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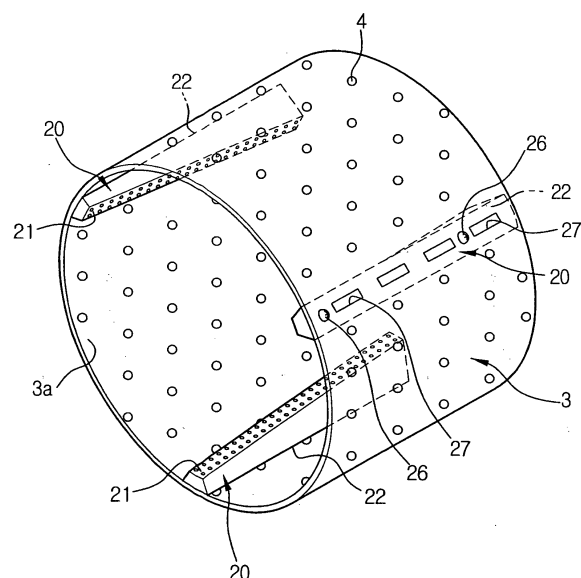
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(54) **Drum type washing machine**

(57) A drum type washing machine has axially-extending lifters (20) arranged around an inner peripheral surface of a rotatable tub (3) which is upwardly inclined to allow easy laundry loading and unloading. The lifters each have a height gradually reducing to correspond to the inclination angle of the rotatable tub from a rear end of the rotatable tub to a front end thereof. Each lifter has, at its top portion (21), a wave-shaped structure including crests (21a) and valleys (21b) alternately arranged at a certain pitch. Each of the crests and valleys has water spray holes (23). The lifter includes at least one partition plate (31, 32) which divides the interior of the lifter into at least two chambers (41, 42, 43). Accordingly, wash water raised by each lifter is uniformly sprayed throughout the length of the lifter.

FIG. 3



Description

[0001] The present invention relates to a drum type washing machine, and more particularly but not exclusively, to a drum type washing machine in which axially-extending lifters arranged around an inner peripheral surface of a rotatable tub upwardly inclinedly installed to allow easy laundry loading and unloading operations have an improved structure, thereby being capable of achieving an improvement in wash performance.

[0002] A conventional washing machine generally includes a housing forming an outer appearance of the washing machine, a cylindrical water tub installed in the housing and adapted to contain wash water, a cylindrical rotatable tub rotatably installed in the water tub and adapted to wash laundry contained therein, a drive motor arranged in the rear of the water tub and adapted to rotate the rotatable tub, and a door hingably mounted to a front wall of the housing.

[0003] Various lifters are protruded from an inner peripheral surface of the rotatable tub to a desired height while being arranged to be circumferentially spaced apart from one another around the rotatable tub and to extend axially along the inner peripheral surface of the rotatable tub. When the rotatable tub rotates, the laundry and wash water in the rotatable tub are raised by the lifters in a sequential fashion, and then dropped, so that the laundry is washed.

[0004] Openings are provided at respective front ends of the water tub and rotatable tub such that they are opened and closed by the door. When the door is open, it is possible to put laundry into the rotatable tub through the openings or to take the laundry out of the rotatable tub through the openings. When the door is closed, the water tub and rotatable tub are sealed against the outside of the door. In this state, a wash cycle can be carried out.

[0005] In the drum type washing machine having the above mentioned configuration, loading or unloading of laundry is carried out through the door mounted to the front wall of the housing. In order to carry out the loading or unloading of laundry through the opening of the rotatable tub after opening the door, however, the user must bend his body to lower his posture because the housing of the above-mentioned drum type washing machine typically has a height much lower than peoples' average height, and the opening of the rotatable tub is forwardly directed. For this reason, there is inconvenience.

[0006] In order to eliminate or at least reduce such inconvenience, improved drum type washing machines have recently been developed. In such a drum type washing machine, the rotatable tub is upwardly inclined such that the opening thereof is upwardly directed, so that the user can perform loading and unloading of laundry without bending his body too much.

[0007] In such a structure in which the rotatable tub is inclined, a relatively large amount of laundry is posi-

tioned at the rear end portion of the rotatable tub, whereas a relatively small amount of laundry is positioned at the front end portion of the rotatable tub. In particular, since the lifters on the inner peripheral surface of the rotatable tub have a constant height throughout the length of the rotatable tub, the laundry positioned at the rear end portion of the rotatable tub is stacked up to a level considerably higher than the height of the lifters, whereas the laundry positioned at the front end portion of the rotatable tub is stacked to a level lower than the height of the lifters.

[0008] When the rotatable tub rotates in such a state, the laundry positioned at a level higher than the height of the lifters at the rear end portion of the rotatable tub may not be lifted by the lifters, so that it is ineffectively washed. On the other hand, the amount of laundry lifted by the lifters at the front end portion of the rotatable tub is relatively small. As a result, the lifters operate inefficiently.

[0009] Furthermore, the laundry not lifted by the lifters at the rear end portion of the rotatable tub may be entangled as the lifters are rotated along with the rotatable tub. As a result, the laundry may be damaged. There is also inconvenience in that the user must disentangle the entangled laundry after completion of the washing process.

[0010] Meanwhile, the laundry distributed in a relatively small amount at the front end portion of the rotatable tub is easily lifted by the lifters, and then moved toward the rear end portion of the rotatable tub. As a result, the laundry tends to bunch up at the rear end portion of the rotatable tub even more.

[0011] When the laundry is mainly positioned at the rear end portion of the rotatable tub, dynamic unbalance also occurs because a relatively large load is applied to the rear end portion of the rotatable tub, whereas a relatively small load is applied to the front end portion of the rotatable tub. As a result, the rotating operation of the rotatable tub is inefficiently carried out.

[0012] Since the rotatable tub of the conventional drum type washing machine is upwardly inclined as it extends forwardly, and the lifters arranged thereon have a constant height, wash water, which is mixed with detergent and introduced into a bottom portion of the rotatable tub at the front end portions of the lifters, is raised in accordance with an upward movement of the lifters, and then downwardly sprayed through water spray holes provided at the lifters. However, the amount of wash water sprayed through the water spray holes is small. A large amount of wash water flows toward the rear end portions of the lifters. For this reason, the wash water is mainly sprayed by the rear end portions of the lifters. As a result, the laundry positioned at the front end portion of the rotatable tub is insufficiently doused with the wash water, so that the laundry is ineffectively washed.

[0013] The present invention addresses problems involved with the above mentioned conventional drum

type washing machines. Embodiments of the invention provide a drum type washing machine in which axially-extending lifters arranged around an inner peripheral surface of a rotatable tub which is upwardly inclined have an improved structure, thereby achieving an improvement in wash performance.

[0014] In accordance with one aspect, the present invention provides a drum type washing machine including: a housing; a rotatable tub rotatably positioned in the housing and upwardly inclined toward a front wall of the housing at a predetermined angle; and at least one lifter arranged on an inner peripheral surface of the rotatable tub, the lifter protruding from the inner peripheral surface of the rotatable tub so that its top portion is horizontal with respect to the housing when the lifter is positioned at a lowest level of the rotatable tub.

[0015] The lifter may extend from a rear end of the rotatable tub to a front end thereof.

[0016] The lifter may include, at its top portion, water spray holes for downwardly spraying wash water raised by the lifter.

[0017] The inclination angle of the rotatable tub may be about 5° to 15°.

[0018] In accordance with another aspect, the present invention provides a drum type washing machine comprising: a housing; a rotatable tub rotatably positioned in the housing and upwardly inclined toward a front wall of the housing at an inclination angle; and at least one lifter arranged axially along an inner peripheral surface of the rotatable tub, the lifter having a height which gradually reduces as the lifter extends from a rear end of the rotatable tub to a front end thereof so that a top portion of the lifter has an angle equal to the inclination angle of the rotatable tub with respect to a bottom portion of the lifter.

[0019] The top portion of the lifter may have a wave-shaped structure including crests and valleys alternately arranged at a predetermined pitch. Each of the crests and valleys may have water spray holes for downwardly spraying wash water raised by the lifter.

[0020] The water spray holes may be longitudinally arranged in rows, in which corresponding water spray holes in respective rows are laterally aligned.

[0021] The lifter may include, in the interior thereof, partition plates which divide the interior of the lifter into chambers.

[0022] Each partition plate may be inclined toward a front end of the lifter such that an upper end of the partition plate is closer to the front end of the lifter than a lower end of the partition plate.

[0023] The partition plates may have different inclination angles, respectively.

[0024] The partition plates may be arranged at different spaces, respectively.

[0025] In accordance with another aspect, the present invention provides a drum type washing machine comprising: a housing; a rotatable tub rotatably positioned in the housing and upwardly inclined toward a front wall

of the housing an inclination angle; and at least one lifter arranged on an inner peripheral surface of the rotatable tub, the lifter including at a top portion thereof a plurality of grooves and a plurality of protrusions.

[0026] In accordance with still another aspect, the present invention provides a drum type washing machine comprising: a housing; a rotatable tub rotatably positioned in the housing and upwardly inclined toward a front wall of the housing at an inclination angle; and at least one lifter arranged on an inner peripheral surface of the rotatable tub, the lifter including, in an interior thereof, at least one partition plate which divides the interior of the lifter into at least two chambers.

[0027] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

[0028] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings in which:

FIG. 1 is a sectional view schematically illustrating the configuration of a drum type washing machine according to the present invention;

FIG. 2 is a sectional view of the rotatable tub shown in FIG. 1, illustrating a structure of lifters arranged on the rotatable tub in accordance with an embodiment of the present invention;

FIG. 3 is a perspective view of the rotatable tub shown in FIG. 1, illustrating the structure of lifters arranged on the rotatable tub;

FIG. 4 is a perspective view of one lifter shown in FIG. 2;

FIG. 5 is a cross-sectional view taken along the line V-V in FIG. 4;

FIG. 6 is a perspective view of the rotatable tub corresponding to FIG. 3, illustrating a structure of lifters according to another embodiment of the present invention;

FIG. 7 is a perspective view of one lifter shown in FIG. 6, illustrating a top portion of the lifter having a wave-shaped structure; and

FIG. 8 is a cross-sectional view taken along the line VIII-VIII in FIG. 7, illustrating partition plates arranged in the interior of the lifter.

[0029] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein

like reference numerals refer to the like elements throughout. The embodiments are described below to explain the present invention by referring to the figures.

[0030] FIG. 1 is a sectional view schematically illustrating the configuration of a drum type washing machine according to an embodiment of the present invention. As shown in FIG. 1, the drum type washing machine includes a housing 1 having an approximately box shape to define an outer appearance of the washing machine, a drum-shaped water tub 2 installed in the housing 1 and adapted to contain wash water, a drum-shaped rotatable tub 3 rotatably positioned in the water tub 2 and including spin-dry holes 4 at a peripheral wall of the rotatable tub, and a drive motor 5 adapted to rotate the rotatable tub 3, in order to wash and spin-dry laundry contained in the rotatable tub 3.

[0031] Openings 2a and 3a are provided at respective front ends of the water tub 2 and rotatable tub 3, in order to allow laundry to be put into the rotatable tub 3 and to be taken out of the rotatable tub 3. A door 6 is hingably mounted to a front wall of the housing 1, so as to open and close the openings 2a and 3a of the water tub 2 and rotatable tub 3.

[0032] Installed at the top of the housing 1 are a water supply pipe 7 for receiving wash water from an external water supply source, and a detergent container 8 for containing detergent, and mixing the detergent with the wash water supplied via the water supply pipe 7. A drain pump 9 and a drain hose 10 are installed at the bottom of the housing 1, in order to externally drain wash water after completion of a wash cycle.

[0033] The drive motor 5 is fixedly mounted to a rear end of the water tub 2 outside the water tub 2. A rotatable shaft 5a, which is connected to the drive motor 5 at one end thereof, is fixedly coupled to a rear end of the rotatable tub 3 at the other end of the rotatable shaft, so that it transmits a rotating force from the drive motor 5 to the rotatable tub 3, thereby causing the rotatable tub 3 to rotate.

[0034] The rotatable tub 3 is upwardly inclined at a certain angle α (FIG. 2) toward the front wall of the housing 1, in order to allow the user to perform loading and unloading of laundry without bending his body excessively. Similarly, the water tub 2 is upwardly inclined at an angle equal to the inclination angle α of the rotatable tub 3, while being suspended in the housing 1. Of course, the water tub 2 and rotatable tub 3 have different inclination angles in some cases.

[0035] It is advantageous that the inclination angle α of the rotatable tub 3 be as large as possible, in order to conveniently perform loading and unloading of laundry in front of the housing 1. However, where the inclination angle α is excessively large, the amount of laundry positioned at a rear end portion of the rotatable tub 3 increases excessively, so that a degradation in wash performance occurs. Accordingly, it is desirable to determine the inclination angle α of the rotatable tub 3 within a range from about 5° to about 15°, taking into con-

sideration the convenience in laundry loading and unloading operations, and the wash performance.

[0036] Lifters 20 are arranged on an inner peripheral surface of the rotatable tub 3 such that they are circumferentially uniformly spaced apart from one another around the rotatable tub 3 while extending axially along the rotatable tub 3. As the rotatable tub 3 rotates, the lifters 20 raise laundry contained in the rotatable tub 3, along with wash water, and then release the raised laundry and wash water at a certain level, thereby causing the laundry and wash water to be dropped. Thus, the laundry is washed.

[0037] Due to the arrangement of the rotatable tub 3 upwardly inclined toward the front wall of the housing 1, the laundry contained in the rotatable tub 3 may be mainly positioned at the rear end portion of the rotatable tub 3 adjacent to the rear wall of the housing 1, as compared to the front end portion of the rotatable tub 3 adjacent to the door 6. In order to effectively lift the laundry positioned in such a state, the lifters 20 have a height decreasing gradually as they extend from the rear end of the rotatable tub 3 to the front end thereof. Such a structure of the lifters 20 will be described hereinafter, with reference to FIGS. 2 to 5.

[0038] FIGS. 2 and 3 are sectional and perspective views illustrating the structure of the lifters arranged on the inner peripheral surface of the rotatable tub shown in FIG. 1, respectively.

[0039] As shown in FIG. 2, the rotatable tub 3 is upwardly inclined toward the front wall of the housing 1 (FIG. 1) at an angle α , so that the central axis of the rotatable tub 3, that is, a central line C_1-C_1 , intersects a horizontal line H_1-H_1 at the angle α . In accordance with this arrangement, a relatively large amount of laundry is positioned at the rear end portion of the rotatable tub 3, as compared to the front end portion of the rotatable tub 3.

[0040] Similarly, each lifter 20 has a height gradually reduced as it extends from the rear end of the rotatable tub 3 to the front end thereof so that lines respectively extending along top and bottom portions 21 and 22 of the lifter 20 intersect at the angle α . In accordance with this structure, the top portion 21 of the lifter 20 is rendered parallel to the horizontal line H_1-H_1 when the lifter 20 is positioned at a lowest level of the rotatable tub 3.

[0041] Here, the bottom portion 22 of each lifter 20 is a lifter portion contacting the inner peripheral surface of the rotatable tub 3, whereas the top portion 21 of each lifter 20 is a lifter portion spaced apart from the inner peripheral surface of the rotatable tub 3 by a maximum distance.

[0042] In accordance with such a structure thereof, the lifters 20 can lift a relatively large amount of laundry at their rear end portions having a relatively large height when they are positioned at the lowest level of the rotatable tub 3, while lifting a relatively small amount of laundry at their front end portions having a relatively small height. Accordingly, the rotatable tub 3 is main-

tained in a dynamically balanced state, so that it can uniformly wash all of the laundry while rotating smoothly.

[0043] Since a relatively small amount of laundry is distributed at the front end portions of the lifters 20 having a relatively small height during a washing process, movement of the laundry positioned at the front end portions of the lifters 20 toward the rear end portion of the rotatable tub 3 does not occur.

[0044] As shown in FIG. 3, the lifters 20 are arranged around the rotatable tub 3 such that they are circumferentially uniformly spaced apart from one another while extending axially from the rear end of the rotatable tub 3 to the front end thereof, that is, throughout the length of the rotatable tub 3. Accordingly, the lifters 20 can effectively lift all of the laundry contained in the rotatable tub 3.

[0045] The top portion 21 of each lifter 20 has a constant width, while including water spray holes 23. The water spray holes 23 are longitudinally arranged along several lines.

[0046] Each lifter 20 also has a structure to spray wash water. That is, each lifter 20 has a downwardly-opened hollow structure for receiving wash water in its interior. Further, openings 27 are provided at a portion of the rotatable tub 3 to which an associated one of the lifters 20 is coupled. Also, the bottom portion 22 of each lifter 20 is opened to communicate with the openings 27 associated therewith. When the lifter 20 is positioned at a lowest level thereof, wash water can be introduced into the interior of the lifter 20 through the openings 27 associated therewith and the opened lower end 22 thereof.

[0047] Accordingly, wash water introduced into the interior of each lifter 20 via the opened bottom portion 22 thereof at the bottom side of the rotatable tub 3 is downwardly sprayed through the water spray holes 23 at the top side of the rotatable tub 3. Thus, the wash water, which is mixed with detergent, can sufficiently permeate into the laundry, so that the laundry can be rapidly washed.

[0048] Although not shown in the drawings, spray holes may also be provided at the opposite side portions of each lifter 20, so as to laterally spray wash water.

[0049] As shown in FIGS. 4 and 5, a pair of bosses 24 are provided in the interior of each lifter 20 such that they are integral with the lifter 20. The bosses 24 protrude downwardly from an inner surface of the top portion 21 of the lifter 20. A threaded coupling hole 25 is formed at a protruded end of each boss 24. Accordingly, the lifter 20 can be mounted to the rotatable tub 3 by coupling threaded screws 26 to respective coupling holes 25 outside the rotatable tub 3.

[0050] Meanwhile, the wash water introduced into the interior of each lifter 20 via the opened bottom portion 22 thereof at the bottom side of the rotatable tub 3 may flow down toward the rear end portion of the lifter 20 as it is moved from the bottom side of the rotatable tub 3 to the top side thereof, because the front end portion of the lifter 20 is positioned at a level higher than the rear

end portion of the lifter 20 in accordance with the movement, due to the structure of the lifter 20 having a height gradually reduced toward the front end of the rotatable tub 3. As a result, a comparatively small amount of wash water is sprayed through the water spray holes 24 at the front end portions of the lifters 20. Rather, the wash water is mainly sprayed through the water spray holes 24 at the rear end portions of the lifters 20.

[0051] In order to avoid such a phenomenon, each lifter has partition plates arranged in the interior thereof. This structure will be described hereinafter, with reference to FIGS. 4 and 5 showing an inner structure of one lifter.

[0052] Referring to FIGS. 4 and 5, the lifter 20 according to the present invention includes first and second partition plates 31 and 32 arranged in the interior of the lifter 20 to extend laterally while being longitudinally spaced apart from each other by a certain distance. The interior of the lifter 20 is divided into first through third chambers 41 to 43 by the partition plates 31 and 32.

[0053] By virtue of the first partition plate 31, wash water contained in the first chamber 41 positioned at a relatively high level does not flow down toward the second chamber 42 when the associated lifter 20 is positioned at the top side of the rotatable tub 3. Similarly, wash water contained in the second chamber 42 does not flow down toward the third chamber 43 by virtue of the second partition plate 32.

[0054] Accordingly, the wash water contained in the first chamber 41 at the front end portion of the lifter 20 is sprayed only at the front end portion of the rotatable tub 3, whereas the wash water contained in the second chamber 42 at an intermediate portion of the lifter 20 is sprayed only at an intermediate portion of the rotatable tub 3. Similarly, the wash water contained in the third chamber 43 at the rear end portion of the lifter 20 is sprayed only at the rear end portion of the rotatable tub 3.

[0055] The first and second partition plates 31 and 32 are arranged to appropriately divide the interior of the lifter 20 so that the first through third chambers 41 to 43 have approximately equal capacities, in order to spray approximately equal amounts of wash water from the first through third chambers 41 to 43, respectively. To this end, the first and second partition plates 31 and 32 are inclined toward the front end of the lifter 20 such that the upper end of each partition plate is closer to the front end of the lifter 20 than the lower end of the partition plate. Also, the first and second partition plates 31 and 32 have different inclination angles, respectively.

[0056] In accordance with such an arrangement, the upper ends of the first and second partition plates 31 and 32 divide the top portion 21 of the lifter 20 into three sections respectively having different, but approximately equal lengths. The lower ends of the first and second partition plates 31 and 32 divide the bottom portion 22 of the lifter 20 into three sections such that the section corresponding to the first chamber 41 has the largest

length, and the section corresponding to the third chamber 43 has the smallest length. Thus, the first through third chambers 41 to 43 have approximately equal capacities, respectively.

[0057] Although the lifter 20 has been illustrated as having a structure in which three chambers 41 to 43 are defined by two partition plates 31 and 33, an increased number of chambers may be defined by arranging an increased number of partition plates in the interior of the lifter. In this case, it is possible to more uniformly spray wash water mixed with detergent through all water spray holes formed at the top portion of the lifter.

[0058] Now, a process for washing laundry by the drum type washing machine having the above configuration according to the present invention will be described.

[0059] First, the user opens the door 6, and puts laundry into the rotatable tub 3 which is upwardly inclined. At this time, the user can conveniently perform these operations without lowering his posture excessively. The laundry is distributed in the rotatable tub 3 such that a relatively large amount of laundry is positioned at the rear end portion of the rotatable tub 3, whereas a relatively small amount of laundry is positioned at the front end portion of the rotatable tub 3.

[0060] Thereafter, the user closes the door 6, and operates a control panel (not shown) to operate the washing machine. As the washing machine operates, a water supply cycle is begun. That is, wash water mixed with detergent is introduced into the water tub 2 via the water supply pipe 7 and detergent container 8, so that it fills a lower portion of the water tub 2. When a desired amount of wash water corresponding to the amount of laundry to be washed is supplied, the water supply cycle is completed. After completion of the water supply cycle, the drive motor 5 alternately rotates the rotatable tub 3 in clockwise and anticlockwise directions, along with the rotatable shaft 5a. Thus, the laundry contained in the rotatable tub 3 is washed.

[0061] Although a relatively large amount of laundry is positioned at the rear end portion of the rotatable tub 3 during the wash cycle, the lifters 20 can lift the laundry without problem because it has, at its rear end portion, a height larger than that at its front end portion, so that the laundry is effectively washed. Also, the rotatable tub 3 can rotate in a dynamically balanced state.

[0062] When the lifters 20 are sequentially moved to a level adjacent to the top of the rotatable tub 3 while lifting the laundry, in accordance with rotation of the rotatable tub 3, the laundry is released from the lifters 20, and then dropped, so that it is washed. Simultaneously, the wash water mixed with detergent is introduced into each lifter 20 through its bottom portion 22 at the bottom side of the rotatable tub 3, and then downwardly sprayed through the water spray holes 23 provided at the top portion 21 of the lifter 20, so that it permeates into the laundry.

[0063] At this time, the wash water does not flow down

from the front end portion of the lifter 20 to the rear end portion thereof because the first through third chambers 41 to 43 respectively having approximately equal capacities are separated in the interior of the lifter 20 by the first and second partition plates 31 and 32.

[0064] That is, the wash water contained in the first chamber 41 is sprayed only through the water spray holes 23 formed at the front end portion of the lifter 20, whereas the wash water contained in the second chamber 42 is sprayed only through the water spray holes 23 formed at the intermediate portion of the lifter 20. Similarly, the wash water contained in the third chamber 43 is sprayed only through the water spray holes 23 formed at the rear end portion of the lifter 20.

[0065] Accordingly, the wash water can be uniformly sprayed throughout the length of the lifter 20. Thus, the wash water mixed with detergent is sufficiently sprayed not only over the laundry positioned at the rear end of the rotatable tub 3, but also over the laundry positioned at the intermediate and front end portions of the rotatable tub 3, so that the entire portion of the laundry is uniformly wetted by the wash water.

[0066] After completion of the wash cycle, the laundry is rinsed and spin-dried through rinse and spin-dry cycles. Thus, washing of the laundry is completed. In the rinse cycle, all of the laundry can also be uniformly rinsed in accordance with the function and effect of the first and second partition plates 31 and 32.

[0067] After completion of the washing of the laundry, the user again opens the door 6, and takes the laundry out of the rotatable tub 3. At this time, the user can conveniently perform these operations without lowering his posture too much because the rotatable tub 3 is upwardly inclined.

[0068] FIGS. 6 to 8 illustrate a lifter structure according to another embodiment of the present invention, respectively. FIG. 6 shows lifters arranged on the inner peripheral surface of the rotatable tub. FIG. 7 shows a lifter having a wave-shaped surface at its top portion. FIG. 8 shows partition plates arranged in the interior of the lifter.

[0069] Referring to FIGS. 6 and 7, a lifter 20a has a similar structure as the lifter 20 shown in FIG. 3, except that its surface, that is, its top portion 21, has a wave-shaped structure including grooves and protrusions respectively having round surfaces while being alternately arranged.

[0070] That is, the top portion 21 of the lifter 20a has an inclined structure having a height gradually reduced toward the front end of the rotatable tub 3. Crests 21a and valleys 21b are also alternately arranged at a certain pitch on the top portion 21 of the lifter 20a. Also, water spray holes 23 are provided at the wave-shaped top portion 21 such that they are longitudinally arranged in several rows. Corresponding water spray holes 23 in respective rows are laterally aligned at each crest 21a and each valley 21b.

[0071] Since the lifter 20a has, at its top portion 21, a

wave-shaped structure including crests 21a and valleys 21b, wash water introduced into the interior of the lifter 20a stays at spaces defined in the interior of the lifter 20a by the crests 21a without immediately flowing down from the front end portion of the lifter 20a to the rear end portion thereof, and is subsequently sprayed toward the bottom side of the rotatable tub 3 through the water spray holes 23. Accordingly, a sufficient amount of wash water can be sprayed even at the front end portion of the lifter 20a.

[0072] In addition, since the water spray holes 23 are longitudinally arranged in rows along the crests 21a and valleys 21b, wash water, which has not been discharged through the water spray holes 23 at a higher level than one of the crests 21a, flows into a next level one of the crests 21a, and is then discharged through the water spray holes 23 of the next level crest 21a.

[0073] Thus, the wash water does not immediately flow down from the front end of the lifter 20a to the rear end thereof, so that the wash water is not mainly sprayed only at the rear end of the lifter 20a.

[0074] Since the top portion 21 of the lifter 20a has a wave-shaped structure, a frictional force is applied to the laundry in the process of alternately rotating the rotatable tub 3 in clockwise and counter-clockwise direction.

[0075] Meanwhile, as shown in FIG. 8, the lifter 20a may include, at its top portion 21, round crests 21a and round valleys 21b, while also including, in the interior thereof, partition plates, for example, the partition plates 31 and 32 of FIGS. 4 and 5.

[0076] With such a structure of the lifter 20a, wash water received in the lifter 20a primarily stays at the spaces defined in the interior of the lifter 20a by the crests 21a, so that the wash water is slowed from flowing toward lower level portions of the lifter 20a. Further, the wash water no longer flows toward the lower level portions of the lifter 20a because of the first and second partition plates 31 and 32. Thus, it is possible to more effectively prevent the wash water from flowing down from the front end portion of the lifter 20a to the rear end portion thereof.

[0077] As is apparent from the above description, in the drum type washing machine according to one embodiment of the present invention, the rotatable tub is upwardly inclined toward the front wall of the housing, and each lifter protruded from the inner peripheral surface of the rotatable tub has a structure in which its top portion is horizontally maintained when it is positioned at a lowest level of the rotatable tub. Accordingly, even when a relatively large amount of laundry is distributed at the rear end portion of the rotatable tub, it is possible to lift the laundry without problem, and thus, to rapidly and effectively wash the laundry.

[0078] By virtue of such structures in the drum type washing machine according to embodiments of the present invention, the laundry can be stably lifted by the lifters. Accordingly, the rotatable tub can be rotated in a

dynamically stable state.

[0079] In addition, the laundry is not entangled or lumped. Accordingly, the rotatable tub is rotated in a balanced state during a spin-dry process. It is also unnecessary to disentangle the washed laundry.

[0080] In the drum type washing machine according to another embodiment of the present invention, partition plates are arranged in each lifter to define, in the interior of the lifter, chambers respectively having approximately equal capacities. By virtue of such a structure, wash water mixed with detergent can be uniformly sprayed throughout the length of the lifter. Accordingly, it is possible to rapidly and effectively wash even the laundry distributed at the front end portion of the rotatable tub positioned at a relatively high level.

[0081] In the drum type washing machine according to another embodiment of the present invention, each lifter has a wave-shaped structure at its top portion. Water spray holes are arranged in rows at the crests and valleys of the wave-shaped structure. With this structure implemented either alone or along with a plurality of partition plates, it is possible to uniformly spray wash water mixed with detergent throughout the length of the lifter, while applying a frictional force to the laundry. Accordingly, the laundry can be more rapidly and effectively washed.

[0082] Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0083] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0084] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0085] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A drum type washing machine comprising:

- a housing (1);
a rotatable tub (3) rotatably positioned in the housing and upwardly inclined toward a front wall of the housing at an inclination angle; and at least one lifter (20) arranged on an inner peripheral surface of the rotatable tub, the lifter extending from the inner peripheral surface of the rotatable tub so that a top portion of the lifter is horizontal with respect to the housing when the lifter is positioned at a lowest level of the rotatable tub.
2. The drum type washing machine according to claim 1, wherein the lifter has a length extending from a rear end of the rotatable tub to a front end thereof.
 3. The drum type washing machine according to claim 1 or 2, wherein the lifter includes a plurality of water spray holes (23) for downwardly spraying wash water raised by the lifter at the top portion of the lifter.
 4. The drum type washing machine according to any preceding claim, wherein the inclination angle of the rotatable tub is substantially between 5° and 15°.
 5. The drum type washing machine according to claim 4, wherein a height of the lifter gradually reduces as the lifter extends from a rear end of the rotatable tub to a front end thereof, and
wherein the top portion of the lifter has an angle equal to the inclination angle of the rotatable tub with respect to a bottom portion of the lifter.
 6. The drum type washing machine according to any preceding claim, further comprising:

another lifter (20),

wherein the lifters are positioned around the rotatable tub such that the lifters are circumferentially spaced uniformly apart from one another.
 7. The drum type washing machine according to any preceding claim, wherein a first surface (21) of the at least one lifter has a constant width, the first surface being closest to a center of the rotatable tub.
 8. The drum type washing machine according to any preceding claim, wherein each lifter includes a hollow structure which receives wash water, the hollow structure having a plurality of openings which are open in a direction extending from a center of the rotatable tub.
 9. The drum type washing machine according to any preceding claim, wherein the lifter includes a plurality of water spray holes at opposite side portions of the lifter.
 10. The drum type washing machine according to any preceding claim, further comprising:

at least one pair of bosses (24) formed integrally with the lifter, the bosses extending from a first face of the lifter closest to a center of the rotatable tub,

wherein each boss includes a threaded coupling hole (25) at an end of the each boss farthest from the first face of the lifter.
 11. The drum type washing machine according to claim 10, wherein the lifter is attached to the rotatable tub via at least one threaded coupling screw (26) threaded through a coupling hole positioned on an exterior portion of the rotatable tub.
 12. A drum type washing machine comprising:

a housing (1);
a rotatable tub (3) rotatably positioned in the housing and upwardly inclined toward a front wall of the housing at an inclination angle; and at least one lifter (20) arranged axially along an inner peripheral surface of the rotatable tub, the lifter having a height which gradually reduces as the lifter extends from a rear end of the rotatable tub to a front end thereof so that a top portion of the lifter has an angle equal to the inclination angle of the rotatable tub with respect to a bottom portion of the lifter.
 13. The drum type washing machine according to claim 12, wherein the inclination angle of the rotatable tub is substantially between 5° and 15°.
 14. The drum type washing machine according to claim 12 or 13, wherein the top portion (21) of the lifter has a wave-shaped structure including a plurality of crests (21a) and a plurality of valleys (21b) alternately arranged at a particular pitch, and each of the crests and valleys has a plurality of water spray holes (23) which downwardly spray wash water raised by the lifter.
 15. The drum type washing machine according to claim 14, wherein the water spray holes are longitudinally arranged in a plurality of rows, and corresponding water spray holes in respective rows are laterally aligned.
 16. The drum type washing machine according to any of claims 12 to 15, wherein the lifter includes in an interior of the lifter a plurality of partition plates (31, 32) which divide the interior of the lifter into a plurality of chambers (41, 42, 43).

17. The drum type washing machine according to claim 16, wherein the chambers (41, 42, 43) have substantially equal volumes.
18. The drum type washing machine according to claim 16 or 17, wherein each partition plate is inclined toward a front end of the lifter such that an upper end of the partition plate is closer to a front end of the lifter than a lower end of the partition plate.
19. The drum type washing machine according to any of claims 16 to 18, wherein the partition plates each have different inclination angles, respectively.
20. The drum type washing machine according to any of claims 16 to 19, wherein the partition plates are arranged at different spaces, respectively.
21. A drum type washing machine comprising:
- a housing (1);
 - a rotatable tub (3) rotatably positioned in the housing and upwardly inclined toward a front wall of the housing at an inclination angle; and
 - at least one lifter (20) arranged on an inner peripheral surface of the rotatable tub, the lifter including at a top portion (21) thereof a plurality of grooves (21b) and a plurality of protrusions (21a).
22. The drum type washing machine according to claim 21, wherein the top portion of the lifter has a wave-shaped structure including a plurality of crests corresponding to the protrusions (21a) and a plurality of valleys corresponding to the grooves (21b), the crests and protrusions being alternately arranged at a particular pitch, and each of the crests and protrusions has a plurality of water spray holes (23) which downwardly spray wash water raised by the lifter.
23. A drum type washing machine comprising:
- a housing (1);
 - a rotatable tub (3) rotatably positioned in the housing and upwardly inclined toward a front wall of the housing at an inclination angle; and
 - at least one lifter (20) arranged on an inner peripheral surface of the rotatable tub, the lifter including, in an interior thereof, at least one partition plate (31, 32) which divides the interior of the lifter into at least two chambers (41, 42, 43).
24. The drum type washing machine according to claim 23, wherein the lifter has, at a front end thereof, a height smaller than a rear end of the lifter, and the partition plates are arranged such that the chambers each have a same capacity.

FIG. 1

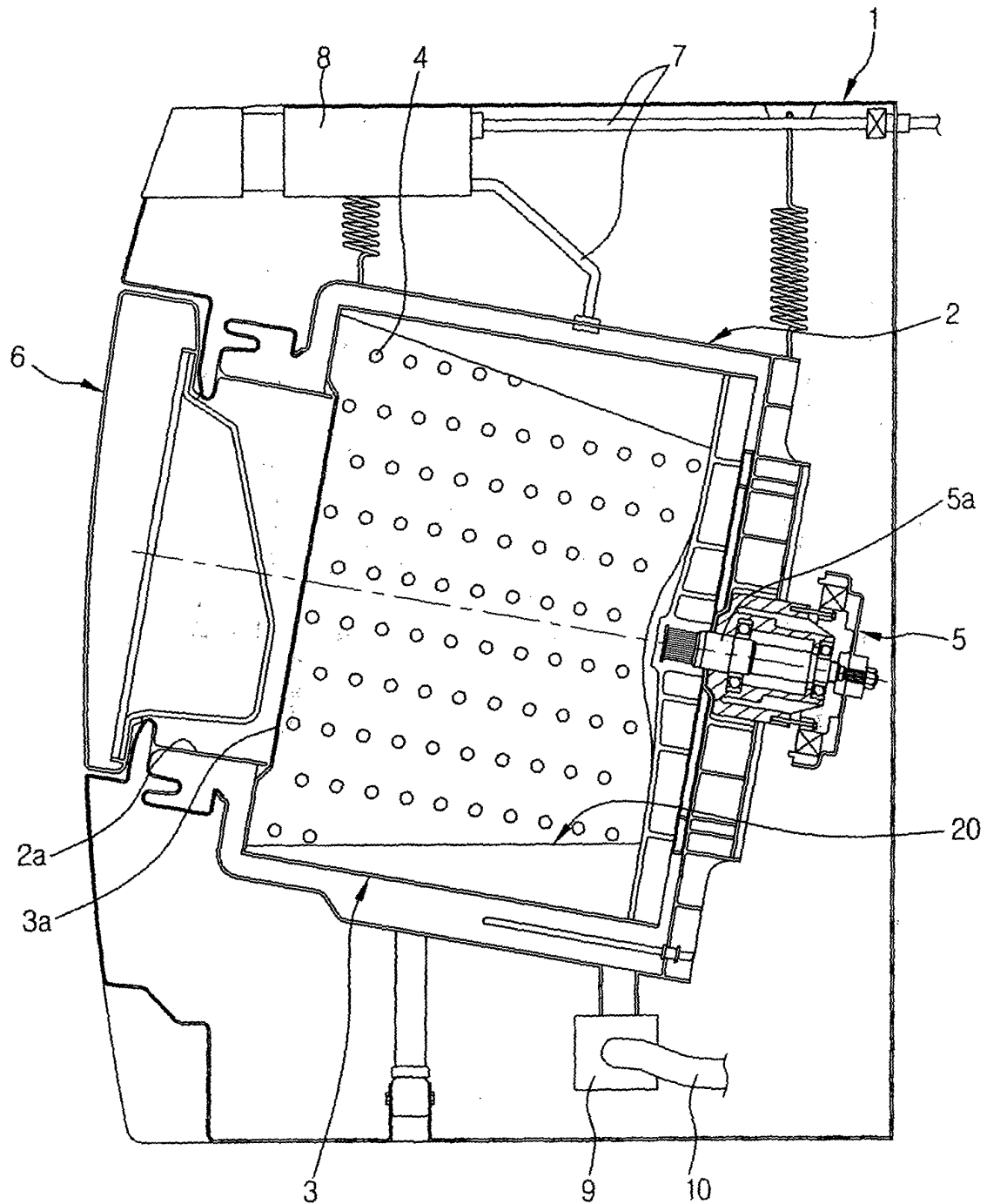


FIG. 2

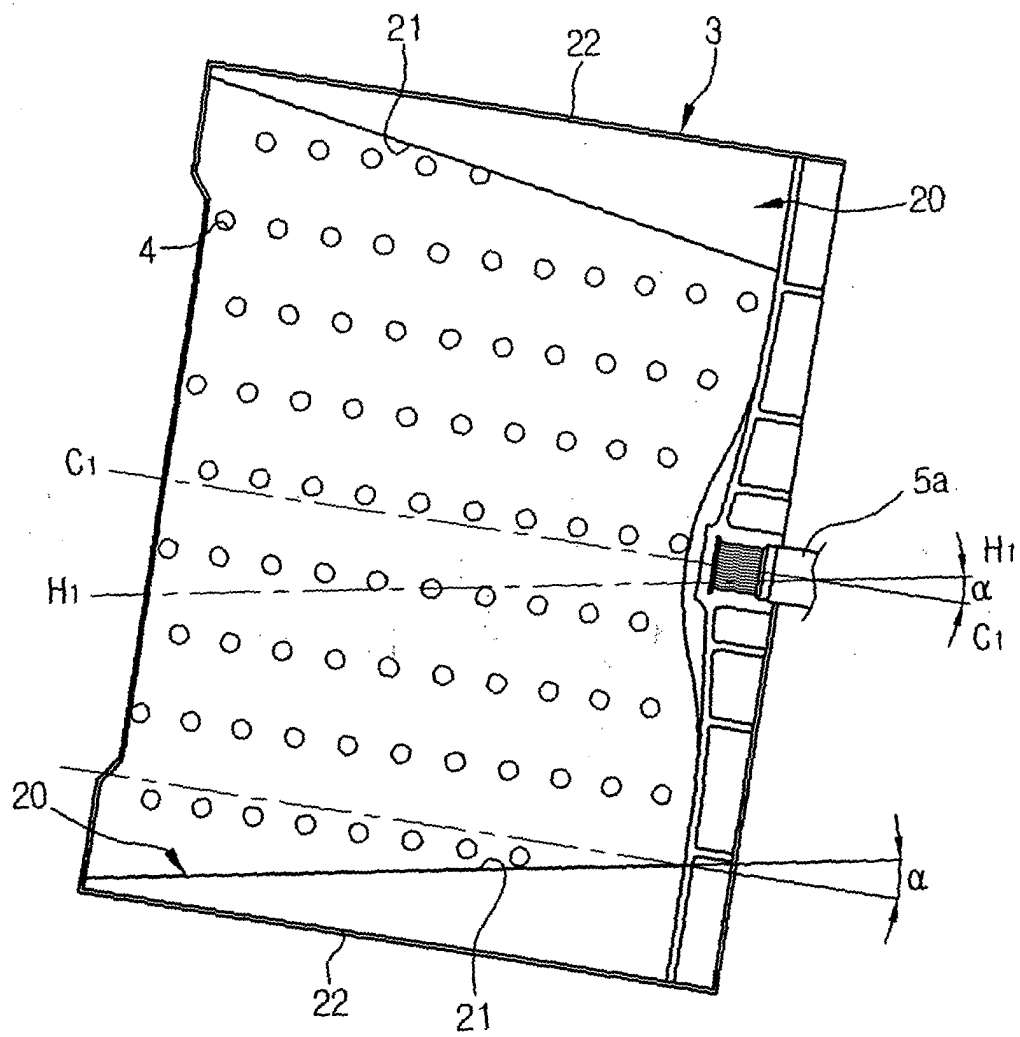


FIG. 3

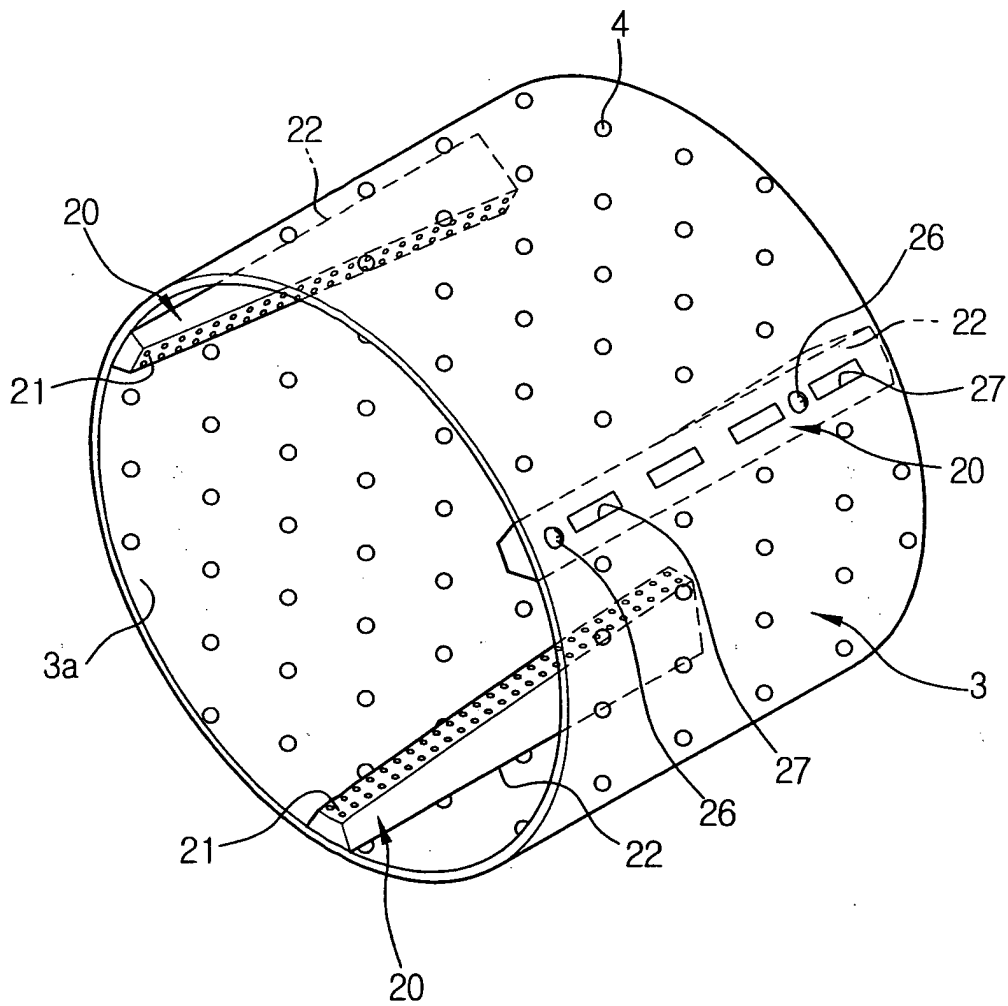


FIG. 4

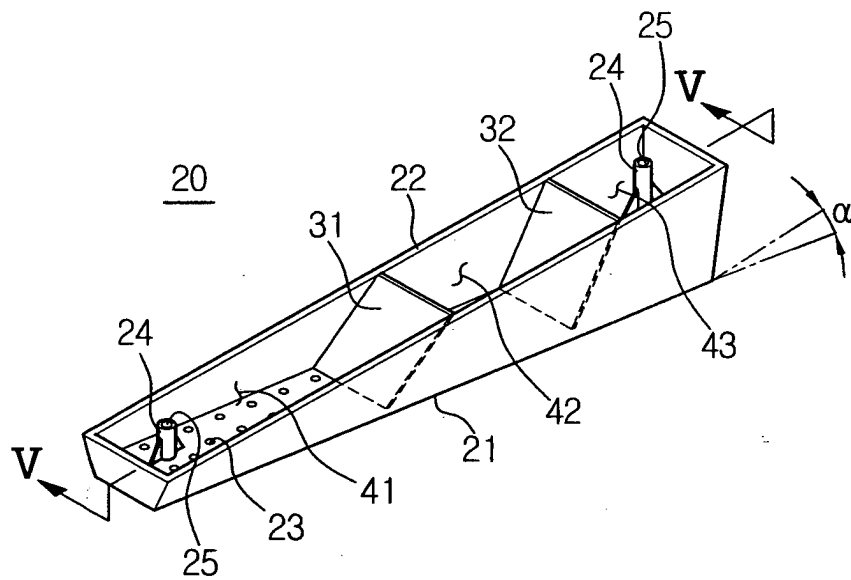


FIG. 5

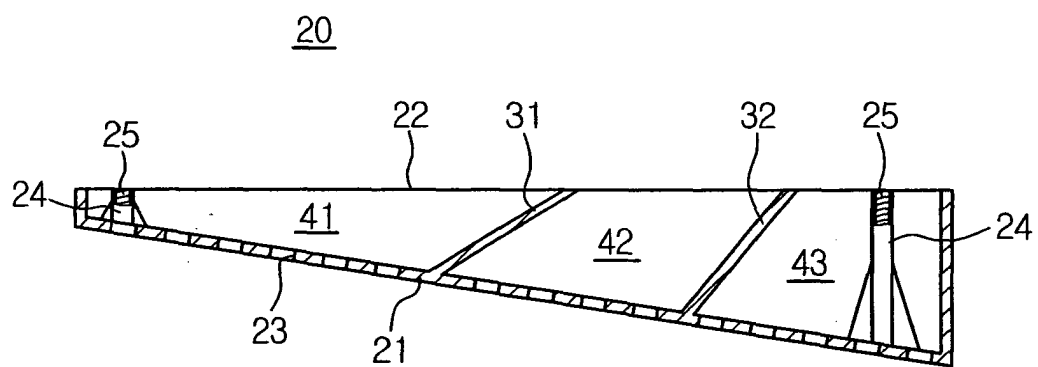


FIG. 6

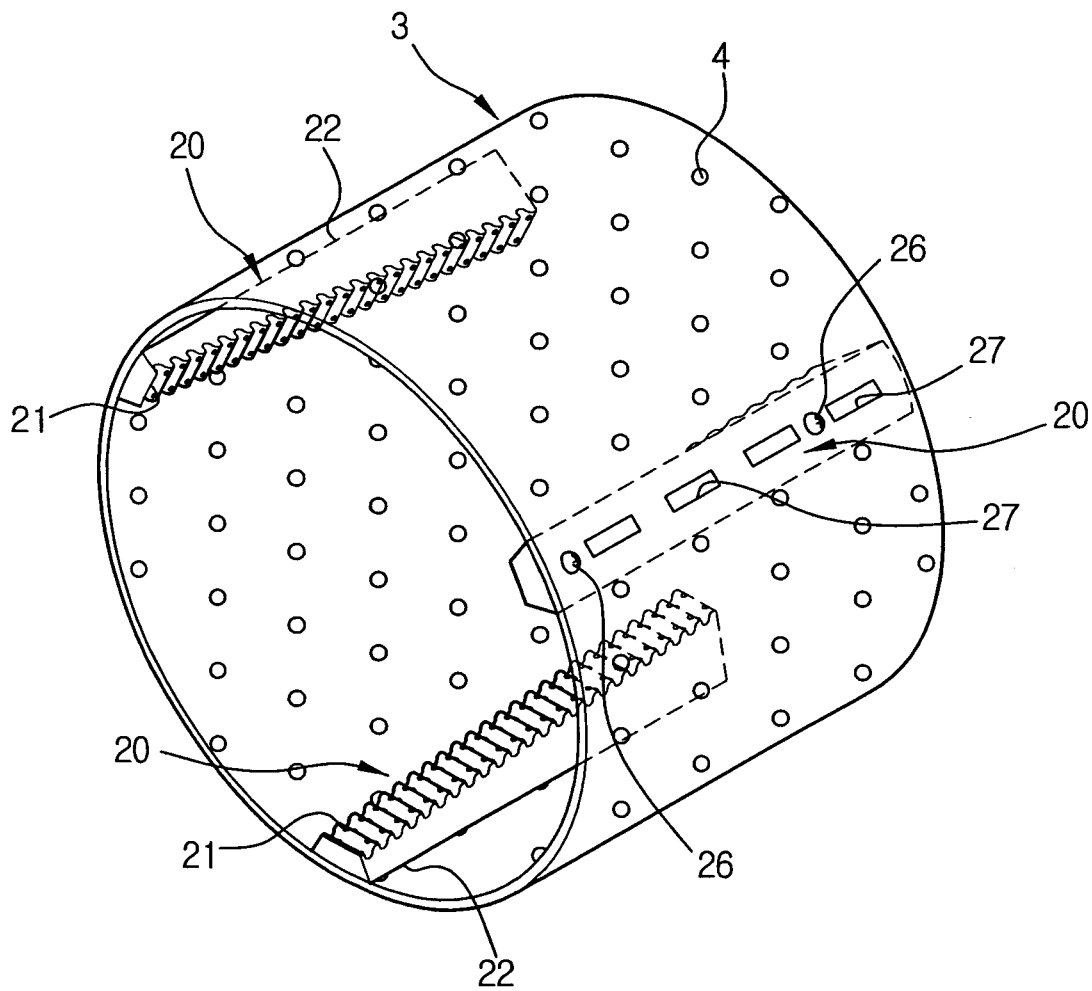


FIG. 7

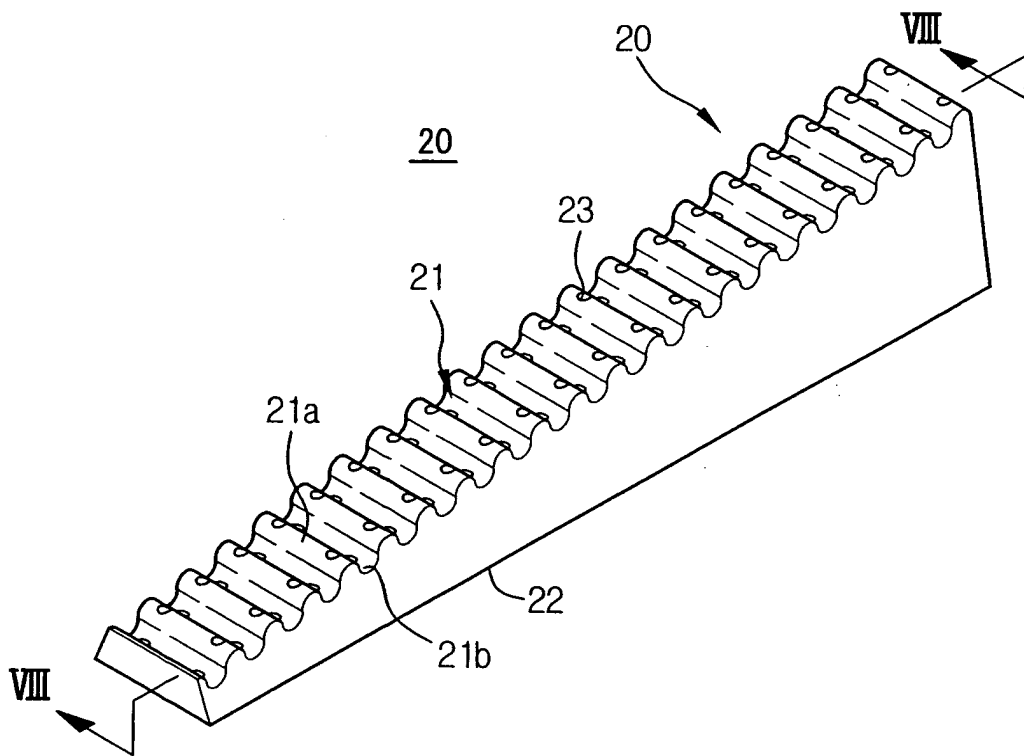
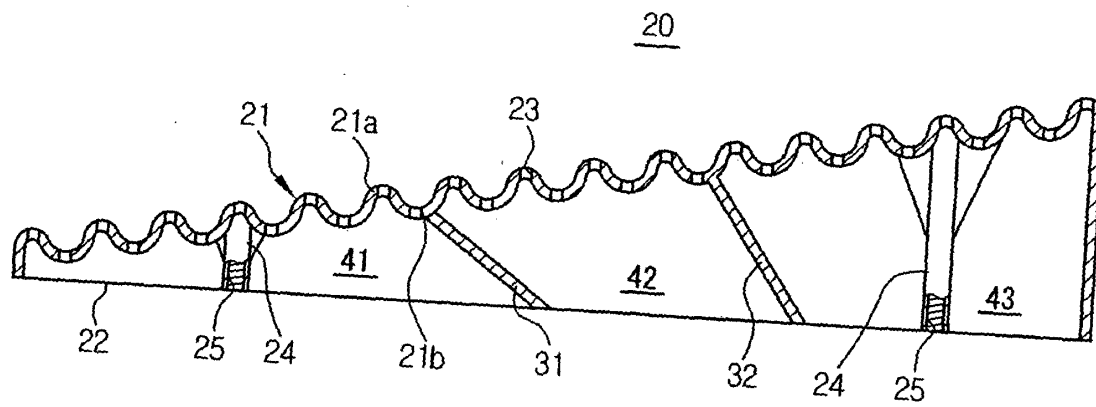


FIG. 8





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 25 4132

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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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