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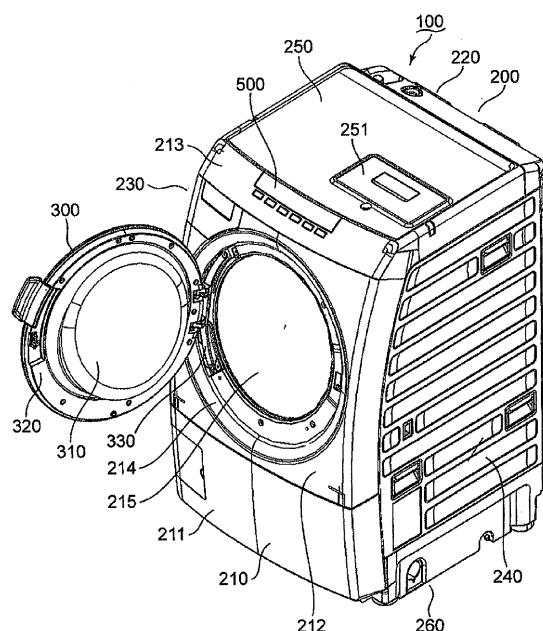
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(54) **Spin Dryer**

(57) Present invention provides spin dryer (400), comprising: drum (440, 440A, 440B) including inner wall surface (443) for defining storage space (R) in which laundry is stored; and drive portion (430) for rotating drum (440, 440A, 440B), wherein inner wall surface (443) includes draining area (452) in which draining portion (453) is formed to discharge water from laundry, and ridge portion (450) which protrudes inside the drum (440, 440A, 440B), ridge portion (450) has first primary ridge (451a) extending in first direction along draining area (452), second primary ridge (451b) extending in first direction so that draining area (452) intervenes between first and second primary ridges (451a, 451b), and secondary ridge portion (455) including base end (456, 458) connected to at least one of first and second primary ridges (451a, 451b), and wherein secondary ridge portion (455) includes tip end (457, 459) connected to draining area (452).

FIG. 1



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention is related to a spin dryer for performing a spin-drying process on laundry.

Description of the Related Art

[0002] Laundry processors such as washing machines, dryers, and washing and drying machines which perform predetermined processes on laundry (washing, spin-drying, rinsing and drying processes) typically have a spin dryer for performing a spin-drying process on laundry. The spin-drying process is performed inside a rotary drum configured to rotate in the laundry processor.

[0003] Japanese Patent Publication No. 2001-504006 discloses a spin dryer configured to perform a spin-drying process in a rotary drum. Japanese Patent Publication No. 2001-504006 discloses a rotary drum including several curved surfaces which are arranged in a hexagonal grid. The substantially hexagonal curved surfaces protrude inside the rotary drum, respectively. Draining holes for discharging water from laundry to the outside of the rotary drum are formed in edges which divide the curved surfaces, respectively. The draining holes are adjacent to the corners of the curved surfaces.

[0004] When the rotary drum rotates, the laundry is pressed or slammed against the inner wall of the rotary drum by the centrifugal force resulting from the rotation. As a result, water squeezed from the laundry flows toward the edges along the curved surfaces by the centrifugal action. The water is then discharged from the draining holes formed in the edges to the outside of the rotary drum.

[0005] According to the spin-dry technologies disclosed in Japanese Patent Publication No. 2001-504006, it becomes likely that the water moving along the curved surfaces sticks to the laundry again after the squeeze from the laundry. Therefore, it is less likely that the spin-drying technologies of Japanese Patent Publication No. 2001-504006 achieve sufficiently high spin-drying efficiency.

[0006] Japanese Patent Publication No. 2008-212635 discloses a rotary drum including an inner wall which has a spin-drying area divided by inwardly protruding ridge portions. The spin-drying area is divided into several square areas by circumferential ridges formed along a circumferential direction of the rotary drum and orthogonal ridges which are orthogonal to the circumferential ridges. Flat surfaces inclined toward the outside of the rotary drum are formed in the square areas, respectively. Therefore, square pyramid-shaped spaces are formed in the square areas, respectively. A draining hole is formed at the apex of each square pyramid-shaped space to discharge water from the rotary drum.

[0007] According to the spin-dry technologies disclosed in Japanese Patent Publication No. 2008-212635, the water squeezed from laundry by the circumferential and orthogonal ridges is shaken off by the circumferential or orthogonal ridges, and then guided to the square pyramid-shaped space formed in each square area. Therefore, unlike the spin-dry technologies of Japanese Patent Publication No. 2001-504006, the spin-dry technologies of Japanese Patent Publication No. 2008-212635 may preferably reduce an amount of water returning to the laundry.

[0008] It is likely that the circumferential and orthogonal ridges of the rotary drum disclosed in Japanese Patent Publication No. 2008-212635 prevent water from moving between the adjacent square areas. Therefore, if a large amount of water is locally squeezed from laundry, the square pyramid-shaped spaces of specific square areas become filled with the water. As a result, the water sticks to the laundry again, which decreases the spin-drying efficiency.

SUMMARY OF THE INVENTION

[0009] An object of the present invention is to provide a spin dryer to achieve high spin-drying efficiency.

[0010] A spin dryer according to one aspect of the present invention has a drum including an inner wall surface configured to define a storage space in which laundry is stored; and a drive portion configured to rotate the drum, wherein the inner wall surface includes a draining area in which a draining portion is formed to discharge water from the laundry outside the drum, and a ridge portion which protrudes inside the drum with respect to the draining area, the ridge portion has a first primary ridge extending in a first direction along the draining area, a second primary ridge extending in the first direction so that the draining area intervenes between the first and second primary ridges, and a secondary ridge portion including a base end connected to at least one of the first and second primary ridges, and wherein the secondary ridge portion includes a tip end connected to the draining area.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a schematic perspective view of a washing and drying machine which incorporates a processor exemplified as a spin dryer according to the first embodiment;

FIG. 2 is a schematic cross-sectional view of the washing and drying machine shown in FIG. 1;

FIGS. 3A and 3B are schematic perspective views of a rotary drum mounted to the washing and drying machine shown in FIG. 2;

FIG. 4 is a schematic front view of the rotary drum shown in FIGS. 3A and 3B;

FIGS. 5A to 5D are schematic views of a spin-drying process area formed in the rotary drum shown in FIG. 4;

FIGS. 6A to 6F are schematic views of the spin-drying process area formed in the rotary drum shown in FIG. 4;

FIG. 7 is a schematic view showing an arrangement of draining holes in the spin-drying process area shown in FIGS. 5A to 6F;

FIG. 8 is a schematic front view of a rotary drum which is used in a processor exemplified as a spin dryer according to the second embodiment;

FIG. 9 is a schematic view of a spin-drying process area formed in the rotary drum shown in FIG. 8;

FIG. 10 is a schematic front view of a rotary drum which is used in a processor exemplified as a spin dryer according to the third embodiment; and

FIG. 11 is a schematic view of a spin-drying process area formed in the rotary drum shown in FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Various embodiments of a spin dryer are described hereinafter with reference to the accompanying drawings. It should be noted that directional terms such as "upper/above," "lower/below," "left" and "right" are used hereinafter to merely clarify the descriptions and not to limit methodologies of the spin dryer in any way.

<First Embodiment>

(Entire Configuration of Washing and Drying Machine)

[0013] FIG. 1 is a perspective view of a washing and drying machine which incorporates a spin dryer according to one embodiment. The spin dryer incorporated in the washing and drying machine is exemplified in the following descriptions. Alternatively, the spin dryer may be incorporated in a washing machine without dry functions or in a dryer without washing functions.

[0014] A washing and drying machine 100 has a housing 200 and a door 300. The housing 200 is formed into a substantially rectangular-boxed shape. The housing 200 includes an upright front wall 210, a back wall 220 opposite to the front wall 210, left wall 230 and right wall 240 which vertically stand between the front and back walls 210, 220, a top wall 250 forming the upper surface of the housing 200, and a bottom wall 260 forming the lower surface of the housing 200.

[0015] The front wall 210 includes a lower wall 211 disposed on a lower portion of the front wall 210, a main wall 212 above the lower wall 211, and an upper wall 213 above the main wall 212. The main wall 212 and the upper wall 213 are upwardly curved and inclined toward the back wall 220.

[0016] The main wall 212 includes an annular concave surface 214 which forms a complementary concave area

to the substantially disc-shaped door 300. The concave surface 214 surrounds an opening 215 formed in substantially the center of the main wall 212. The opening 215 is communicated with a washing and drying tub (described later) stored in the housing 200. A user may put or take out laundry (or clothes and alike) in or from the housing 200 through the opening 215.

[0017] The washing and drying machine 100 comprises a hinge structure 330 configured to connect the pivotal door 300 with the housing 200. The hinge structure 330 allows the door 300 to turn between a closing position where the door 300 closes the opening 215 and an opening position where the door 300 opens the opening 215. The door 300 turned to the closing position is received in the concave area surrounded by the concave surface 214. It should be noted that the door 300 shown in FIG. 1 is positioned at the opening position.

[0018] FIG. 2 is a schematic cross-sectional view of the washing and drying machine 100 of which the door 300 is situated at the closing position. The entire structure of the washing and drying machine 100 is further described with reference to FIGS. 1 and 2.

[0019] As shown in FIG. 2, a processor 400 exemplified as a spin dryer is situated in the housing 200. In the present embodiment, the processor 400 executes processes required for washing and drying laundry, such as spin-drying, washing, rinsing and drying processes. If the spin dryer is incorporated in a washing machine without dry functions, a processor configured to perform spin-drying, washing and rinsing processes is exemplified as the spin dryer. Also if the spin dryer is incorporated in a dryer without washing functions, a processor configured to perform spin-drying and drying processes is exemplified as the spin dryer.

[0020] The processor 400 comprises the aforementioned washing and drying tub 410. The washing and drying tub 410 includes a cylindrical water tub 420 which is supported and rocks in the housing 200, and a cylindrical rotary drum 440 which has a closed bottom and is supported in the water tub 420. The processor 400 also includes a motor 430 configured to rotate the rotary drum 440. The motor 430 is mounted to the outer bottom surface of the water tub 420. The opening of the water tub 420 is formed by a substantially cylindrical tubular port 114 which projects toward the door 300 at the closing position. A substantially cylindrical seal member 115 is fitted into the tubular port 114. In the present embodiment, laundry is put and stored in the rotary drum 440 through the opening 215 of the housing 200. Therefore, the rotary drum 440 is exemplified as the drum. Furthermore, the motor 430 configured to rotate the rotary drum 440 is exemplified as the drive portion.

[0021] As shown in FIG. 1, the door 300 includes a transparent window 310, which looks like a substantially trapezoidal cone with a closed bottom, and a substantially disc-shaped support frame 320 configured to support the window 310. As shown in FIG. 2, when the door 300 is disposed in the closing position, the window 310

is inserted into the opening 215 formed on the housing 200, and pressed to the seal member 115, which is attached to the water tub 420. Accordingly, a watertight seal structure is formed between the water tub 420 and the window 310. A user may see laundry in the washing and drying tub 410 through the transparent window 310 while the door 300 is situated at the closing position.

[0022] As shown in FIG. 2, a discharge port 116 configured to discharge washing liquid and an inflow port 117 into which the washing liquid flows are formed in the water tub 420. The washing liquid used for washing the laundry is circulated between the discharge port 116 and the inflow port 117.

[0023] The housing 200 further stores therein a feed system 120 configured to feed water into the water tub 420, a drainage system 130 configured to drain or circulate the washing liquid in the water tub 420, and a drying system 140 configured to send hot air to the washing and drying tub 410 to dry laundry. It should be noted that the drying system 140 is not required if the processor 400 is incorporated in the washing machine without dry functions. Also, the feed system 120 or the drainage system 130 may not be used if the processor 400 is incorporated in the dryer without washing functions.

[0024] The drying system 140 includes a circulation pipeline 142, which has one end connected to an exhaust port 141 of the water tub 420 and a vent for sending drying air from the bottom of the water tub 420, and a blower 143 situated in the circulation pipeline 142 to blow air in the circulation pipeline 142. Optionally, the drying system 140 may also include a filter configured to recover or remove yarn wastes and dust, a dehumidifier configured to dehumidify air introduced after the dust removal, and a heater configured to heat the air after the dust removal, which results in dry and hot air. It should be noted that FIG. 1 shows a cover 251 attached to the top wall 250 of the housing 200. The cover 251 is used for attaching and removing the filter in the drying system 140.

[0025] As shown in FIG. 1, the washing and drying machine 100 comprises an operation panel 500 on the upper wall 213. The operation panel 500 allows a user to select a mode of operation courses or various functions of the washing and drying machine 100. As shown in FIG. 2, the operation panel 500 includes a control circuit 510. The control circuit 510 may work for displaying input information from the user on a display of the operation panel 500. If the washing and drying machine 100 is set to activate by means of the operation panel 500, for example, the control circuit 510 receives detection signals from a liquid level sensor configured to detect a liquid level in the water tub 420, an optical sensor 131, which is used as a turbidity sensor for detecting turbidity of the washing liquid, as well as from an electrode sensor 132, which is used as an electrical conductive sensor for detecting the electrical conductivity of the washing liquid. Control elements such as a solenoid valve included in the feed system 120 and a drain valve 133 included in the drainage system 130 are controlled on the basis of

these detection signals. The motor 430, the feed system 120, the drainage system 130 and the drying system 140 are automatically controlled by the control circuit 510 in response to the mode setting or control programs to execute washing, rinsing, spin-drying and drying processes.

[0026] As shown in FIG. 2, the feed system 120 includes a feed pipeline 121 connected to the water tub 420, and a detergent storage 122 configured to store detergent.

[0027] The feed system 120 shown in FIG. 2 may timely open/close the solenoid valve (see the solid arrows in FIG. 2) to feed water to the water tub 420 via the feed pipeline 121. The washing and drying machine 100 may exploit water fed by the feed system 120 to timely introduce detergent stored in the detergent storage 122, which partially transverses the feed pipeline 121, into the water tub 420.

[0028] The drainage system 130 includes a first pipeline 134, which has one end connected to the discharge port 116 of the water tub 420, a drainage control unit 135, which is connected to the other end of the first pipeline 134 and receives washing liquid from the water tub 420, and a second pipeline 137 which extends between a circulation pump 136 of the drainage control unit 135 and the water tub 420. The circulation pump 136 is fixed to a board 138 in the housing 200. One end of the second pipeline 137 is connected to an ejection port of the circulation pump 136 while the other end of the second pipeline 137 is connected to the inflow port 117 of the water tub 420. The water tub 420, the first pipeline 134, the drainage control unit 135 and the second pipeline 137 form a circulation path for the washing liquid. The circulation pump 136 allows the washing liquid to flow and circulate from the discharge port 116 toward the inflow port 117 along the circulation path.

[0029] In addition to the circulation pump 136, the drainage control unit 135 includes the optical sensor 131, which is used as a turbidity sensor for detecting turbidity of the washing liquid, the electrode sensor 132, which is used as an electrical conductive sensor for detecting the electrical conductivity of the washing liquid, a drainage pipeline 139 for draining the washing liquid to the outside, the drain valve 133, which is disposed in the middle of the drainage pipeline 139 and opens/closes the drainage pipeline 139, and a filter 144, which collects lint (yarn wastes and alike) contained in the washing liquid flowing from the first pipeline 134.

[0030] The drain valve 133 opens as appropriate, for example, at the end of the washing or rinsing process. As a result, washing water flowing from the first pipeline 134 into the drainage control unit 135 is subjected to a lint removal process by the filter 144, and eventually discharged to the outside.

[0031] When the drain valve 133 is closed and the circulation pump 136 is activated, washing liquid in the water tub 420 flows into the drainage control unit 135 via the first pipeline 134. Thereafter, the washing liquid pass-

es through the filter 144 in the drainage control unit 135, and then is subjected to impurity removal. After passing through the filter 144, the washing liquid flows into the circulation pump 136 through a suction pipeline 145 connected to a suction port of the circulation pump 136, and then is returned to the water tub 420 through the second pipeline 137 connected to the ejection port of the circulation pump 136. Quality washing and rinsing processes may be achieved if this circulation of the washing liquid is repeatedly carried out as appropriate during the washing and rinsing process.

[0032] The rotational speed of the circulation pump 136 may be variable. If higher rotational speed (e.g., 3500 rpm) of the circulation pump 136 is set, washing liquid flowing into the inflow port 117 of the water tub 420 moves along a trajectory extending toward the rotary drum 440 (see the arrow Fi in FIG. 2). On the other hand, if lower rotational speed (e.g., 1000 rpm) of the circulation pump 136 is set, washing liquid flowing into the inflow port 117 of the water tub 420 moves toward a space between the rotary drum 440 and the water tub 420 (see the arrow Fo in FIG. 2).

[0033] For example, once at least one of the washing and rinsing processes commences, the circulation pump 136 is rotated at low speed to prevent detergent from remaining undissolved after washing process, or highly concentrated softener, which is just introduced into the water tub 420, from spreading over the laundry in the rotary drum 440.

[0034] The washing liquid flowing into the space between the rotary drum 440 and the water tub 420 is discharged from the discharge port 116 to the drainage system 130, and again, returns to the inflow port 117 of the water tub 420 (a water tub circulation process). Repetitive water tub circulation processes may facilitate to dissolve detergent completely and make softener concentration uniform, which may prevent such problems as stains on the laundry caused by the undissolved detergent or the highly concentrated softener.

[0035] The water tub circulation process is preferably set, for example, approximately 10 seconds after water feeding process for the washing and/or rinsing process. Alternatively, the water tub circulation process is preferably started, for example, if a liquid level of approximately 40 mm from the lowest portion of the water tub 420 is detected, so that it becomes less likely that the circulation pump 136 is activated without a sufficient amount of the washing liquid. Therefore, it becomes less likely that there are abnormal noise such as bubble intrusion sound in the circulation pump 136, an abnormal temperature of the circulation pump 136 arising from the insufficient amount of the washing liquid, and the activation of the circulation pump 136 under such abnormal temperature.

[0036] The washing and drying machine 100 may further comprise a pump configured to supply bathwater to the water tub 420. In this case, it is preferred that the water tub circulation process is performed after supplying the bathwater to the water tub using the bathwater supply

pump in order to prevent simultaneous operation of the bathwater supply pump and the circulation pump 136 as well as generation of loud noise that makes a user uncomfortable.

[0037] A user may operate the operation panel 500 to reserve predetermined operations of the washing and drying machine 100. If the predetermined operations of the washing and drying machine 100 are reserved, for example, the water tub circulation process is preferably performed for a period of time, which is twice as long as usual. As a result, even if detergent is solidified while the washing and drying machine 100 is on reservation standby (during a period of time from setting the reservation mode to activation of the washing and drying machine 100), the detergent is dissolved thoroughly. This may not only result in quality washing performance during the reserved operation but also reduce residual detergent.

[0038] Optionally the washing and drying machine 100 may further comprise a temperature sensor. The duration of the water tub circulation process may be changed in response to a temperature of the washing water, which is measured by the temperature sensor. For instance, if the temperature sensor detects 5°C of washing water temperature, the washing and drying machine 100 may continue the water tub circulation process for a period of time which is, for example, twice as long as the water tub circulation process under a condition that the temperature sensor detects 20°C of washing water temperature.

(Rotary drum)

[0039] FIGS. 3A and 3B are schematic perspective views of the rotary drum 440. FIG. 3A is a perspective view of the rotary drum 440 with baffles. FIG. 3B is a perspective view of the rotary drum 440 without the baffles. The rotary drum 440 is further described with reference to FIGS. 2 to 3B.

[0040] As shown in FIG. 2, the rotary drum 440 includes a substantially disc-shaped bottom plate 441, and a circumferential wall 442 which extends from the periphery of the bottom plate 441 toward the door 300. As shown in FIGS. 3A and 3B, the circumferential wall 442 includes an inner wall surface 443, which defines a storage space R for storing laundry, and an outer wall surface 444 opposite to the inner wall surface 443.

[0041] Baffles 445, which are in a shape of a substantially trapezoidal column, are attached to the inner wall 443. In the present embodiment, three baffles 445 project toward the center of the storage space R at a substantially regular interval from the inner wall 443 to define divided areas. Alternatively, two or less baffles 445 or four or more baffles 445 may be attached to the inner wall surface 443. The arrangement, the number or the shape of the baffles 445 is appropriately determined on the basis of the spin-drying efficiency and the rotational speed of the motor 430 rotating the rotary drum 440.

[0042] Processing surfaces 446 are formed in the three divided areas of the inner wall 443 divided by the three

baffles 445. In the present embodiment, the processing surfaces 446 appear on both the inner and outer wall surfaces 443, 444. The processing surface 446 may appear only on the inner wall surface 443.

[0043] FIG. 4 is a front view of the rotary drum 440. The processing surfaces 446 are described with reference to FIGS. 2 to 4.

[0044] The outer wall surface 444 of the rotary drum 440 includes the processing surfaces 446 and a base surface 447 surrounding the processing surfaces 446. Attachment holes 448 which are used to attach the baffles 445 are formed on the base surface 447 between the processing surfaces 446.

[0045] The outer and inner wall surfaces 444, 443 turn in a direction of an arrow A1 shown in FIG. 4, while the motor 430 is rotated. Several ridge portions 450 which extend in a different direction from the direction of the arrow A1 are formed in each processing surface 446.

[0046] The ridge portions 450 are inclined at an inclined angle of approximately 45° with respect to the arrow A1, and include primary ridge portions 451 which transverse the processing surfaces 446, respectively. In the present embodiment, the extension direction of the primary ridge portions 451 is exemplified as the first direction. In addition, the direction indicated by the arrow A1 is exemplified as the second direction.

[0047] One of a series of the primary ridge portions 451, which are arranged in a circumferential direction of the circumferential wall 442 of the rotary drum 440, is exemplified as the first primary ridge. The primary ridge portion 451 adjacent to the primary ridge portion 451 exemplified as the first primary ridge is exemplified as the second primary ridge. In the following descriptions, the primary ridge portion 451 denoted by the reference numeral "451a" shown in FIG. 4 is described as the first primary ridge. The primary ridge portion 451 denoted by the reference numeral "451b" shown in FIG. 4 is described as the second primary ridge. However, these reference numerals "451 a" and "451 b" are assigned to these ridge portions, not to limit methodologies of the spin dryer in any way, but to merely clarify the descriptions. The primary ridge portions 451 are formed by applying pressure from the outer wall surface 444 toward the center of the rotary drum 440. The first and second primary ridges 451a, 451b define a strip of a spin-drying area.

[0048] A draining area 452 extending along the first direction intervenes between the first and second primary ridges 451a, 451b. A draining portion 453 piercing through the circumferential wall 442 is formed in the draining area 452. The draining portion 453 includes a series of draining holes 454 provided in the draining area 452. Unlike the formation of the primary ridge portions 451, it is not necessary to apply pressure from the outer wall surface 444 to the center of the rotary drum 440 in order to form the draining area 452. Therefore, a distance between the rotation axis of the rotary drum 440 and the draining area 452 is substantially equal to a distance be-

tween the rotating axis of the rotary drum 440 and the base surface 447. On the other hand, the primary ridge portions 451 in the rotary drum 440 protrude inward with respect to the draining area 452, so that water from the laundry is sent toward the draining area 452 by the centrifugal force resulting from the rotation of the rotary drum 440. The water reaches the draining area 452 and is discharged to the outside of the rotary drum 440 through the draining portion 453 piercing through the circumferential wall 442.

[0049] Each ridge portion 450 includes several secondary ridge portions 455 which have base ends connected to the primary ridge portions 451 and tip ends connected to the draining area 452. In the present embodiment, the secondary ridge portions 455 extend in a perpendicular direction to the primary ridge portions 451. Alternatively, the secondary ridge portions 455 may incline at another angle with respect to the primary ridge portions 451 and extend to the draining area 452. In the present embodiment, each secondary ridge portion 455 includes a first secondary ridge 455a, which has a first base end connected to the first primary ridge 451a, and a second secondary ridge 455b, which has a second base end connected to the second primary ridge 451b. Alternatively, the secondary ridge portion 455 may extend from one of the first and second primary ridges 451a, 451b to the draining area 452. A first tip end opposite to the first base end of the first secondary ridge 455a is connected to the draining area 452. A second tip end opposite to the second base end of the second secondary ridge 455b is connected to the draining area 452.

[0050] Like the primary ridge portions 451, the secondary ridge portions 455 are formed by applying pressure from the outer wall surface 444 toward the center of the rotary drum 440. Therefore, the secondary ridge portions 455 in the rotary drum 440 protrude inward with respect to the draining area 452.

[0051] FIGS. 5A-5D are schematic enlarged views of the spin-drying area defined between the first and second primary ridges 451a, 451b. FIG. 5A is a schematic enlarged planar view of one of the processing surfaces 446. FIG. 5B is a schematic view showing relief of the processing surface 446 along a line A-A shown in FIG. 5A. FIG. 5C is a schematic view showing relief of the processing surface 446 along a line B-B shown in FIG. 5A. FIG. 5D is a schematic view showing relief of the processing surface 446 along a line C-C shown in FIG. 5A. The processing surface 446 is further described with reference to FIGS. 4 to 5D.

[0052] As described above, the first secondary ridge 455a, which is formed in the spin-drying area defined between the first and second primary ridges 451a, 451b, includes a first base end 456 connected to the first primary ridge 451a and a first tip end 457 connected to the draining area 452. As shown in FIGS. 4 to 5D, the first secondary ridges 455a extend from the first primary ridges 451a. One of the first secondary ridges 455a is exemplified as the first dewatering ridge 461. The first second-

ary ridge 455a adjacent to the first dewatering ridge 461 is exemplified as the second dewatering ridge 462. In FIG. 5A, the line A-A passes along the first secondary ridge 455a selected as the first dewatering ridge 461. It should be noted that the selection of the first and second dewatering ridges 461, 462 is not interpreted in a limited way and is for making the descriptions clear.

[0053] The second secondary ridge 455b, which is formed in the spin-drying area defined between the first and second primary ridges 451a, 451b, includes a second base end 458 connected to the second primary ridge 451b and a second tip end 459 connected to the draining area 452. As shown in FIGS. 4 to 5D, the second secondary ridges 455b extend from the second primary ridges 451b. One of the second secondary ridges 455b is exemplified as the third dewatering ridge 463. The second secondary ridge 455b adjacent to the third dewatering ridge 463 is exemplified as the fourth dewatering ridge 464. In FIG. 5A, the line B-B passes between the fourth dewatering ridge 464 and the first secondary ridge 455a, which is selected as the first dewatering ridge 461. In FIG. 5A, the line C-C passes along the second secondary ridge 455b selected as the fourth dewatering ridge 464. It should be noted that the selection of the third and fourth dewatering ridges 463, 464 is not interpreted in a limited way and is for making the descriptions clear.

[0054] In the present embodiment, an area between a straight line L1, which connects the first tip ends 457 of the first and second dewatering ridges 461, 462, and a straight line L2, which connects the second tip ends 459 of the third and fourth dewatering ridges 463, 464, is defined as the draining area 452. The first and second tip ends 457, 459 are formed in the most centrifugal positions in the spin-drying area defined between the first and second primary ridges 451a, 451b. On the other hand, the first base end 456 on the ridge line of the first primary ridge 451a and the second base end 458 on the second primary ridge 451b are formed in the closest positions to the center of the rotary drum 440 in the spin-drying area defined between the first and second primary ridges 451a, 451b.

[0055] As shown in FIGS. 5A-5D, the first tip end 457 of the first dewatering ridge 461 is formed between the third and fourth dewatering ridges 463, 464. It should be noted that the first and second dewatering ridges 461, 462 are selected in order to facilitate understanding of the descriptions. Therefore, the first tip end 457 of the second dewatering ridge 462 may be formed between the third and fourth dewatering ridges 463, 464.

[0056] The second tip end 459 of the fourth dewatering ridge 464 is formed between the first and second dewatering ridges 461, 462. It should be noted that the third and fourth dewatering ridges 463, 464 are selected in order to facilitate understanding of the descriptions. Therefore, the second tip end 459 of the third dewatering ridge 463 may be formed between the first and second dewatering ridges 461, 462.

[0057] The first secondary ridges 455a intervene be-

tween the second secondary ridges 455b, respectively. Thus, a line which successively connects the first tip ends 457 with the second tip ends 459 becomes a cross-stitch pattern.

[0058] As shown in FIG. 5B, the first base end 456 is closer to the center of the rotary drum 440 than the first tip end 457. Also, as shown in FIG. 5B, the second base end 458 is closer to the center of the rotary drum 440 than the second tip end 459.

[0059] A substantially isosceles right triangular area, which is formed by connecting the first base end 456 of the first dewatering ridge 461, the first base end 456 of the second dewatering ridge 462, and the second tip end 459 of the fourth dewatering ridge 464 formed between the first and second dewatering ridges 461, 462, is exemplified as the first primary dewatering surface 471. The first primary dewatering surface 471 guides water squeezed from laundry by the first primary ridge 451a, to the strip-shaped spin-drying area between the first and second primary ridges 451a, 451b.

[0060] A substantially isosceles right triangular area, which is formed by connecting the second base end 458 of the third dewatering ridge 463, the second base end 458 of the fourth dewatering ridge 464, and the first tip end 457 of the first dewatering ridge 461 formed between the third and fourth dewatering ridges 463, 464, is exemplified as the second primary dewatering surface 472. The second primary dewatering surface 472 guides water squeezed from laundry by the second primary ridge 451b, to the strip-shaped spin-drying area between the first and second primary ridges 451a, 451b.

[0061] A substantially isosceles right triangular area, which is formed by connecting the first base end 456 of the first dewatering ridge 461, the first tip end 457 of the first dewatering ridge 461, and the second tip end 459 of the fourth dewatering ridge 464, is exemplified as the first secondary dewatering surface 473. The first secondary dewatering surface 473 guides water squeezed from laundry by the first dewatering ridge 461 or other water existing in the spin-drying area, to the second tip end 459 of the fourth dewatering ridge 464, which is formed in the most centrifugal position in the spin-drying area.

[0062] A substantially isosceles right triangular area, which is formed by connecting the first base end 456 of the second dewatering ridge 462, the first tip end 457 of the second dewatering ridge 462, and the second tip end 459 of the fourth dewatering ridge 464, is exemplified as the second secondary dewatering surface 474. The second secondary dewatering surface 474 guides water squeezed from laundry by the second dewatering ridge 462 or other water existing in the spin-drying area, to the second tip end 459 of the fourth dewatering ridge 464, which is formed in the most centrifugal position in the spin-drying area.

[0063] A substantially isosceles right triangular area, which is formed by connecting the second base end 458 of the third dewatering ridge 463, the second tip end 459 of the third dewatering ridge 463, and the first tip end 457

of the first dewatering ridge 461, is exemplified as the third secondary dewatering surface 475. The third secondary dewatering surface 475 guides water squeezed from laundry by the third dewatering ridge 463 or other water existing in the spin-drying area, to the first tip end 457 of the first dewatering ridge 461, which is formed in the most centrifugal position in the spin-drying area.

[0064] A substantially isosceles right triangular area, which is formed by connecting the second base end 458 of the fourth dewatering ridge 464, the second tip end 459 of the fourth dewatering ridge 464, and the first tip end 457 of the first dewatering ridge 461, is exemplified as the fourth secondary dewatering surface 476. The fourth secondary dewatering surface 476 guides water squeezed from laundry by the fourth dewatering ridge 464 or other water existing in the spin-drying area, to the first tip end 457 of the first dewatering ridge 461, which is formed in the most centrifugal position in the spin-drying area.

[0065] FIGS. 6A to 6F are schematic enlarged views of the spin-drying area defined between the first and second primary ridges 451a, 451b. FIG. 6A is a schematic enlarged planar view of the processing surface 446. FIG. 6B is a schematic view showing relief of the processing surface 446 along a line D-D illustrated between the second primary ridge 451b and the straight line L1 representing one boundary of the draining area 452. FIG. 6C is a schematic view showing relief of the processing surface 446 along the straight line L1. FIG. 6D is a schematic view showing relief of the processing surface 446 along a line E-E illustrated between the straight lines L1 and L2 representing boundaries of the draining area 452. FIG. 6E is a schematic view showing relief of the processing surface 446 along the straight line L2. FIG. 6F is a schematic view showing relief of the processing surface 446 along a line F-F illustrated between the first primary ridge 451a and the straight line L2. The processing surface 446 is further described with reference to FIGS. 4 to 6F.

[0066] As shown in FIG. 6F, the first secondary dewatering surface 473 inclines to the center of the rotary drum 440 with respect to the first primary dewatering surface 471 in the first direction. As shown in FIG. 5C, the first primary dewatering surface 471 inclines to the center of the rotary drum 440 with respect to the first secondary dewatering surface 473 in the perpendicular direction to the first direction. Therefore, a boundary 481 between the first primary dewatering surface 471 and the first secondary dewatering surface 473 is bent in the centrifugal direction. Like the boundary 481, a boundary 482 between the second secondary dewatering surface 474, which is line-symmetric with the fourth dewatering ridge 464, and the first primary dewatering surface 471 is also bent in the centrifugal direction. The boundaries 481, 482 which extend between each first base end 456 and the second tip end 459 of the fourth dewatering ridge 464 incline in the centrifugal direction toward the second tip end 459. Therefore, water on the first primary dewatering surface 471, the first secondary dewatering surface 473

or the second secondary dewatering surface 474 partially flows toward the boundaries 481, 482 as the rotary drum 440 rotates. The water which reaches the boundaries 481, 482 flows toward the second tip end 459 of the fourth dewatering ridge 464.

[0067] As shown in FIG. 6B, the fourth secondary dewatering surface 476 inclines to the center of the rotary drum 440 with respect to the second primary dewatering surface 472 in the first direction. As shown in FIG. 5C, the second primary dewatering surface 472 inclines to the center of the rotary drum 440 with respect to the fourth secondary dewatering surface 476 in the perpendicular direction to the first direction. Therefore, a boundary 484 between the second primary dewatering surface 472 and the fourth secondary dewatering surface 476 is bent in the centrifugal direction. Like the boundary 484, a boundary 483 between the third secondary dewatering surface 475, which is line-symmetric with the first dewatering ridge 461, and the second primary dewatering surface 472 is also bent in the centrifugal direction. The boundaries 483, 484 which extend between each second base end 458 and the first tip end 457 of the first dewatering ridge 461 incline in the centrifugal direction toward the first tip end 457. Therefore, water on the second primary dewatering surface 472, the third secondary dewatering surface 475 or the fourth secondary dewatering surface 476 partially flows toward the boundaries 483, 484 as the rotary drum 440 rotates. The water which reaches the boundaries 483, 484 flows toward the first tip end 457 of the first dewatering ridge 461.

[0068] As shown in FIG. 6D, gentle relief is repeated in the draining area 452. A boundary 485 between the third and first dewatering ridges 463, 461 is bent in the centrifugal direction. A boundary 486 between the first and fourth dewatering ridges 461, 464 is bent in the centrifugal direction. A boundary 487 between the fourth and second dewatering ridges 464, 462 is bent in the centrifugal direction. The boundaries 485, 486 are connected to each other at the first tip end 457 of the first dewatering ridge 461. The boundaries 486, 487 are connected to each other at the second tip end 459 of the fourth dewatering ridge 464. Thus, the boundaries 485, 486, 487 form a cross-stitch pattern in the draining area 452. It should be noted that the boundaries 485, 486, 487 are situated in the most centrifugal positions in the processing surface 446, like the first and second tip ends 457, 459.

[0069] FIG. 7 is a schematic enlarged view of the processing surface 446 for depicting an arrangement of the draining holes 454. The arrangement of the draining holes 454 is described with reference to FIGS. 4 to 7.

[0070] The draining holes 454 are formed in the draining area 452. As shown in FIG. 7, a series of the draining holes 454 are provided along the boundaries 485, 486, 487.

[0071] As described above, the water guided toward the boundary 481, 482, 483 or 484 by the first primary dewatering surface 471, the second primary dewatering surface 472, the first secondary dewatering surface 473,

the second secondary dewatering surface 474, the third secondary dewatering surface 475 and the fourth secondary dewatering surface 476, moves toward the first or second tip end 457, 459.

[0072] As described above, the boundaries 485, 486, 487 as well as the first and second tip ends 457, 459 are formed in substantially the same centrifugal positions. Therefore, the water concentrating in the first and/or second tip end 457, 459 flows along the boundaries 485, 486, 487 so as to reduce a difference in water level.

[0073] The draining holes 454 formed on the boundaries 485, 486, 487 as well as the first and second tip ends 457, 459 preferably discharge, to the outside of the rotary drum 440, the water flowing so as to reduce the water level difference. Thus, even if a large amount of water is locally squeezed from the laundry, it becomes less likely that the water is locally accumulated on the processing surface 446 of the rotary drum 440, which results in high spin-drying efficiency.

[0074] In FIG. 7, the draining holes 454 are formed on the first tip and second ends 457, 459. Alternatively, the draining holes 454 may be formed only on the boundary between the first secondary dewatering surface 473 and the third or fourth secondary dewatering surface 475, 476 as well as the boundary between the second secondary dewatering surface 474 and the third or fourth secondary dewatering surface 475, 476. Yet alternatively, the draining holes 454 may be formed only on the first and second tip ends 457, 459.

<Second Embodiment>

[0075] FIG. 8 is a schematic front view of a rotary drum used in a spin dryer according to the second embodiment. The same reference numerals are assigned to the same components as those of the first embodiment. The differences with the first embodiment are described with reference to FIG. 8. In the present embodiment, the processing surfaces formed on the circumferential wall are mainly different from those of the first embodiment. It should be noted that the descriptions according to the first embodiment are preferably incorporated to describe the components, which are not described hereinafter.

[0076] Like the rotary drum 440 described in the context of the first embodiment, attachment holes 448 which is used to attach baffles are formed on a circumferential surface 442 of a rotary drum 440A according to the second embodiment. A processing surface 446A is formed between a pair of areas on a base surface 447 with the attachment holes 448 to which the baffles are attached.

[0077] A series of primary ridge portions 451 (first and second primary ridges 451a, 451b), which extend in a first direction (a direction inclined at an angle of approximately 30° with respect to a direction shown by an arrow A1) different from a circumferential direction of the circumferential wall 442 shown by the arrow A1, are provided on the processing surface 446A.

[0078] FIG. 9 is a schematic enlarged view of a spin-

drying area defined between the first and second primary ridges 451a, 451b. The processing surface 446A is further described with reference to FIGS. 8 and 9.

[0079] In the present embodiment, first and second primary dewatering surfaces 471A, 472A form isosceles triangular areas having obtuse angles of approximately 120°. First and second secondary dewatering surfaces 473A, 474A which are adjacent to the first primary dewatering surface 471A form substantially equilateral triangular areas. Third and fourth secondary dewatering surfaces 475A, 476A which are adjacent to the second primary dewatering surface 472A form substantially equilateral triangular areas.

[0080] Like the first embodiment, an area between a straight line L1 connecting first tip ends 457 to each other and a straight line L2 connecting second tip ends 459 to each other is used as a draining area 452. Boundaries 485, 486, 487 are arranged in a cross-stitch pattern in the draining area 452. A series of draining holes 454 are provided along the cross-stitch pattern. The cross-stitch pattern that is illustrated by the boundaries formed between secondary ridge portions 455 in the draining area 452 is bent more gently than the cross-stitch pattern described in the context of the first embodiment. Therefore, water flows more smoothly along the cross-stitch pattern.

<Third Embodiment>

[0081] FIG. 10 is a schematic front view of a rotary drum used in a spin dryer according to the third embodiment. The same reference numerals are assigned to the same components as those of the first embodiment. Differences from the first embodiment are described with reference to FIG. 10. In the present embodiment, the processing surfaces formed on the circumferential wall are mainly different from those of the first embodiment. It should be noted that the descriptions according to the first embodiment are preferably incorporated to describe the components, which are not described hereinafter.

[0082] Like the rotary drum 440 described in the context of the first embodiment, attachment holes 448 which are used to attach baffles are formed on a circumferential surface 442 of a rotary drum 440B according to the third embodiment. A processing surface 446B is formed between a pair of areas on a base surface 447 with the attachment holes 448 to which the baffles are attached.

[0083] A series of primary ridge portions 451 (first and second primary ridges 451a, 451b), which extend in a first direction (a direction inclined at an angle of approximately 45° with respect to a direction shown by an arrow A1) different from a circumferential direction of the circumferential wall 442 shown by the arrow A1, are provided on the processing surface 446B.

[0084] FIG. 11 is a schematic enlarged view of a spin-drying area defined between the first and second primary ridges 451a, 451b. The processing surface 446B is further described with reference to FIGS. 10 and 11.

[0085] In the present embodiment, first and second pri-

mary dewatering surfaces 471, 472 form substantially isosceles right triangular areas, like the first embodiment. First and second secondary dewatering surfaces 473B, 474B which are adjacent to the first primary dewatering surface 471 form substantially isosceles triangular areas with apex angles of approximately 45° at first base ends 456. Third and fourth secondary dewatering surfaces 475B, 476B which are adjacent to the second primary dewatering surface 472 form substantially isosceles triangular areas with apex angles of approximately 45° at second base ends 458.

[0086] Like the first embodiment, an area between a straight line L1 connecting first tip ends 457 to each other and a straight line L2 connecting second tip ends 459 to each other is used as a draining area 452. Boundaries 485, 486, 487 are arranged in a cross-stitch pattern in the draining area 452. A series of draining holes 454 are provided along the cross-stitch pattern. The cross-stitch pattern which is illustrated by the boundaries formed between secondary ridge portions 455 in the draining area 452 is bent more gently than the cross-stitch pattern described in the context of the first or second embodiment. Therefore, water flows more smoothly along the cross-stitch pattern.

[0087] In the aforementioned embodiment, the spin-drying area is formed using the triangular planar areas. The spin-drying area may be formed by means of curved surfaces as well. Alternatively, the spin-drying area may be formed using polygonal planar surfaces such as square or hexagonal planar surfaces, in place of or in combination with the triangular planar surfaces.

[0088] The aforementioned embodiments include a spin dryer which mainly has the following configurations. The spin dryer with the following configurations may achieve high spin-drying efficiency.

[0089] A spin dryer according to one aspect of the aforementioned embodiment has a drum including an inner wall surface configured to define a storage space in which laundry is stored; and a drive portion configured to rotate the drum, wherein the inner wall surface includes a draining area in which a draining portion is formed to discharge water from the laundry outside the drum, and a ridge portion which protrudes inside the drum with respect to the draining area, the ridge portion has a first primary ridge extending in a first direction along the draining area, a second primary ridge extending in the first direction so that the draining area intervenes between the first and second primary ridges, and a secondary ridge portion including a base end connected to at least one of the first and second primary ridges, and wherein the secondary ridge portion includes a tip end connected to the draining area.

[0090] According to the aforementioned configuration, once the drum is rotated by the drive portion, the laundry in the storage space is brought into contact with the inner wall surface by the centrifugal force caused by the rotation of the drum. As a result, water is squeezed from the laundry. The water is shaken off by the ridge portion

which protrudes inside the drum with respect to the draining area where the draining portion is formed, and then the water is discharged from the draining portion of the draining area to the outside of the drum. The draining area is formed between the first and second primary ridges which extend in the first direction. The base end of the secondary ridge portion is connected to at least one of the first and second primary ridges. The tip end of the secondary ridge portion, which is connected to the draining area, allows the water to flow between the first and second primary ridges. Therefore, even if a large amount of water is locally squeezed from the laundry, it is less likely that the water is locally accumulated on the inner wall surface, which results in high spin-drying efficiency.

[0091] In the aforementioned configuration, the secondary ridge portion preferably includes a first secondary ridge including a first base end connected to the first primary ridge and a first tip end formed in the draining area; and a second secondary ridge including a second base end connected to the second primary ridge and a second tip end formed in the draining area.

[0092] According to the aforementioned configuration, the secondary ridge portion includes the first secondary ridge which has the first base end connected to the first primary ridge and the first tip end formed in the draining area, and the second secondary ridge which includes the second base end connected to the second primary ridge and the second tip end formed in the draining area. The water squeezed between the first and second primary ridges is efficiently shaken off by the first and second primary ridges, which results in high spin-drying efficiency.

[0093] In the aforementioned configuration, it is preferred that the first secondary ridge includes a first dewatering ridge and a second dewatering ridge which are formed in a spin-drying process area defined between the first and second primary ridges, the second secondary ridge includes a third dewatering ridge and a fourth dewatering ridge which are formed in the spin-drying process area, the first tip end of one of the first and second dewatering ridges is formed between the third and fourth dewatering ridges, and the second tip end of one of the third and fourth dewatering ridges is formed between the first and second dewatering ridges.

[0094] According to the aforementioned configuration, the first secondary ridge includes the first and second dewatering ridges which are formed in the spin-drying process area defined between the first and second primary ridges. The second secondary ridge includes the third and fourth dewatering ridges which are formed in the spin-drying process area. The first tip end of one of the first and second dewatering ridges is formed between the third and fourth dewatering ridges. The second tip end of one of the third and fourth dewatering ridges is formed between the first and second dewatering ridges. Therefore, the first tip end of one of the first and second dewatering ridges and the second tip end of one of the third and fourth dewatering ridges allow the water to flow

between the first and second primary ridges. Thus, even if a large amount of water is locally squeezed from the laundry, it is less likely that the water is locally accumulated on the inner wall surface, which results in high spin-drying efficiency.

[0095] In the aforementioned configuration, it is preferred that the draining area is formed between a line connecting the first tip end of the first dewatering ridge to the first tip end of the second dewatering ridge, and a line connecting the second tip end of the third dewatering ridge to the second tip end of the fourth dewatering ridge.

[0096] According to the aforementioned configuration, the draining area in which the draining portion is formed is situated between the line connecting the first tip end of the first dewatering ridge to the first tip end of the second dewatering ridge and the line connecting the second tip end of the third dewatering ridge to the second tip end of the fourth dewatering ridge. Therefore, it is likely that the water flowing in the draining area is discharged from the draining portion to the outside of the drum.

[0097] In the aforementioned configuration, it is preferred that the draining portion includes a series of draining holes provided in the draining area extending in the first direction.

[0098] According to the aforementioned configuration, the water of the laundry flows along the draining area extending in the first direction. With the series of the draining holes provided in the draining area, it is likely that the water flowing in the draining area is discharged from the draining holes to the outside of the drum.

[0099] In the aforementioned configuration, it is preferred that the first base end is closer to a center of the drum than the first tip end, the second base end is closer to the center of the drum than the second tip end, and the inner wall surface includes a first primary dewatering surface which has apexes defined by the first base end of the first dewatering ridge, the first base end of the second dewatering ridge, and the second tip end of one of the third and fourth dewatering ridges.

[0100] According to the aforementioned configuration, the first base end is closer to the center of the drum than the first tip end. The second base end is closer to the center of the drum than the second tip end. The inner wall surface includes the first primary dewatering surface which has the apexes defined by the first base end of the first dewatering ridge, the first base end of the second dewatering ridge, and the second tip end of one of the third and fourth dewatering ridges. Therefore, it is likely that the water shaken off by the first primary ridge is appropriately guided to the draining area by the first primary dewatering surface.

[0101] In the aforementioned configuration, it is preferred that the inner wall surface includes a second primary dewatering surface which has apexes defined by the second base end of the third dewatering ridge, the second base end of the fourth dewatering ridge, and the first tip end of one of the first and second dewatering ridges.

[0102] According to the aforementioned configuration, the inner wall surface includes the second primary dewatering surface which has the apexes defined by the second base end of the third dewatering ridge, the second base end of the fourth dewatering ridge, and the first tip end of one of the first and second dewatering ridges. Therefore, it is likely that the water shaken off by the second primary ridge is appropriately guided to the draining area by the second primary dewatering surface.

[0103] In the aforementioned configuration described above, it is preferred that the inner wall surface includes a first secondary dewatering surface which has apexes defined by the first base end of the first dewatering ridge, the first tip end of the first dewatering ridge, and the second tip end of one of the third and fourth dewatering ridges.

[0104] According to the aforementioned configuration described above, the inner wall surface includes the first secondary dewatering surface which has the apexes defined by the first base end of the first dewatering ridge, the first tip end of the first dewatering ridge, and the second tip end of one of the third and fourth dewatering ridges. Therefore, it is likely that the water shaken off by the first dewatering ridge is appropriately guided to the draining area by the first secondary dewatering surface.

[0105] In the aforementioned configuration, it is preferred that the inner wall surface includes a second secondary dewatering surface which has apexes defined by the first base end of the second dewatering ridge, the first tip end of the second dewatering ridge, and the second tip end of one of the third and fourth dewatering ridges.

[0106] According to the aforementioned configuration, the inner wall surface includes the second secondary dewatering surface which has the apexes defined by the first base end of the second dewatering ridge, the first tip end of the second dewatering ridge, and the second tip end of one of the third and fourth dewatering ridges. Therefore, it is likely that the water shaken off by the second dewatering ridge is appropriately guided to the draining area by the second secondary dewatering surface.

[0107] In the aforementioned configuration, it is preferred that the inner wall surface includes a third secondary dewatering surface which has apexes defined by the second base end of the third dewatering ridge, the second tip end of the third dewatering ridge, and the first tip end of one of the first and second dewatering ridges.

[0108] According to the aforementioned configuration, the inner wall surface includes the third secondary dewatering surface that has the apexes defined by the second base end of the third dewatering ridge, the second tip end of the third dewatering ridge, and the first tip end of one of the first and second dewatering ridges. Therefore, it is likely that the water shaken off by the third dewatering ridge is appropriately guided to the draining area by the third secondary dewatering surface.

[0109] In the aforementioned configuration, it is pre-

ferred that the inner wall surface includes a fourth secondary dewatering surface which has apexes defined by the second base end of the fourth dewatering ridge, the second tip end of the fourth dewatering ridge, and the first tip end of one of the first and second dewatering ridges.

[0110] According to the aforementioned configuration, the inner wall surface includes the fourth secondary dewatering surface which has the apexes defined by the second base end of the fourth dewatering ridge, the second tip end of the fourth dewatering ridge, and the first tip end of one of the first and second dewatering ridges. Therefore, it is likely that the water shaken off by the fourth dewatering ridge is appropriately guided to the draining area by the fourth secondary dewatering surface.

[0111] In the aforementioned configuration, it is preferred that at least a part of the draining holes are formed along a boundary between the first secondary dewatering surface and the third secondary dewatering surface.

[0112] According to the aforementioned configuration, a part of the water flowing along the first and third secondary dewatering surfaces moves toward the boundary between the first and third secondary dewatering surfaces in response to the inclinations of the first and third secondary dewatering surfaces. Because at least a part of the draining holes are formed along the boundary between the first and third secondary dewatering surfaces, it is likely that the water is appropriately discharged to the outside of the drum.

[0113] In the aforementioned configuration, it is preferred that at least a part of the draining holes are formed along a boundary between the first secondary dewatering surface and the fourth secondary dewatering surface.

[0114] According to the aforementioned configuration, a part of the water component flowing along the first and fourth secondary dewatering surfaces flow toward the boundary between the first and fourth secondary dewatering surfaces in response to the inclinations of the first and fourth secondary dewatering surfaces. Because at least a part of draining holes are formed along the boundary between the first and fourth secondary dewatering surfaces, it is likely that the water component is appropriately discharged to the outside of the drum.

[0115] In the aforementioned configuration, it is preferred that at least a part of the draining holes are formed along a boundary between the second secondary dewatering surface and the third secondary dewatering surface.

[0116] According to the aforementioned configuration, a part of the water flowing along the second and third secondary dewatering surfaces moves toward the boundary between the second and third secondary dewatering surfaces in response to the inclinations of the second and third secondary dewatering surfaces. Because a part of the draining holes are formed along the boundary between the second and third secondary dewatering surfaces, it is likely that the water component

is appropriately discharged to the outside of the drum.

[0117] In this configuration, it is preferred that at least a part of the draining holes are formed along a boundary between the second secondary dewatering surface and the fourth secondary dewatering surface.

[0118] According to the aforementioned configuration, a part of the water flowing along the second and fourth secondary dewatering surfaces flows toward the boundary between the second and fourth secondary dewatering surfaces in response to the inclinations of the second and fourth secondary dewatering surfaces. Because at least a part of the draining holes are formed along the boundary between the second and fourth secondary dewatering surfaces, it is likely that the water is appropriately discharged to the outside of the drum.

[0119] In the aforementioned configuration, it is preferred that the inner wall surface turns in a second direction different from the first direction while the drive portion rotates the drum.

[0120] According to the aforementioned configuration, the inner wall surface turns in the second direction different from the first direction while the drive portion rotates the drum. Therefore, the first primary ridge, the second primary ridge and the secondary ridge portion which are in contact with the laundry in the storage space preferably cause shear forces on the laundry, which facilitates to achieve high spin-drying efficiency. In addition, the first primary ridge, the second primary ridge and the secondary ridge portion preferably shake the water off the laundry and facilitate to flow the water to the draining area, which results in high spin-drying efficiency.

[0121] The methodologies of the present embodiment are preferably utilized in washing machines, dryers, and washing and drying machines.

Claims

1. A spin dryer (400), comprising:

a drum (440, 440A, 440B) including an inner wall surface (443) configured to define a storage space (R) in which laundry is stored; and
a drive portion (430) configured to rotate the drum (440, 440A, 440B), **characterized in that:**

the inner wall surface (443) includes a draining area (452) in which a draining portion (453) is formed to discharge water from the laundry outside the drum (440, 440A, 440B), and a ridge portion (450) which protrudes inside the drum (440, 440A, 440B) with respect to the draining area (452),
the ridge portion (450) has a first primary ridge (451a) extending in a first direction along the draining area (452), a second primary ridge (451b) extending in the first direction so that the draining area (452) inter-

- venues between the first and second primary ridges (451a, 451b), and a secondary ridge portion (455) including a base end (456, 458) connected to at least one of the first and second primary ridges (451a, 451b), and wherein the secondary ridge portion (455) includes a tip end (457, 459) connected to the draining area (452).
2. The spin dryer (400) according to claim 1, wherein the secondary ridge portion (455) includes:
 - a first secondary ridge (455a) including a first base end (456) connected to the first primary ridge (451a) and a first tip end (457) formed in the draining area (452); and
 - a second secondary ridge (455b) including a second base end (458) connected to the second primary ridge (451b) and a second tip end (459) formed in the draining area (452).
 3. The spin dryer (400) according to claim 2, wherein the first secondary ridge (455a) includes a first dewatering ridge (461) and a second dewatering ridge (462) which are formed in a spin-drying process area defined between the first and second primary ridges (451a, 451b), the second secondary ridge (455b) includes a third dewatering ridge (463) and a fourth dewatering ridge (464) which are formed in the spin-drying process area, the first tip end (457) of one of the first and second dewatering ridges (461, 462) is formed between the third and fourth dewatering ridges (463, 464), and the second tip end (459) of one of the third and fourth dewatering ridges (463, 464) is formed between the first and second dewatering ridges (461, 462).
 4. The spin dryer (400) according to claim 3, wherein the draining area (452) is formed between a line connecting the first tip end (457) of the first dewatering ridge (461) to the first tip end (457) of the second dewatering ridge (462) and a line connecting the second tip end (459) of the third dewatering ridge (463) to the second tip end (459) of the fourth dewatering ridge (464).
 5. The spin dryer (400) according to claim 4, wherein the draining portion (453) includes a series of draining holes (454) provided in the draining area (452) extending in the first direction.
 6. The spin dryer (400) according to claim 5, wherein the first base end (456) is closer to a center of the drum (440, 440A, 440B) than the first tip end (457), the second base end (458) is closer to the center of the drum (440, 440A, 440B) than the second tip end (459), and the inner wall surface (443) includes a first primary dewatering surface (471, 471A) which has apexes defined by the first base end (456) of the first dewatering ridge (461), the first base end (456) of the second dewatering ridge (462), and the second tip end (459) of one of the third and fourth dewatering ridges (463, 464).
 7. The spin dryer (400) according to claim 6, wherein the inner wall surface (443) includes a second primary dewatering surface (472, 472A) which has apexes defined by the second base end (458) of the third dewatering ridge (463), the second base end (458) of the fourth dewatering ridge (464), and the first tip end (457) of one of the first and second dewatering ridges (461, 462).
 8. The spin dryer (400) according to claim 6 or 7, wherein the inner wall surface (443) includes a first secondary dewatering surface (473, 473A, 473B) which has apexes defined by the first base end (456) of the first dewatering ridge (461), the first tip end (457) of the first dewatering ridge (461), and the second tip end (459) of one of the third and fourth dewatering ridges (463, 464).
 9. The spin dryer (400) according to claim 8, wherein the inner wall surface (443) includes a second secondary dewatering surface (474, 474A, 474B) which has apexes defined by the first base end (456) of the second dewatering ridge (462), the first tip end (457) of the second dewatering ridge (462), and the second tip end (459) of one of the third and fourth dewatering ridges (463, 464).
 10. The spin dryer (400) according to claim 6 or 7, wherein the inner wall surface (443) includes a third secondary dewatering surface (475, 475A, 475B) which has apexes defined by the second base end (458) of the third dewatering ridge (463), the second tip end (459) of the third dewatering ridge (463), and the first tip end (457) of one of the first and second dewatering ridges (461, 462).
 11. The spin dryer (400) according to claim 10, wherein the inner wall surface (443) includes a fourth secondary dewatering surface (476, 476A, 476B) which has apexes defined by the second base end (458) of the fourth dewatering ridge (464), the second tip end (459) of the fourth dewatering ridge (464), and the first tip end (457) of one of the first and second dewatering ridges (461, 462).
 12. The spin dryer (400) according to claim 10, wherein at least a part of the draining holes (454) are formed along a boundary between the first secondary dewatering surface (473, 473A, 473B) and the third

secondary dewatering surface (475, 475A, 475B).

13. The spin dryer (400) according to claim 11, wherein at least a part of the draining holes (454) are formed along a boundary between the first secondary dewatering surface (473, 473A, 473B) and the fourth secondary dewatering surface (476, 476A, 476B). 5
14. The spin dryer (400) according to claim 10, wherein at least a part of the draining holes (454) are formed along a boundary between the second secondary dewatering surface (474, 474A, 474B) and the third secondary dewatering surface (475, 475A, 475B). 10
15. The spin dryer (400) according to claim 11, wherein at least a part of the draining holes (454) are formed along a boundary between the second secondary dewatering surface (474, 474A, 474B) and the fourth secondary dewatering surface (476, 476A, 476B). 15 20
16. The spin dryer (400) according to any one of claims 1 to 15, wherein the inner wall surface (443) turns in a second direction different from the first direction while the drive portion rotates the drum (440, 440A, 440B). 25

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FIG. 1

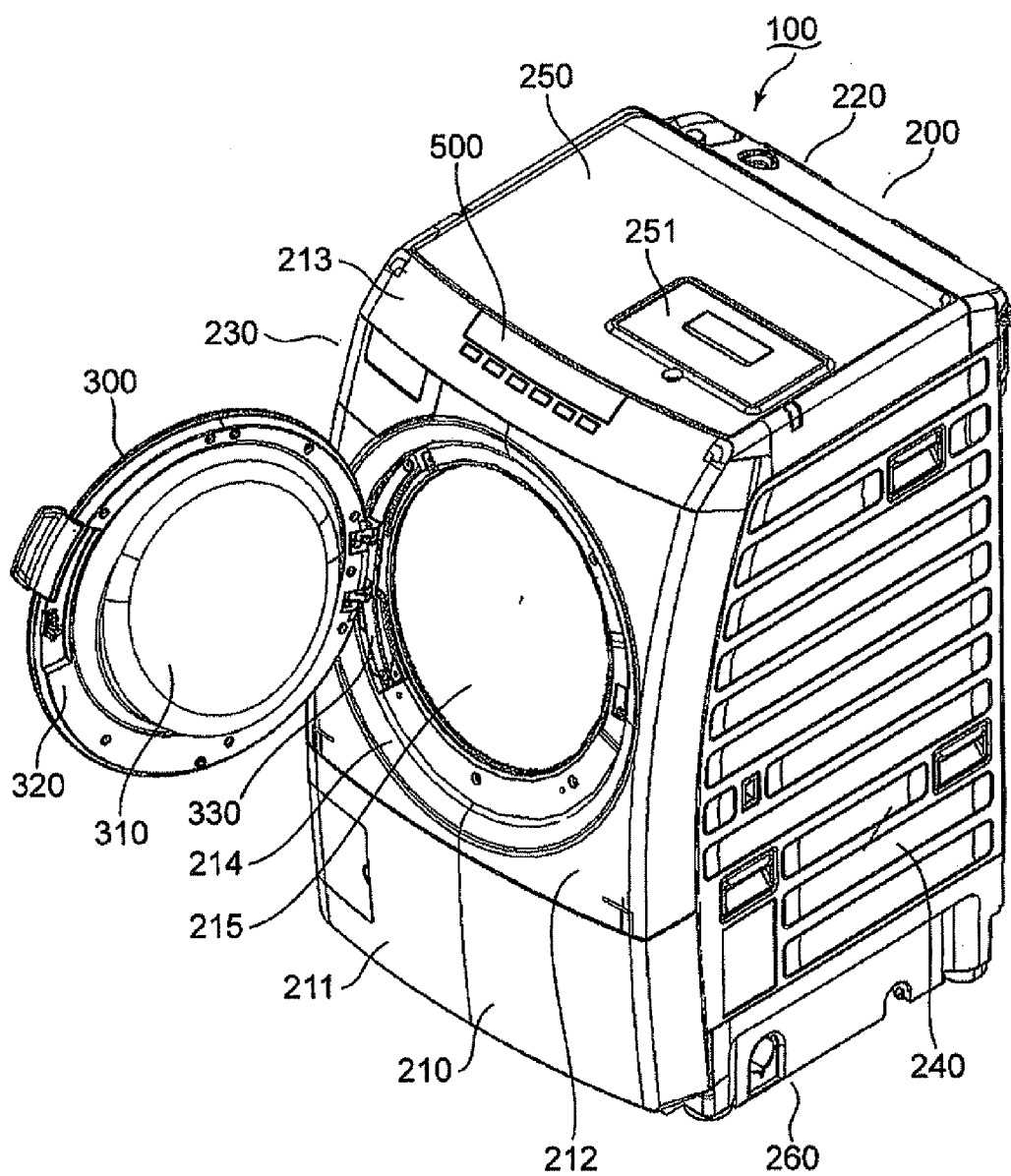
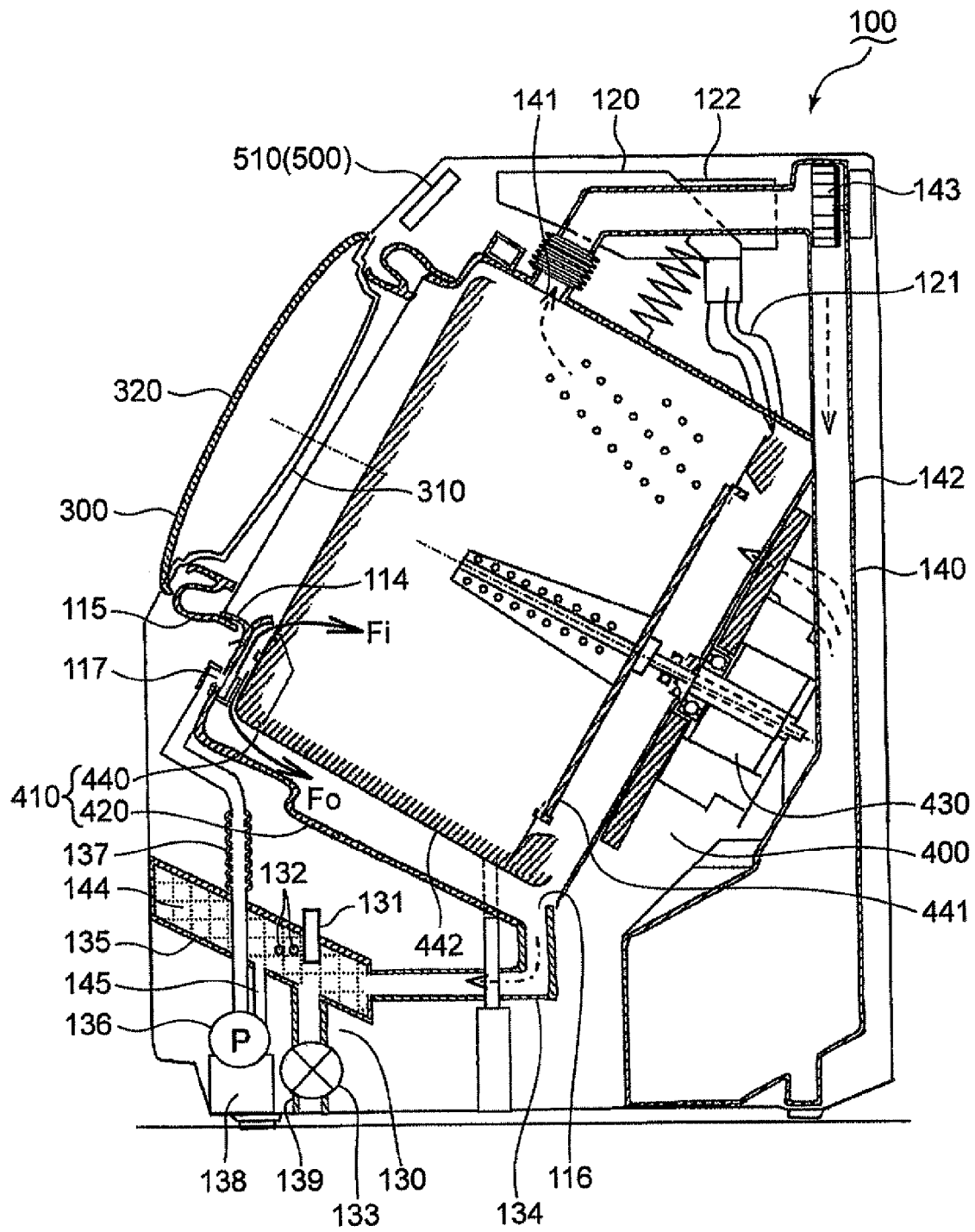


FIG. 2



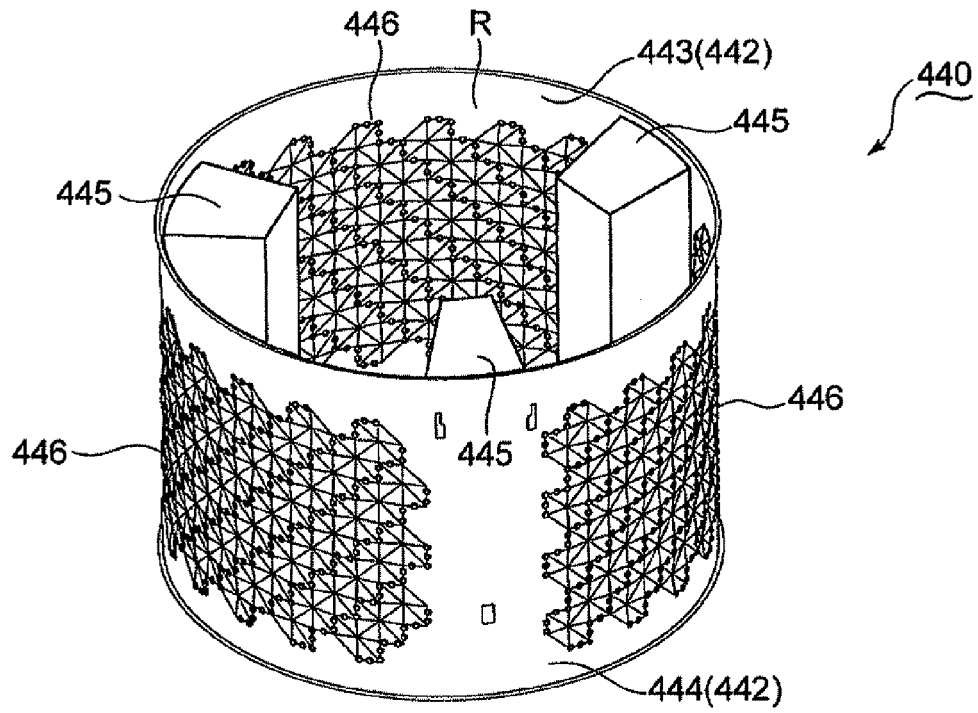


FIG. 3A

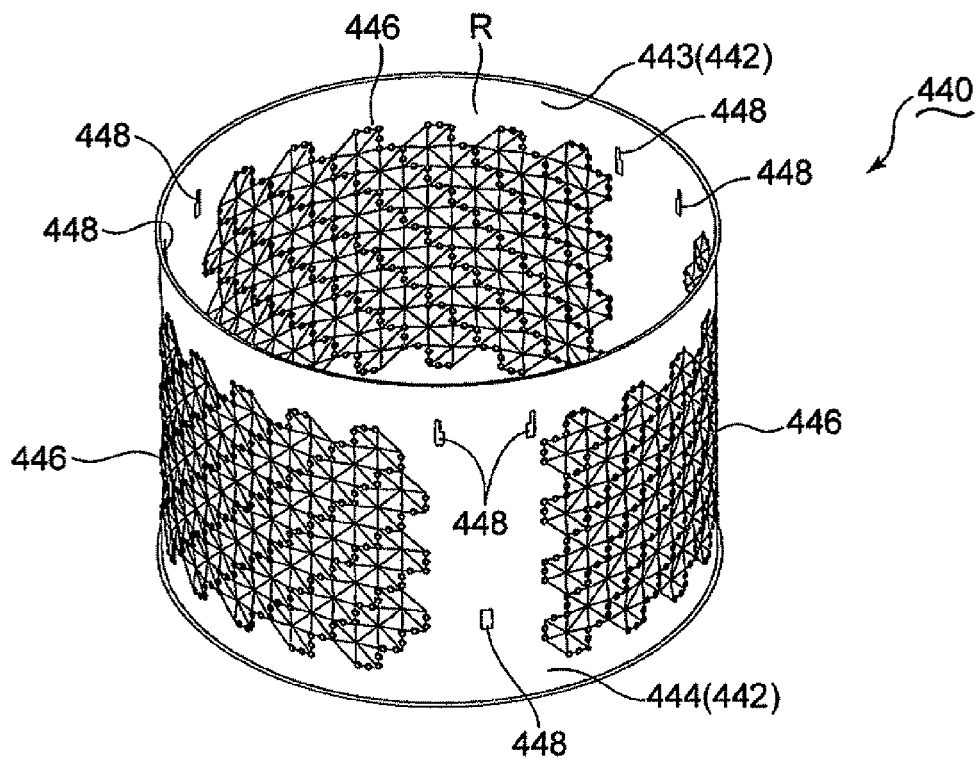
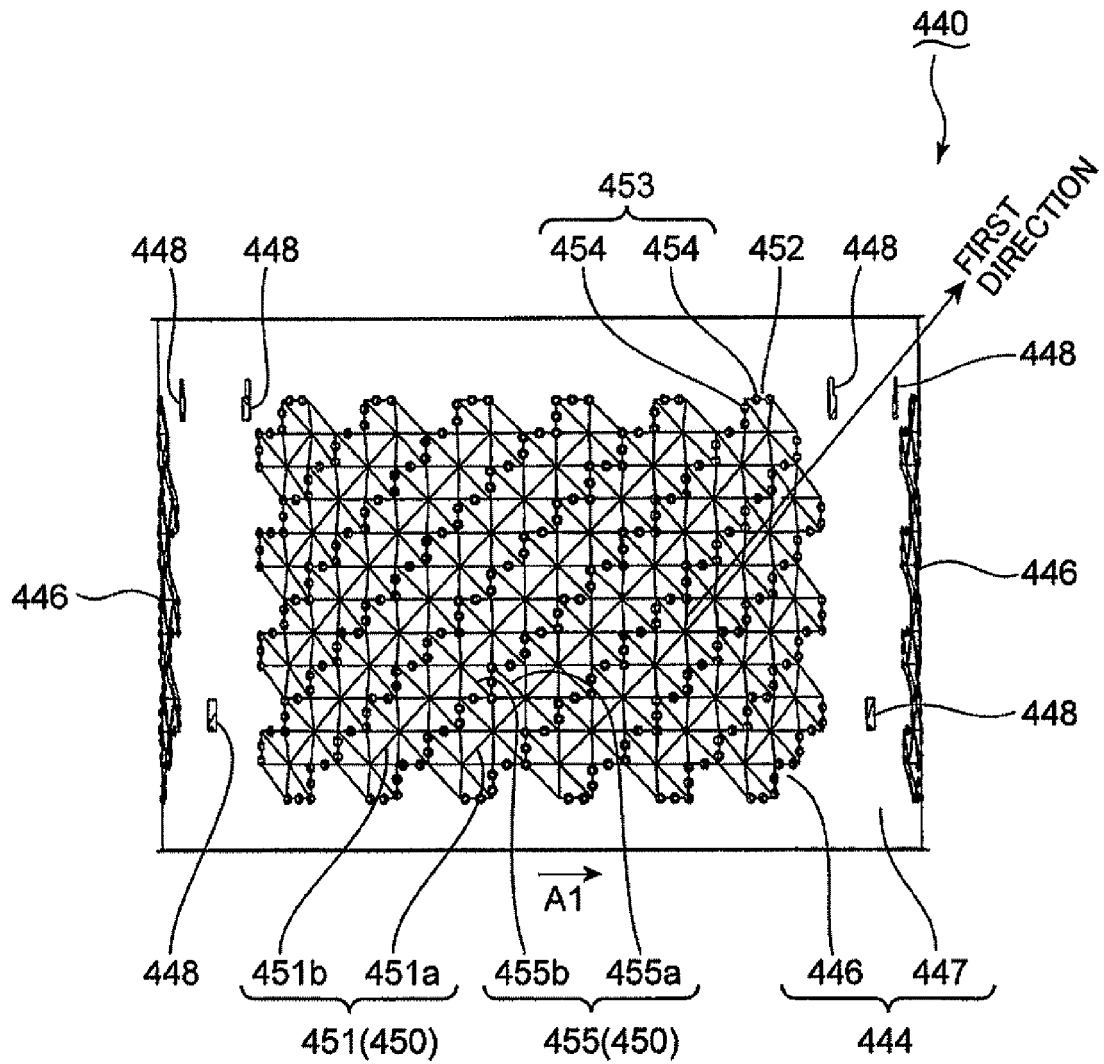


FIG. 3B

FIG. 4



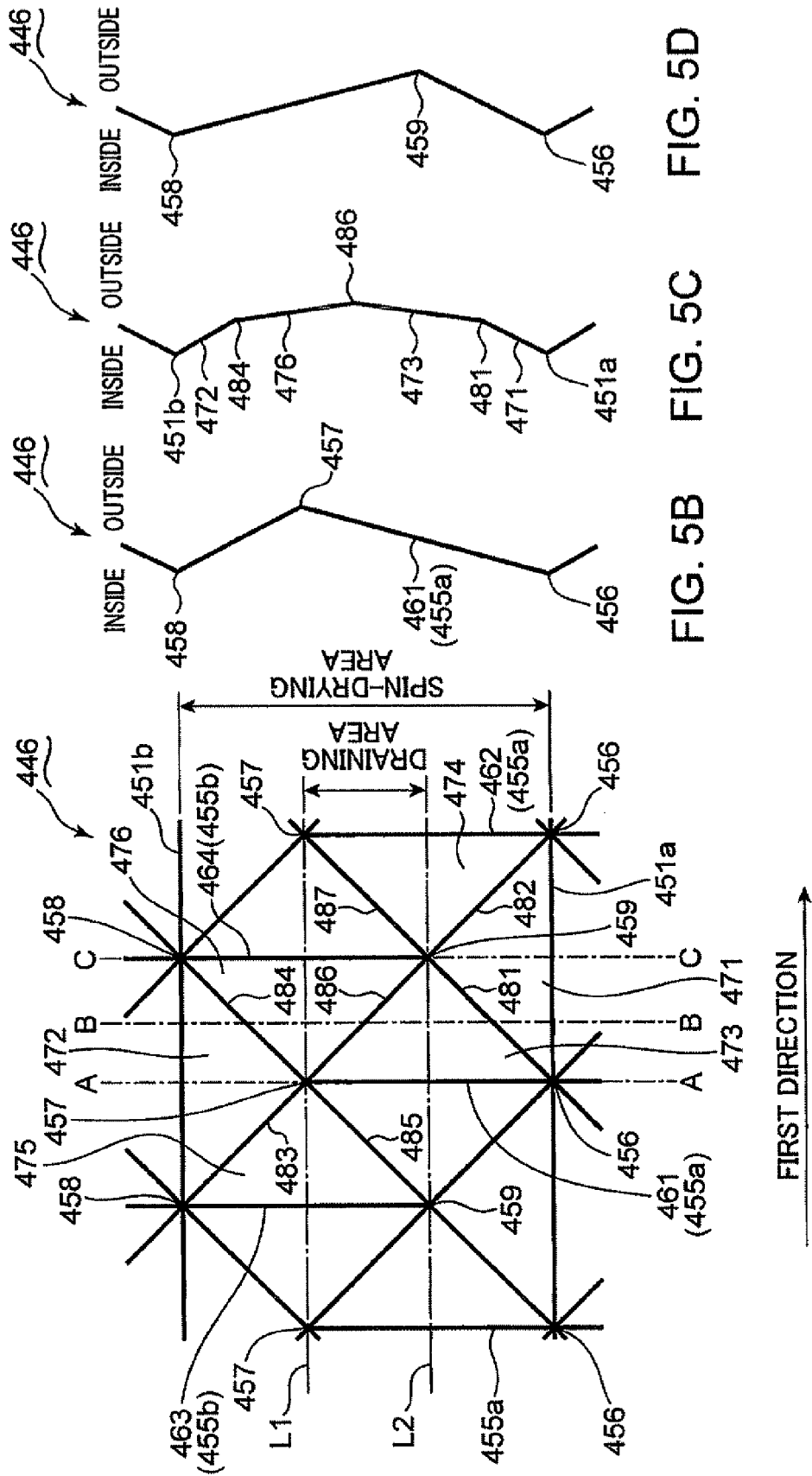


FIG. 5A

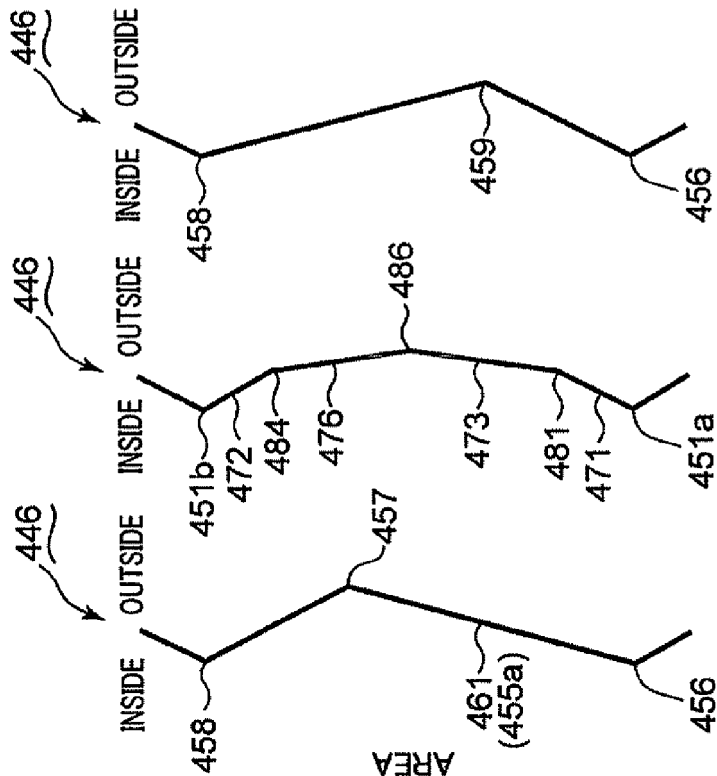


FIG. 5B FIG. 5C FIG. 5D

FIG. 6A

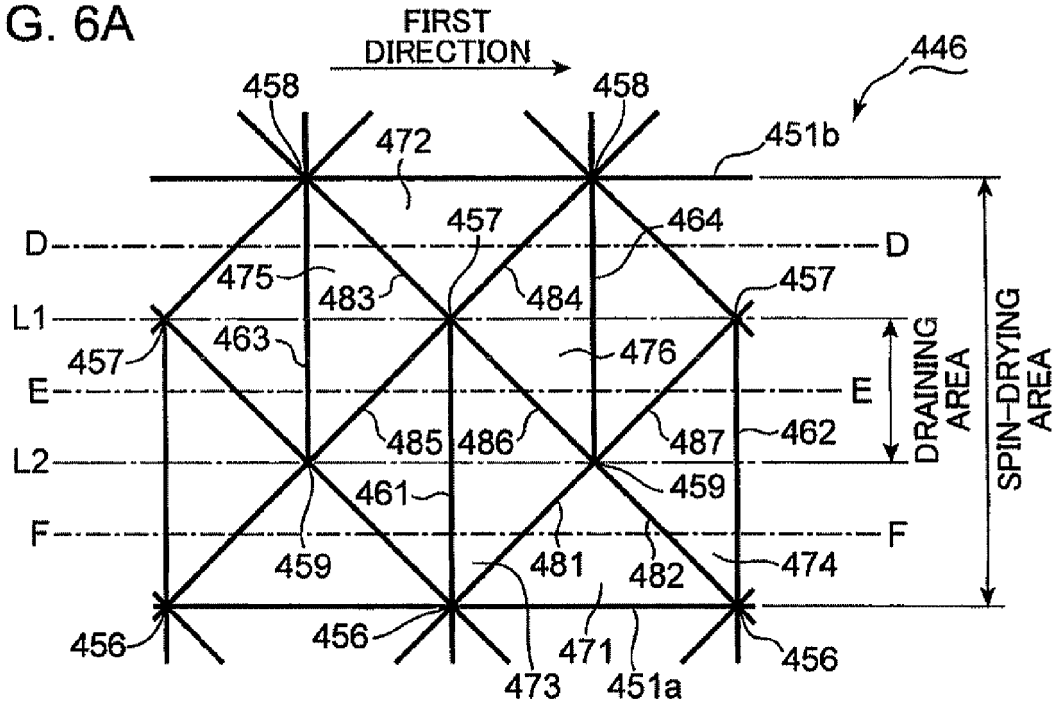


FIG. 6B

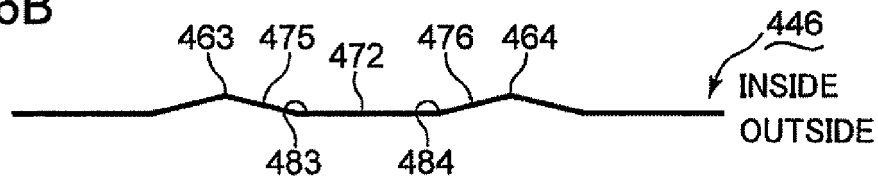


FIG. 6C

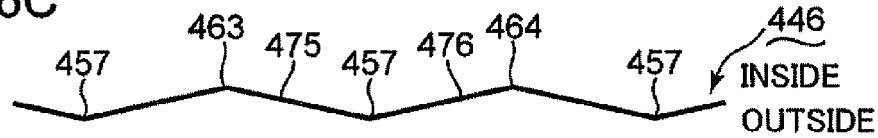


FIG. 6D

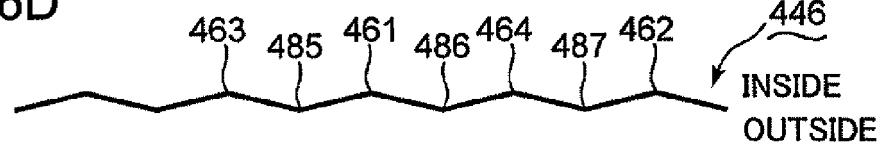


FIG. 6E

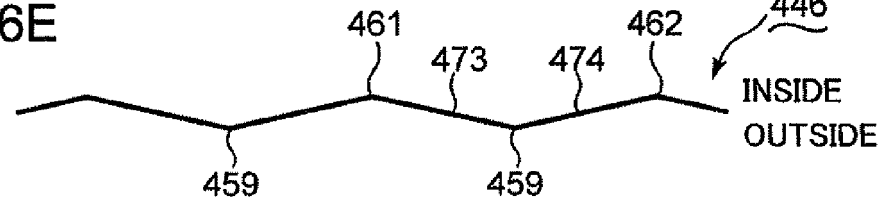


FIG. 6F

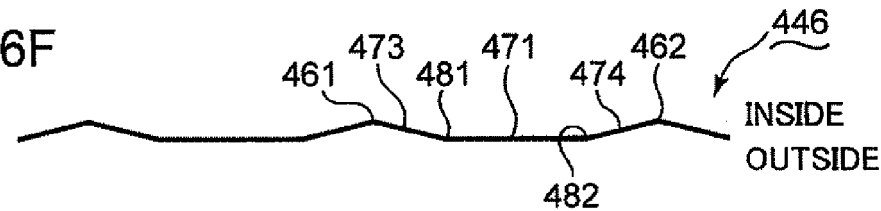


FIG. 7

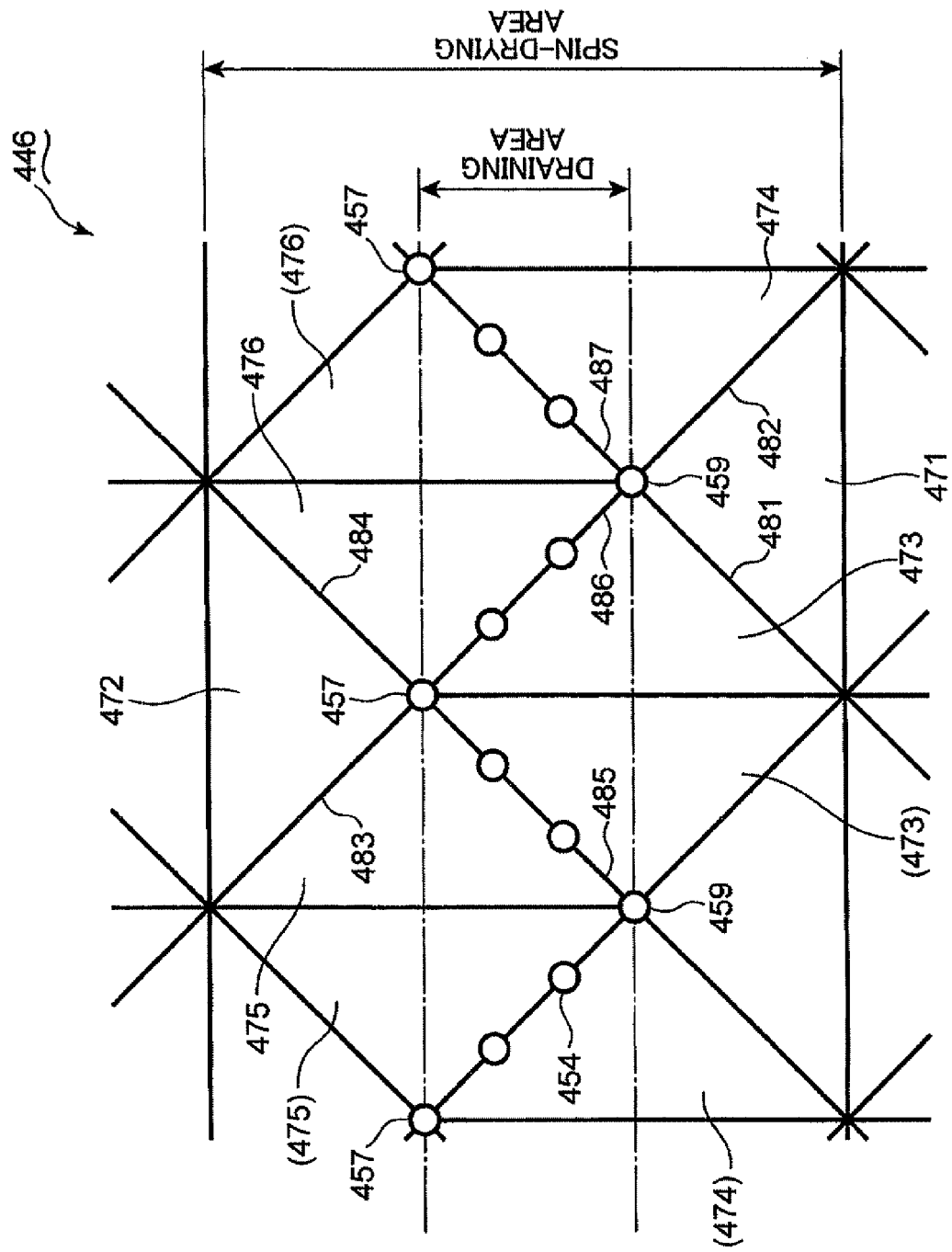


FIG. 8

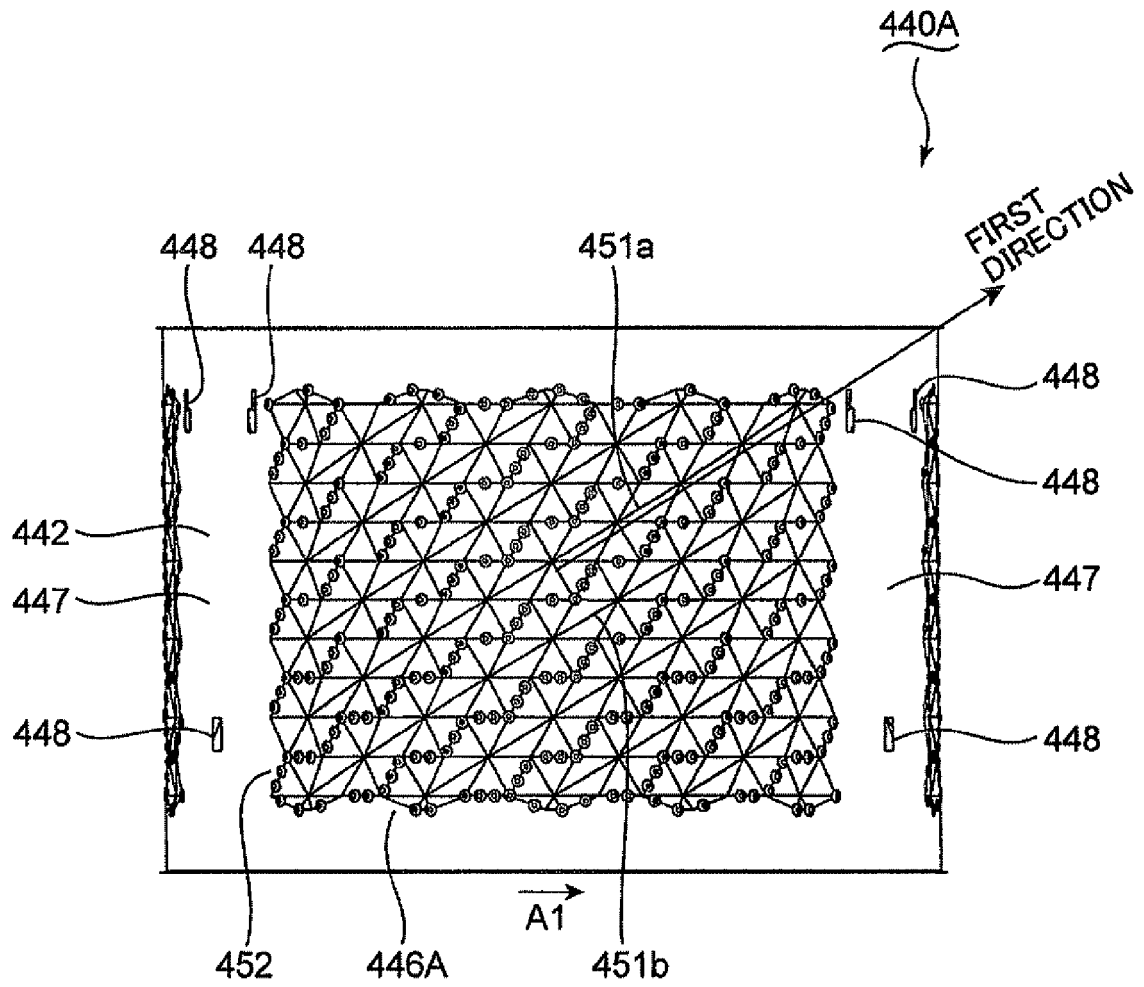


FIG. 9

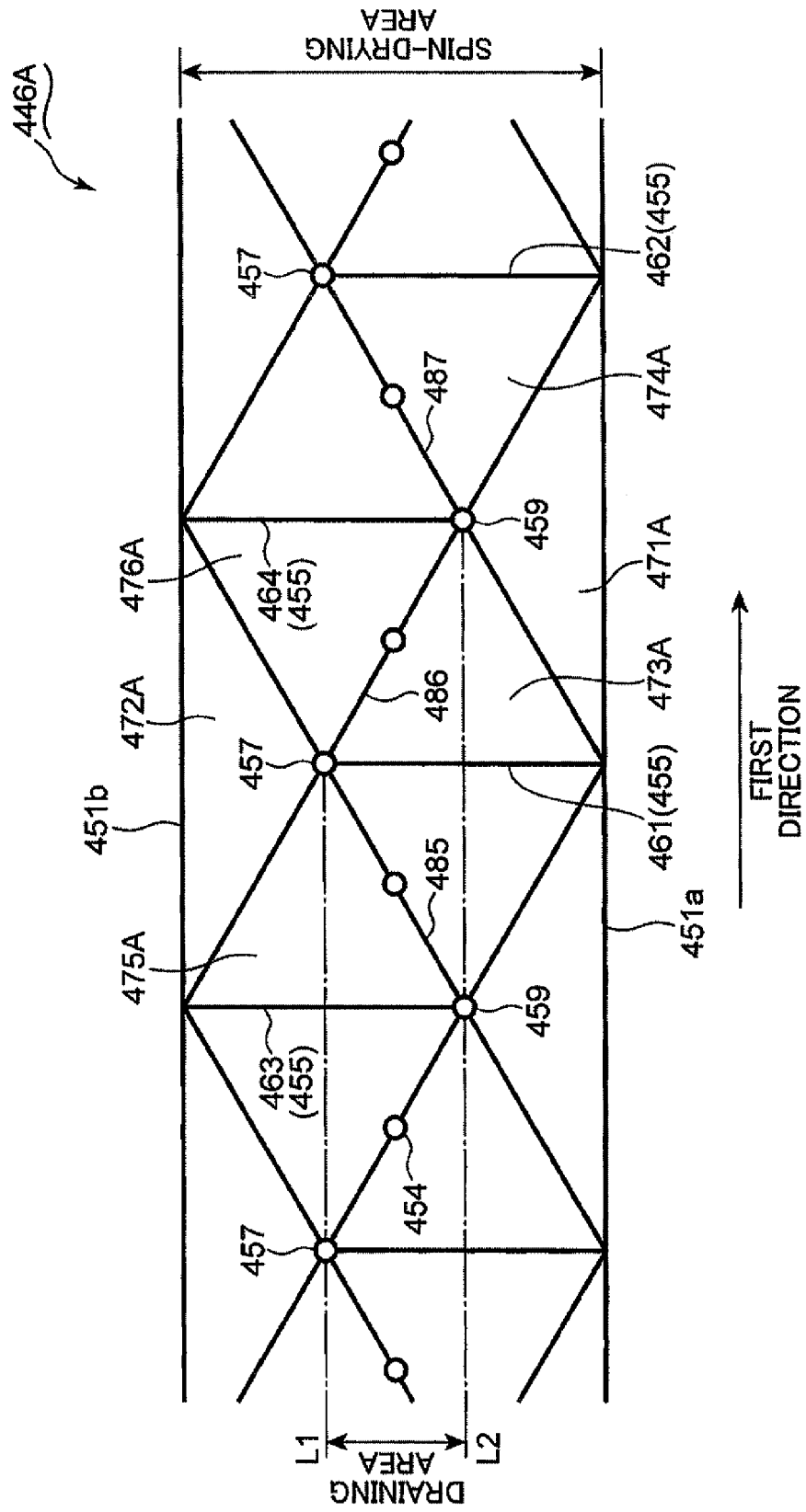


FIG. 10

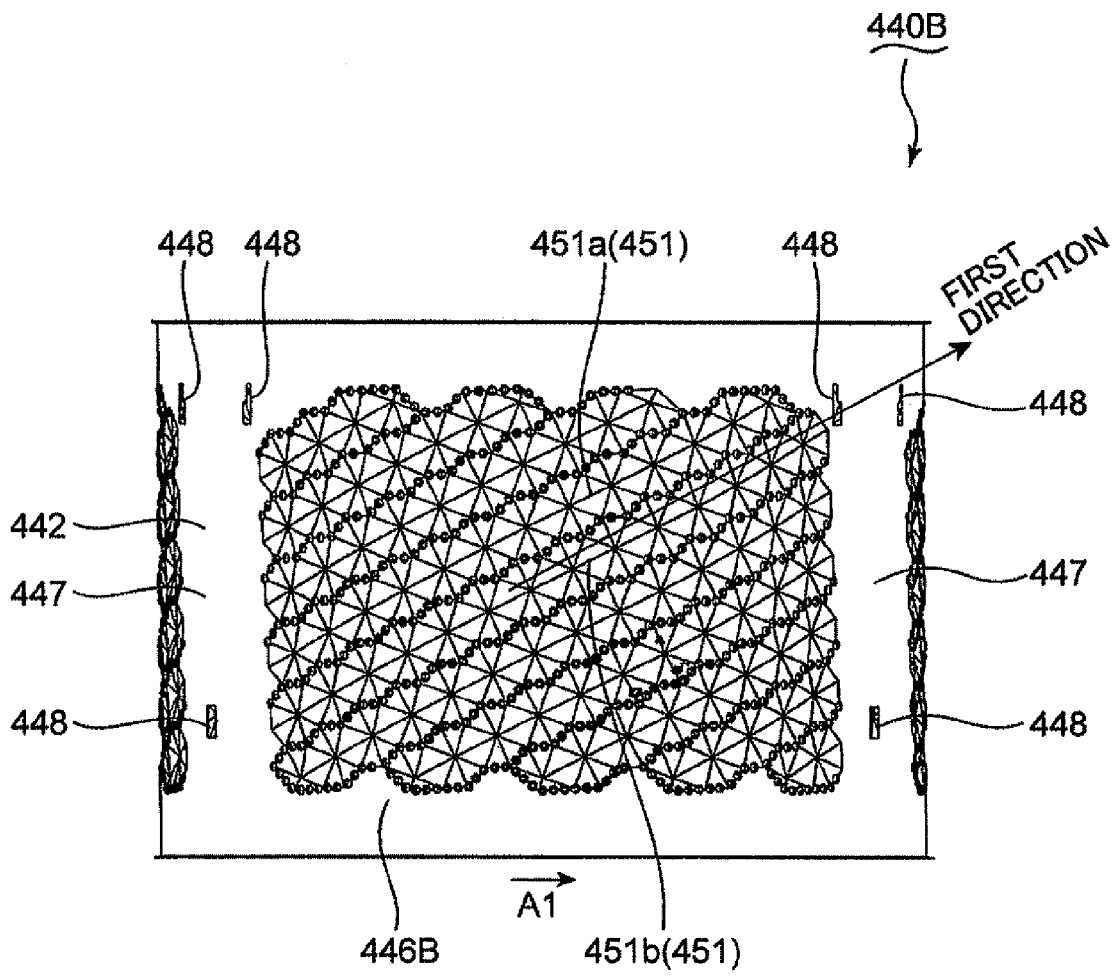
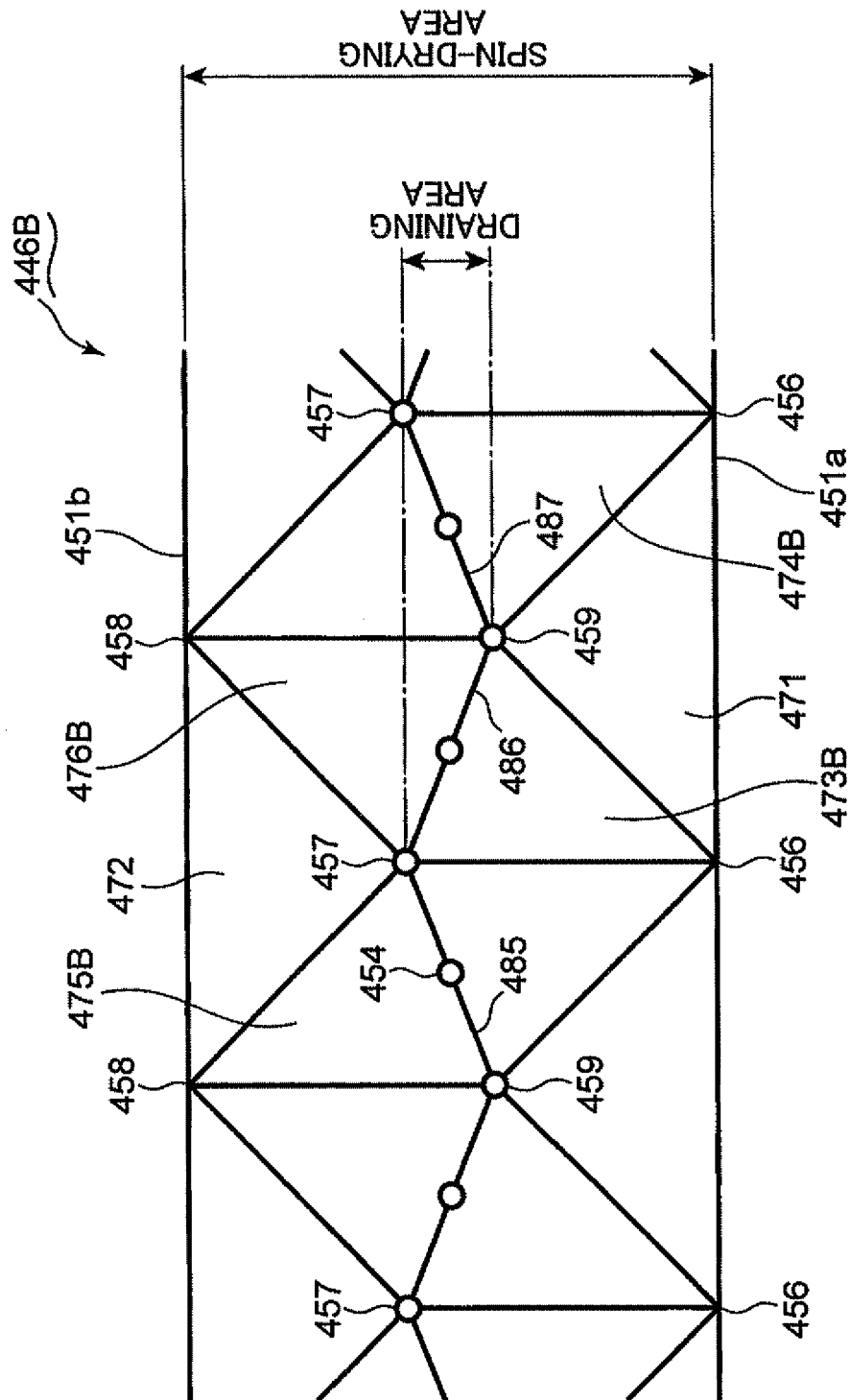


FIG. 11





EUROPEAN SEARCH REPORT

Application Number
EP 11 17 6501

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			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 February 2012	Examiner Diaz y Diaz-Caneja
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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