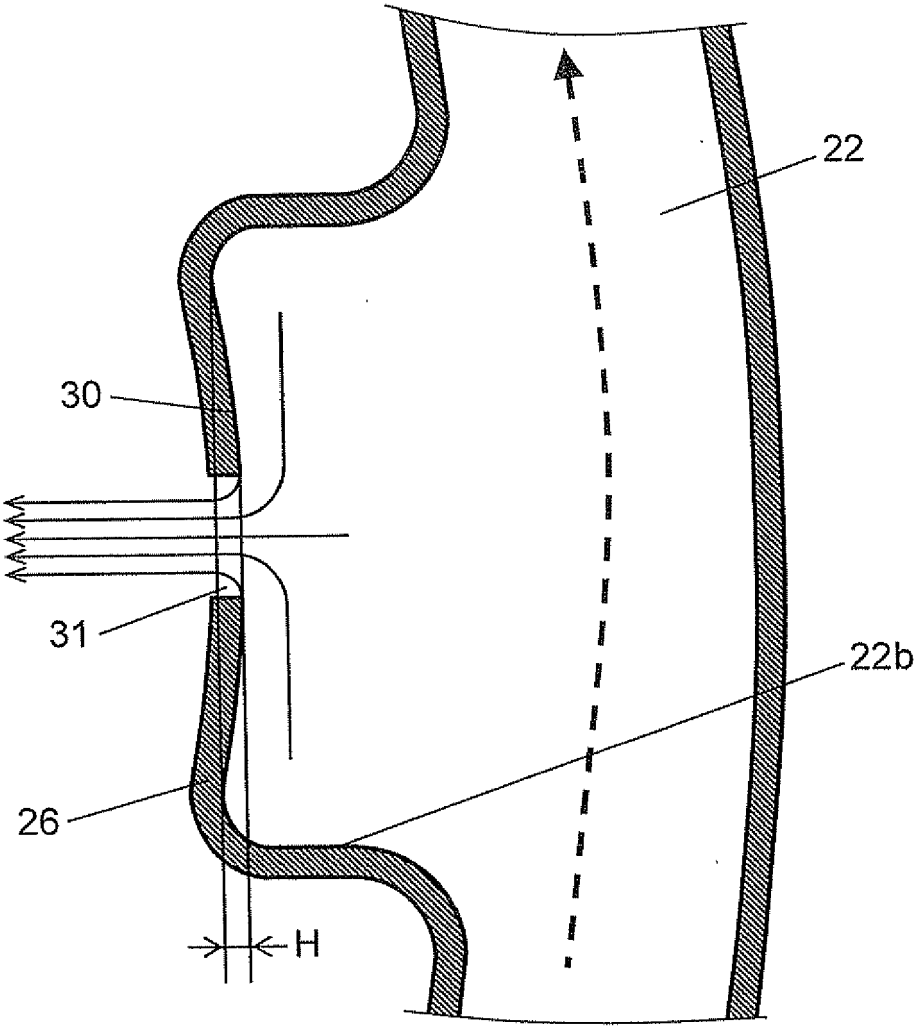


FIG. 12

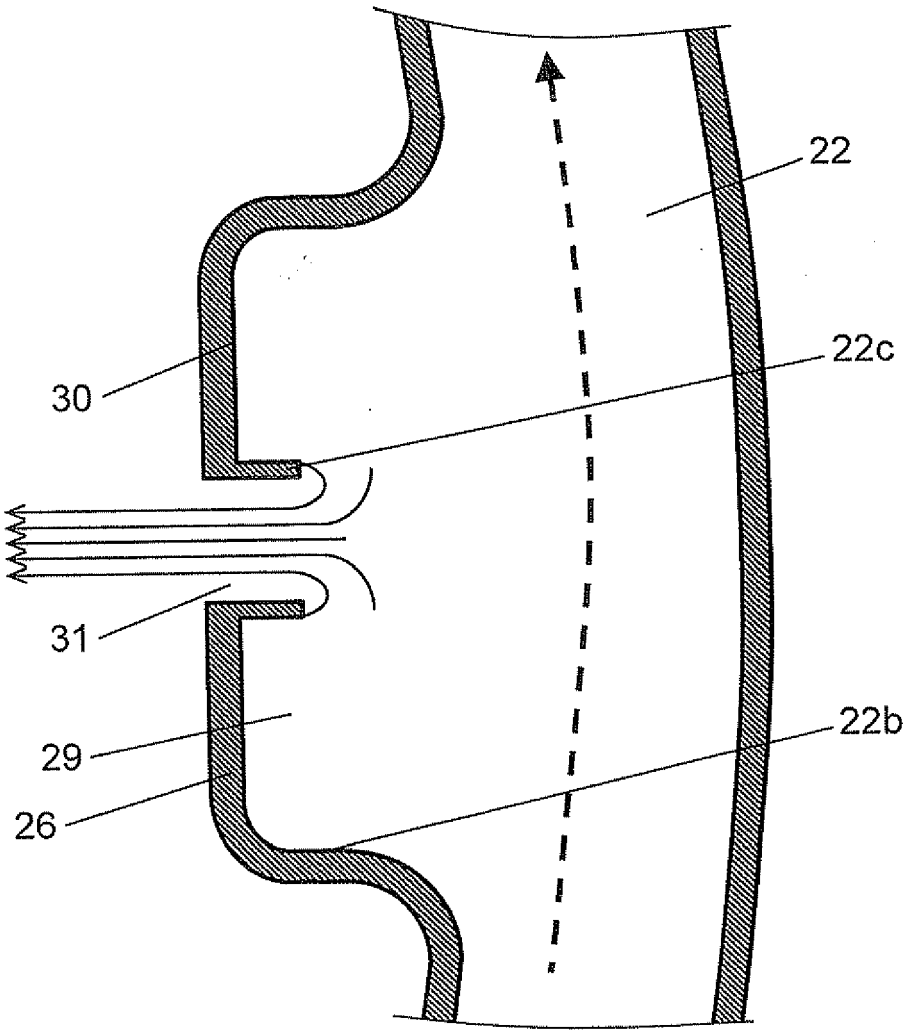


FIG. 13

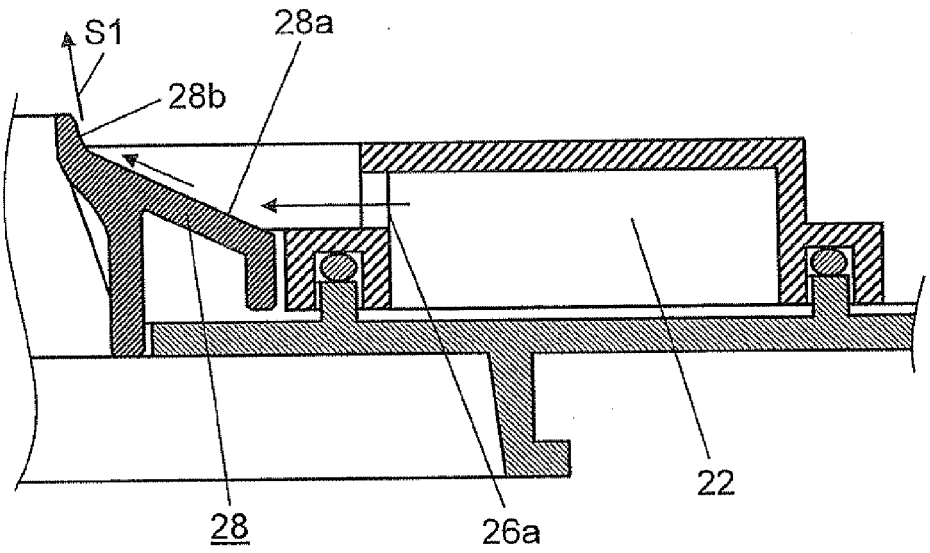


FIG. 14

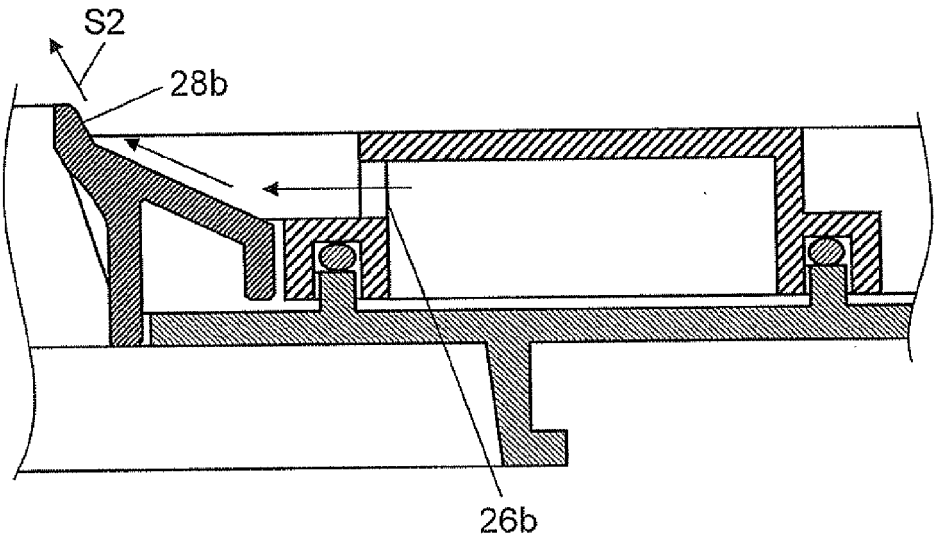


FIG. 15

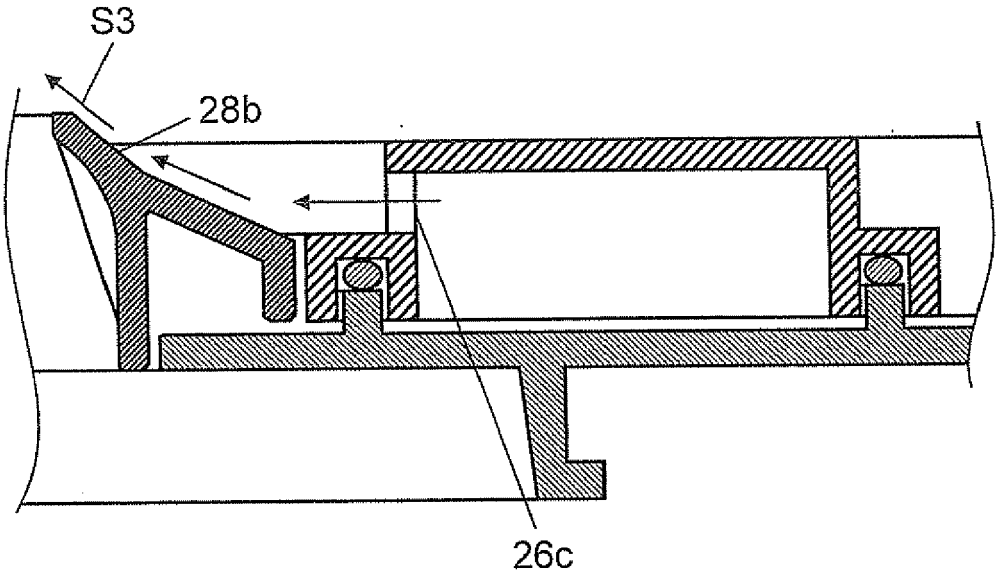


FIG. 16

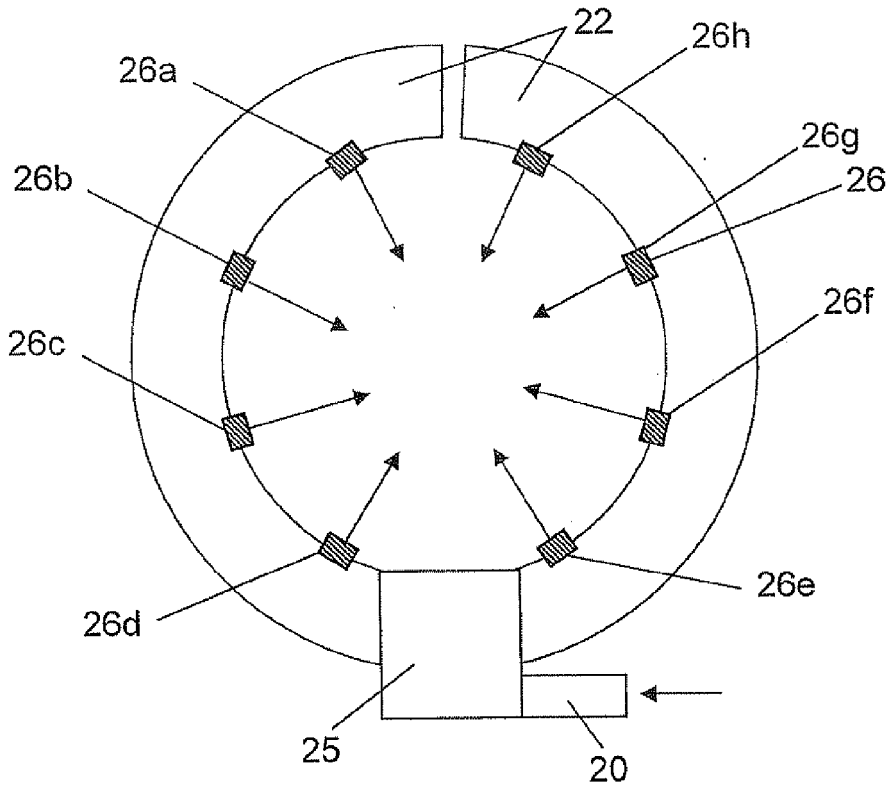


FIG. 17

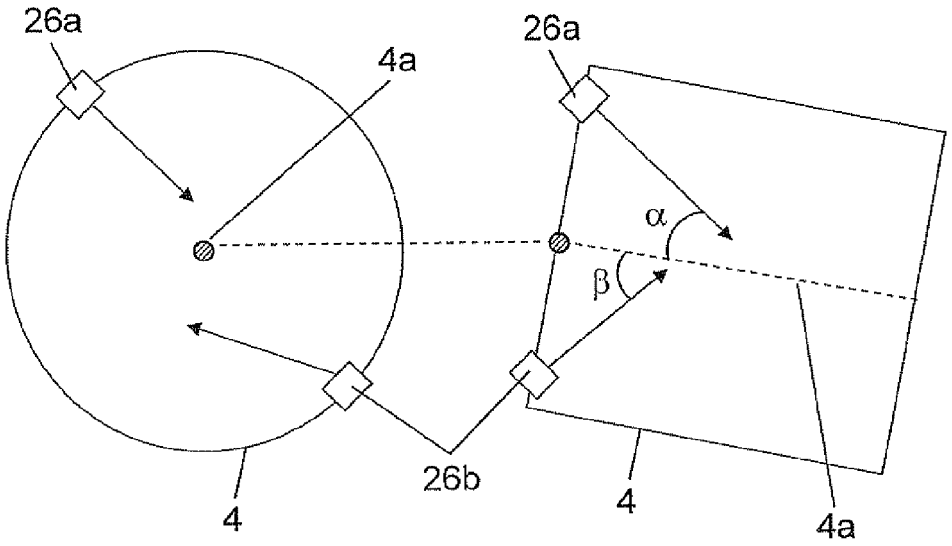


FIG. 18

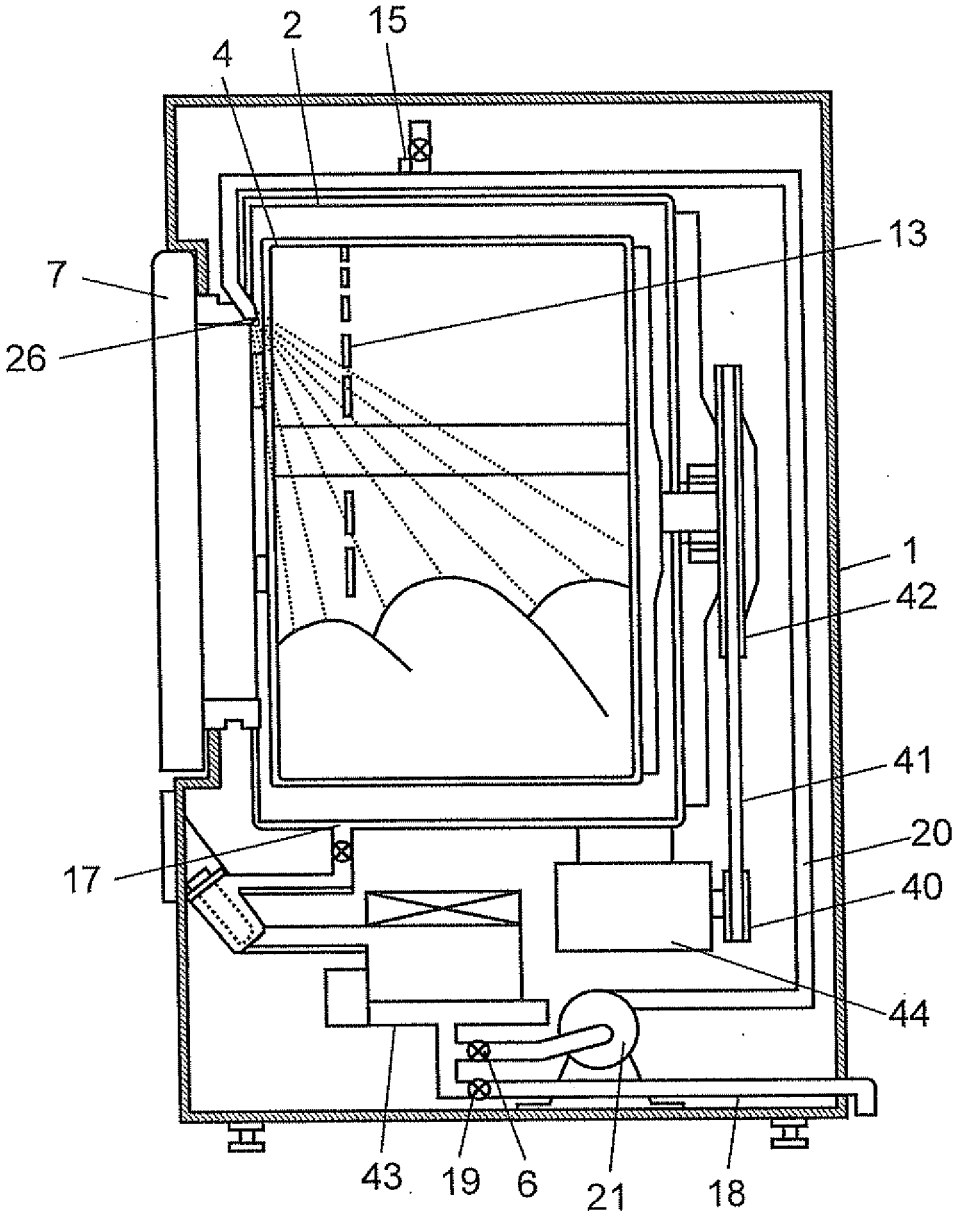
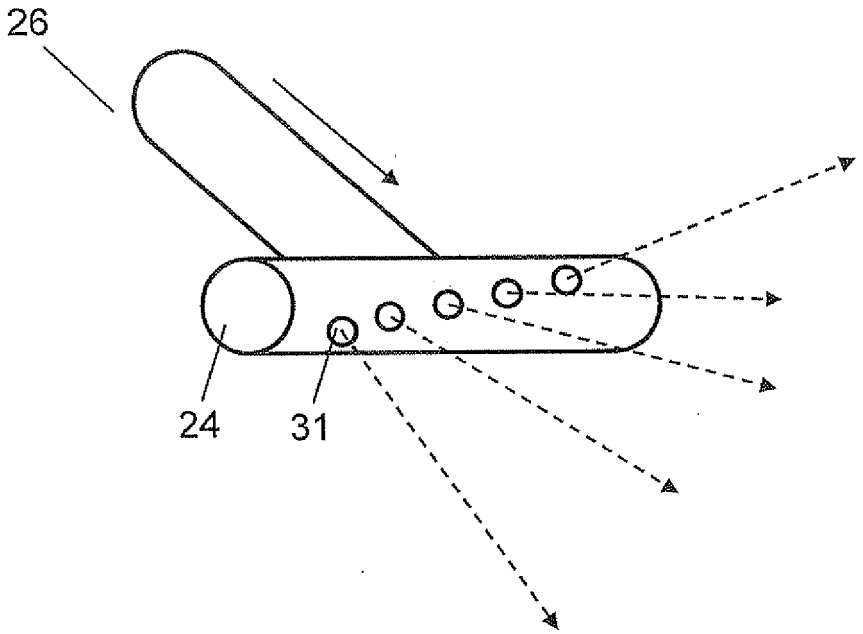


FIG. 19



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Application Number
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Munich	23 July 2013	Diaz y Diaz-Caneja

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