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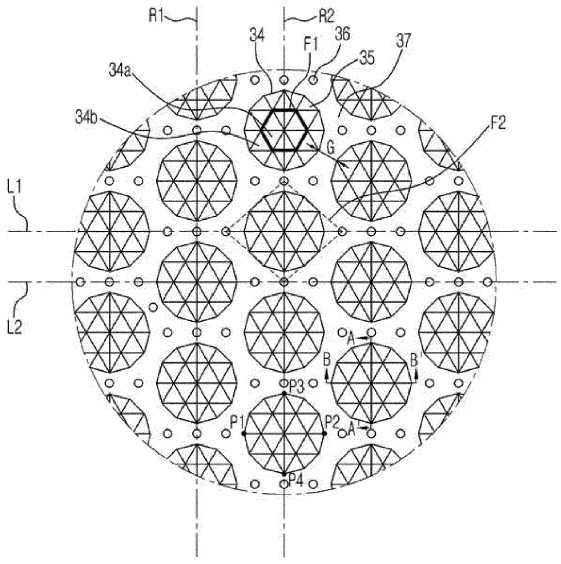
(54) Washing machine

(57) A washing machine including a drum capable of improving washing efficiency is provided. The washing machine includes a body (10), a tub (20) provided at an inside the body to store wash water, a drum (30) rotatably provided at an inner side of the tub to accommodate laundry, a driving apparatus (14) to rotate the drum, protrusions (34) that are formed of polygons having polygonal shapes and protruding inward from the drum, and a through-hole (36) provided between adjacent protrusions (34) to drain water. A protrusion having polygons generates frictional force between laundry and the drum, thereby increasing the washing power. The through-holes (36) are uniformly located around the protrusion (34), thereby preventing a spin dry water bottleneck phenomenon that occurs when water from a spin dry is concentrated on a certain through-hole, and thus enhancing the spin dry efficiency.

FIG. 3



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Description

[0001] The present invention relates to a washing machine, and more particularly, to a washing machine including a drum for enhancing the washing efficiency.

[0002] Generally, washing machines are a pulsator type washing machine or a drum type washing machine depending on a washing method. Each of the pulsator type washing machine and the drum type washing machine includes a tub and a drum.

[0003] However, in a case of the pulsator type washing machine, a rotary shaft of the drum where washing is performed may be provided to be perpendicular to the ground. A pulsator may be installed at a lower portion of the drum to generate water current. In a pulsator type washing machine, when the drum and the pulsator are rotated by a motor in a state in which laundry and detergent water are put into the drum, the pulsator stirs the laundry put into the drum together with wash water, thereby removing dirt from the laundry.

[0004] In a case of the drum type washing machine, lifters may be disposed inside the drum to lift laundry upward.

[0005] In both of the pulsator type washing machine and the drum type washing machine, the drum may be formed at a circumferential part thereof with through-holes that allow water of the tub to be introduced to the drum during a washing operation, and the water of the drum to be discharged during a drainage and spin dry operation.

[0006] Conventionally, the through-holes are arranged on an inner surface of the drum, which is flat. Thus, the laundry does not easily encounter substantial friction with the inner surface of the drum, and thus resulting in a limitation to the washing efficiency.

[0007] It is an aspect of the present invention to provide a washing machine having an improved structure of drum that is capable of enhancing the washing power of laundry while efficiently introducing and discharging wash water to, and from, the drum. Additional aspects 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.

[0008] In accordance with an aspect of the present invention, a washing machine includes a body, a tub, a drum, a driving apparatus, a plurality of protrusions, and at least one through-hole. The tub may be provided inside the body to store wash water therein.

[0009] The drum may be rotatably provided at an inner side of the tub to accommodate laundry therein. The driving apparatus may be configured to rotate the drum. The plurality of protrusions may protrude inward from the drum. The protrusion may be formed by a plurality of polygons that may each have a polygonal shape. The at least one through-hole may be provided between adjacent protrusions among the plurality of protrusions to drain water.

[0010] The protrusions may be spaced apart from one another.

[0011] Each of the polygons may have a different angle with respect to a surface of the drum.

[0012] The polygon may be a triangle having three sides.

[0013] The plurality of triangles may gather at a center of the protrusion, to form a hexagonal shape.

[0014] An outline of the protrusion may be a curved line such that the protrusion has an approximately circular shape.

[0015] The plurality of through-holes may be formed at depressions that are provided more outwardly of the drum than the protrusion, that is to say further from the centre or central axis of the drum.

[0016] The depression may be substantially flat.

[0017] The depression may include a concave part formed by recessing at least one portion of the depression.

[0018] An arrangement of the through-holes provided around the protrusion may have an approximately hexagonal shape.

[0019] The plurality of protrusions may be provided in a plurality of rows and columns. In accordance with an aspect of the present invention, a washing machine includes a body, a tub, a drum, a driving apparatus, a plurality of protrusions and through-holes.

[0020] The tub may be provided at an inside of the body to store wash water. The drum may be rotatably provided at an inner side of the tub to accommodate laundry therein. The driving apparatus may be configured to rotate the drum. The plurality of protrusions may protrude from the drum toward one side. The protrusion may be formed by a plurality of polygons that may be each provided on a different plane. The through-holes may be provided at an outermost area of the drum while being provided on a same plane.

[0021] Each of the plurality of protrusions may have a predetermined pattern.

[0022] The plurality of protrusions may be provided in a first row and a second row such that a protrusion forming the first row is disposed between protrusions forming the second row.

[0023] Each of the plurality of through-holes may be provided between respective protrusions.

[0024] Assuming that the through-hole has a diameter of d, a closest distance between the protrusions may be between d and d+10.

[0025] Each of the plurality of polygons may be a triangle having three sides, the plurality of triangles may gather to form a hexagonal, and triangles may be disposed at a circumference of the hexagonal to form a single protrusion of the plurality of protrusions.

[0026] A portion between the polygons may be rounded.

[0027] An exemplary drum of the washing machine in accordance with the an embodiment of the present invention includes a protrusion having a plurality of polygons that generate frictional force between laundry and

the drum, thereby increasing the washing power. The through-holes may be uniformly located around the protrusion, thereby preventing a spin dry water bottleneck phenomenon that occurs when water from spin dry is concentrated on a certain through-hole, and thus enhancing the spin dry efficiency.

[0028] Additional aspects and/or advantages will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the invention.

[0029] These and/or other aspects of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a cross-sectional view illustrating a washing machine in accordance with an embodiment of the present invention.

FIG. 2 illustrates an exemplary drum of a washing machine in accordance with an embodiment of the present invention.

FIG. 3 is a drawing illustrating an exemplary drum in accordance with an embodiment.

FIGs. 4A -4B are cross-sectional views illustrating an exemplary drum in accordance with an embodiment.

FIGS. 5 to 7 are drawings illustrating drums in accordance with various embodiments.

FIG. 8 is a cross-sectional view illustrating a drum in accordance with an embodiment.

FIG. 9 is a drawing illustrating a drum in accordance with an embodiment.

[0030] 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 like elements throughout. The embodiments are described below to explain the present invention by referring to the figures.

[0031] FIG. 1 is a cross-sectional view illustrating a washing machine in accordance with an embodiment of the present invention. FIG. 2 is an exploded perspective view of an exemplary drum of a washing machine in accordance with an embodiment of the present invention.

[0032] Referring to FIGS. 1 and 2, a washing machine 1 includes a body 10 provided at a front side thereof with an inlet 11 through which laundry is put into, a tub 20 installed at an inside the body 10 to store wash water, and a drum 30 rotatably provided at an inner side of the tub 20 to accommodate laundry. The washing machine 1 includes a door 122 to open and close the inlet 11 of the body 10.

[0033] The tub 20 may be slantingly installed at a predetermined angle α with respect to an installation surface of the washing machine 1 such that a front side part 20a in which an inlet thereof is formed is disposed to be higher than a rear side part 20b of the tub 20. The drum 30 inside the tub 20 may be slantingly installed in the same way as the tub 20. However, the configurations of the tub 20 and the drum 30 are not limited thereto, and therefore the tub 20 and/or the drum 30 may be not slantingly installed.

[0034] The drum 30 may be rotatably supported by a rotary shaft 13 that may be coupled to a rear side part 30a of the drum 30 while passing through the rear side part 20b of the tub 20. A driving motor 14 may be installed at an outer side of the rear side part 20b of the tub 20 to rotate the rotary shaft 13. As the driving motor 14 rotates the rotary shaft 13, the drum 30 inside the tub 20 rotates. The driving motor 14 rotates the drum 30 at a low speed during a washing operation, and may rotate the drum 30 in one direction at a high speed during a spin dry operation.

[0035] At an upper side of the tub 20, a detergent supply apparatus 15 may be provided to supply the inside of the tub 20 with detergent, and a water supply apparatus 16 may be provided to supply the inside of the tub 20 with wash water. The detergent supply device 15 may be installed adjacent to a front side of the body 20. The water supply apparatus 16 includes a first water supply pipe 16 connecting an external water supply pipe i6a to the detergent supply apparatus 15, a second water supply pipe 16c connecting the detergent supply apparatus 15 to the tub 20, and a water supply control valve 16d installed on the first water supply pipe i6d to control supply of water. Such a configuration allows water to be supplied to the inside of the tub 20 via the detergent supply apparatus 15 such that detergent is supplied to the tub 20 together with water.

[0036] A heater 17 may be installed at a lower portion of the inside of the tub 20 to heat the wash water of the tub 20. To facilitate installation of the heater 17, a heater receiving part 20c may be provided at a lower portion of the tub 20 while protruding downward to receive the heater 17 while collecting wash water therein.

[0037] At a lower portion of an outer side of the tub 20, a drainage apparatus 40 may be installed to drain wash water of the tub 20, and a wash water circulation apparatus 50 may be installed to supply wash water in the tub 20 to the inside of the drum 30. The drainage apparatus 40 includes a first drain pipe 42 connecting to a drain port 41 formed at a lower portion of the tub 20, a drain pump 43 installed on the first drain pipe 42, and a second drain pipe 44 connecting to an outlet of the drain pump 43.

[0038] The wash water circulation apparatus 50 includes a bypass valve 51 installed on the second drain pipe 44 at a side of the outlet of the drain pump 43, a wash water circulation pipe 52 extending from the bypass valve 51 to an inlet 31 of the drum 30, and a spray nozzle 53 installed at an outlet of the wash water circulation pipe 52. The bypass valve 51 converts a passage such that wash water of the outlet of the drain pump 43 is drained to the outside or flows toward the wash water circulation pipe 52. The bypass valve 51 may be an electromotive three way valve. If the drain pump 43 is driven in a state in which the bypath valve 51 operates to allow wash water

to flow toward the wash water circulation pipe 52, the wash water in the tub 20 may be sprayed to the inside of the drum 30 through the first drain pipe 42 and the wash water circulation pipe 52. If the drain pump 43 is driven in a state in which the bypath valve 51 operates to allow wash water to flow toward the second drain pipe 44 that guides wash water to the outside, the wash water in the tub 20 may be drained.

[0039] The drum 30 includes a rear side part 30a that may be coupled to the rotary shaft 13, a front side part 30b having an inlet 31, and a circumference part 30c provided in a cylindrical shape and having both ends coupled to the front side part 30b and the rear side part 30a, respectively. A plurality of lifters 33 may be installed at an inner surface of the circumference part 30c of the drum 30 to lift and drops laundry inside the drum 30 when the drum 30 rotates. A plurality of stirring protrusions 32 may be installed at an inner surface of the rear side part 30a of the drum 30 to improve the cleaning power. A plurality of protrusions 34 and a plurality of through-holes 36 are arranged on an inner surface of the drum 30.

[0040] FIG. 3 is a drawing illustrating an exemplary drum in accordance with an embodiment. FIGs. 4A and 4B illustrate exemplary cross sections of protrusions that are illustrated in FIG. 3 in accordance with an embodiment. FIG. 4A illustrates a cross-section along A-A' , and FIG. 4B illustrates a cross-section along B-B'.

[0041] Referring to FIGS. 3, 4A and 4B, the plurality of protrusions 34 may be provided at an inner side of the drum 30, and the plurality of through-holes 36 may be provided around the protrusions 34. As illustrated in FIGS. 4A and 4B, each of the protrusions 34 may be provided to protrude from the outer side to the inner side of the drum 30, but the present invention is not limited thereto. The protrusion 34 includes a plurality of polygons 35 having a polygonal shape. As illustrated in the FIG. 3, the polygons 35 each may have a triangular shape having three sides, but the present invention is not limited thereto. For example, the protrusion 34 may be provided in any other polygonal shape. The polygons 35 may be disposed to have different angles with respect to a surface of the drum 30. That is, each of the polygons 35 may exist on a different plane. Accordingly, the protrusion 34 may be formed by the polygons 35 existing on respectively different planes.

[0042] As illustrated in the FIG. 3, for example, six triangles form a hexagonal pyramid F1, and eighteen triangles are formed around the hexagonal pyramid F1, forming a single protrusion 34 including a total of twenty-four triangles . The hexagonal pyramid F1 located at the center of the protrusion 34 may be referred to as a first protrusion 34a, and protrusions, which are provided as triangles, around the hexagonal pyramid may be referred to as second protrusions 34b. The first protrusion 34a may protrude more inward the drum 30 than the second protrusion 34b.

[0043] The polygon 35 may be provided as a regular triangle, or an isosceles triangle. With respect to a single protrusion 34, a maximum distance between a point P1 and a point P2 of the protrusion 34 in a direction of a rotary shaft of the drum 30 may be defined as Si, and a maximum distance between a point P3 and a point P4 of the protrusion 34 in a circumferential direction of the drum 30 may be defined as S2. In a case in which a polygon 35 is provided as a regular triangle, S1 is equal to S2. In a case in which a polygon 35 is provided as an isosceles triangle, S1 may have a size of half to two times a size of S2. In accordance with an embodiment of the present invention in which the protrusion 34 is composed of twenty-four triangles, S2 may have a size four times a height of the triangle. When the number of triangles used exceeds twenty-four, S2 may be increased in units of multiplication by 2. For example, in a case in which the protrusion 34 is composed of forty-eight triangles, S2 may have a size six times a height of the triangle. A depth of the protrusion 34 formed on the surface of the drum 30 may be defined as S3. In a case in which the polygon 35 is a regular triangle, S1 and S2 each may have sizes five times to thirty times a size of S3. In a case in which the polygon 35 is an isosceles triangle, a larger one of S1 and S2 may have a size five times to thirty times a size of S3. As an example, in a case in which S3 is 2mm, one of S1 and S2 may have a size within a range between 10mm to 60mm.

[0044] In a case in which the polygon 35 is a triangle, a single protrusion 34 may include a maximum number of polygons. Accordingly, the cleaning power may be increased while minimizing the damage of laundry that occurs as a result of the laundry coming into contact with the inner side of the protrusion 34. However, the polygon 35 is not limited to the triangle. The polygon 35 may be provided as a quadrangle, and a hexagon, for example. Sides of the polygon 35 forming an outline of the protrusion 34 may be provided in a curved line. Accordingly, the protrusion 34 may have an approximately circular shape. A portion between the polygons 35 forming the protrusion 34 may be rounded. For example, a portion between the polygons 35 may have a radius of curvature (r) of about 0.2r to 0.5r. Accordingly, the surface of the drum 30 may be smoothly formed to prevent laundry from being damaged.

[0045] The protrusions 34 may be spaced apart from each other. The protrusions 34 may have various arrangements. The plurality of through-holes 36 may be provided around the protrusion 34. At least one through-hole 36 may be provided between the protrusions 34. In accordance with an embodiment of the present invention, the through-hole 36 is illustrated as being provided in one unit thereof between the protrusions 34, but the number of the through-holes 36 provided between the protrusions 34 is not limited thereto.

[0046] The plurality of through-holes 36 may be provided in a depression 37 that is provided further outward from the drum 34 than the protrusion 34. The depression 37 may be provided to be flat when the drum 30 is extended ie. the surface of the drum is laid out flat. However,

in a case in which the drum 37 is rolled and bonded, the depression 37 corresponds to a curved surface.

[0047] The through-hole 36 may be provided in the depression 37. Accordingly, the through-hole 36 may be located distant from the center of the drum 30, so that wash water is efficiently introduced and discharged due to a centrifugal force. For example, when the through-hole 36 is provided in a piercing scheme, the through-hole 36 may have a diameter (see, for example, d1 in FIG. 4) of about 1.8mm to 3.5mm. A gap (see, for example, G in FIG. 3) between adjacent portions of the protrusions 34 may have a size of the diameter (d1) of the through-hole 36 or larger and the diameter (d1) of the through-hole plus about 10mm or smaller.

[0048] The protrusion 34 may have various arrangements. In accordance with an embodiment of the present invention, the protrusion 34 may be provided in a plurality of rows L1 and L2 and a plurality of columns R1 and R2. A row located at an upper side (see, for example, FIG. 3) between the rows L1 and L2 forming protrusions 34 may be defined as a first row L1, and a row located at a lower side between the rows L1 and L2 may be defined as a second row L1. The protrusion 34 forming the second row L2 may be located between the protrusions 34 forming the first low L1. That is, the protrusion 34 forming the second row L2 may be arranged between the protrusions 34 of the first row L1 such that the protrusion 34 forming the first row L1 is provided in a zig-zag manner with the protrusion 34 forming the second row L2. At least one through-hole 36 is provided between the protrusions 34. As illustrated in FIG. 3, for example, four through-holes 36 may be provided around a single protrusion 34, but the number of the through-holes 36 around the protrusion 34 is not limited thereto. As illustrated in FIG. 3, the four through-holes 36 connected to one another with a dotted line form a quadrangle shape F2.

[0049] FIGS. 5 to 8 are drawings illustrating drums in accordance with various embodiments of the present invention.

[0050] As illustrated in FIGS. 5 to 8, protrusions 44 and through-holes 46 may be arranged in various schemes.

[0051] In accordance with an embodiment of the present invention as illustrated in FIG. 5, protrusions 44 of rows L3 and L4 are provided to be in alignment with each other, and protrusions 44 of columns R3 and R4 are provided to be in alignment with each other.

[0052] That is, the protrusion 44 in one row is not disposed between the protrusions 44 in an other row such that the protrusions 44 in a zig-zag manner, different from FIG. 3. A total of four through-holes 46 are arranged around a single protrusion 44, and the rows L3 and L4 are disposed in alignment with each other and the columns R3 and R4 are disposed in alignment with each other, so that only one through-hole 46 is located between one protrusion 44 and another protrusion 44. That is, the through-holes 46 are also arranged along the rows and columns of the protrusions 44. The through-holes 46 may be formed around a single protrusion 54, as illustrated by a dotted line forming a quadrangle shape F2.

[0053] In an embodiment of the present invention illustrated in FIG. 6, through-holes 56 are provided in a different arrangement than FIG. 5. A protrusion 54 forming a first row L5 is located between protrusions 54 forming a second row L6 such that protrusion 54 of the first low L5 and the protrusion 54 of the second row L6 are provided in a zig-zag manner. The through-holes 56 may be located around the protrusion 54. A total of twelve through-holes 56 are located around a single protrusion 54. The through-holes 56, connected by a dashed line form an approximately hexagonal shape F3. That is, the through-holes 56 are arranged to surround the protrusion 54 in a hexagonal shape.

[0054] The through-holes 56 are arranged in a uniform pattern, and when compared to other embodiments, may be provided in a larger number thereof, thereby preventing a spin dry water bottleneck phenomenon that occurs due to a small number of through-holes during a spin dry operation, and thus the spin dry efficiency is improved. In addition, in a case of a product that washes laundry by use of bubbles, a bubble bottle neck phenomenon occurring in a through-hole is improved, so that the time taken for bubbles to be introduced and the amount of bubbles introduced are improved. In addition, the through-holes are uniformly provided in a predetermined pattern, thereby preventing the washing extent of laundry from being varied depending on the position of the laundry.

[0055] In an embodiment of the present invention illustrated in FIGS. 7 and 8, protrusions 64 are provided in alignment with one another. That is, the protrusions 64 are not provided in a zig-zag manner, different from the FIGS. 3 and 6. Through-holes 66 are arranged to have a hexagonal shape around the protrusion 64.

[0056] In accordance with an embodiment of the present invention, the through-hole 66 is provided as a burring hole that is formed through a burring process. Through the burring processing, a rim 68, that is, an outer rim 68 protrudes around the through-hole 66 toward the outer side of the drum 30. Rims 67 and 68 provided on the drum 30 include an inner rim 67 and the outer rim 68. The inner rim 67 has a diameter decreasing outwardly in the drum 30, and the outer rim 68 has a diameter increasing outwardly in the drum 30. The outer rim 68 is located more outward the drum 30 than the inner rim 67.

[0057] When a diameter including the rims 67 and 68 formed through the burring process is defined as d2, and a diameter of the through-hole 64 is determined as d3, a gap G between the most adjacent portions of the protrusions 64 may have a size of the diameter (d3) or larger and the diameter (d3) plus about 10mm or smaller. In the burring process, a cross section of a depression 69 may be determined in consideration of the diameter (d3) of the through-hole 66 that is increased due to the diameter d2, referred to as an inner diameter, during the burring process. Accordingly, when compared to a case without having a burring process, the gap G between the most

adjacent portions of the protrusions 64 is increased.

[0058] In a case in which the burring process is not performed, the laundry may be torn due to a cutting surface of the through-hole. However, in a case in which the burring process is performed, a cutting surface may be formed outside the drum 30, thereby preventing the laundry from being damaged.

[0059] FIG. 9 is a drawing illustrating a drum in accordance with an exemplary embodiment. In accordance with an embodiment of the present invention, a depression 77 may include a concave part 79 formed by recessing at least one portion thereof. That is, the concave part 79 is recessed from the inner side to the outer side of the drum 30. A through-hole 76 is provided at a portion of the concave part 79. The through-hole 76 may be provided at the center of the recess part 79. The through-hole 76 may be located at an outermost area of the drum 30, so that wash water is smoothly introduced and discharged due to a centrifugal force during rotation of the drum 30.

[0060] Although a few embodiments of the present disclosure have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles of the invention, the scope of which is defined in the claims.

Claims

1. A washing machine comprising:

a drum to accommodate laundry therein;
a driving apparatus to rotate the drum;
a plurality of protrusions protruding inwards from the drum, each of the protrusions comprising a plurality of polygons; and
at least one through-hole provided between adjacent protrusions to drain water.

2. The washing machine of claim 1, wherein the protrusions are spaced apart from one another.

3. The washing machine of claim 1 or 2, wherein each of the polygons has a different angle with respect to a surface of the drum.

4. The washing machine of any one of the preceding claims, wherein each of the polygons is a triangle.

5. The washing machine of claim 4, wherein a plurality of triangles at a centre of the protrusion form a hexagonal shape.

6. The washing machine of any one of the preceding claims, wherein an outline of each of the protrusions is provided in a curved line such that the protrusion has an approximately circular shape.

7. The washing machine of any one of the preceding claims, wherein the plurality of through-holes are formed at depressions that are provided further from the centre of the drum than the protrusions.

8. The washing machine of claim 7, wherein the depressions are provided to be substantially flat.

9. The washing machine of claim 7, wherein the depression includes a concave part formed by recessing at least one portion of the depression.

10. The washing machine of any one of the preceding claims, wherein an arrangement of the through-holes provided around the protrusion has an approximately hexagonal shape.

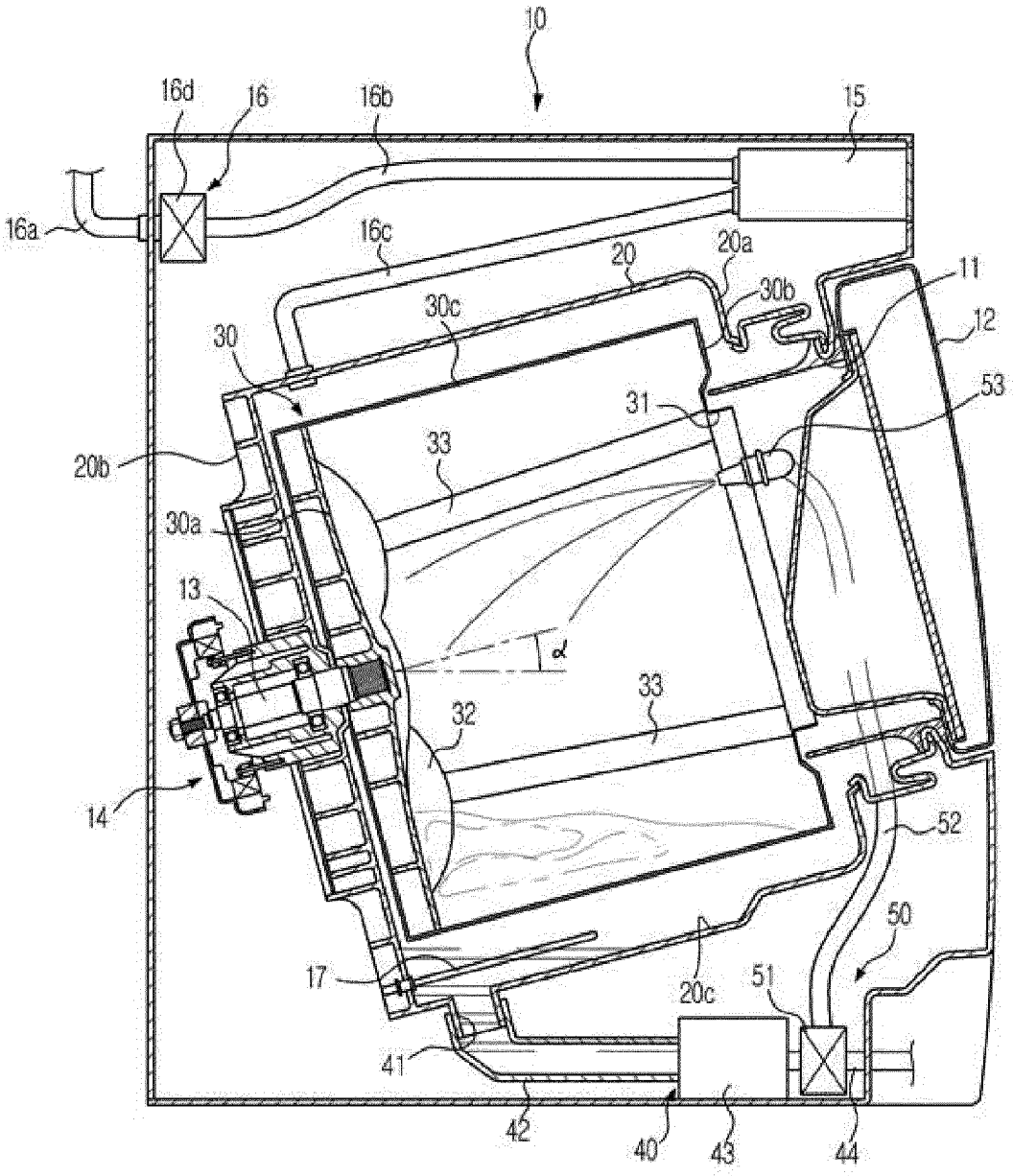
11. The washing machine of any one of the preceding claims, wherein the plurality of protrusions are provided in a first row and a second row such that a protrusion forming the first row is disposed between protrusions forming the second row.

12. The washing machine of any one of the preceding claims, wherein when assuming that the through-hole has a diameter of d, a closest distance between the protrusions is between d and d+10.

13. The washing machine of any one of the preceding claims, wherein each of the plurality of polygons is a triangle, the plurality of triangles form a hexagon and triangles are disposed at a circumference of the hexagonal to form a single protrusion.

14. The washing machine of any one of the preceding claims, wherein a portion between the polygons is rounded.

FIG. 1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10
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44

FIG. 2

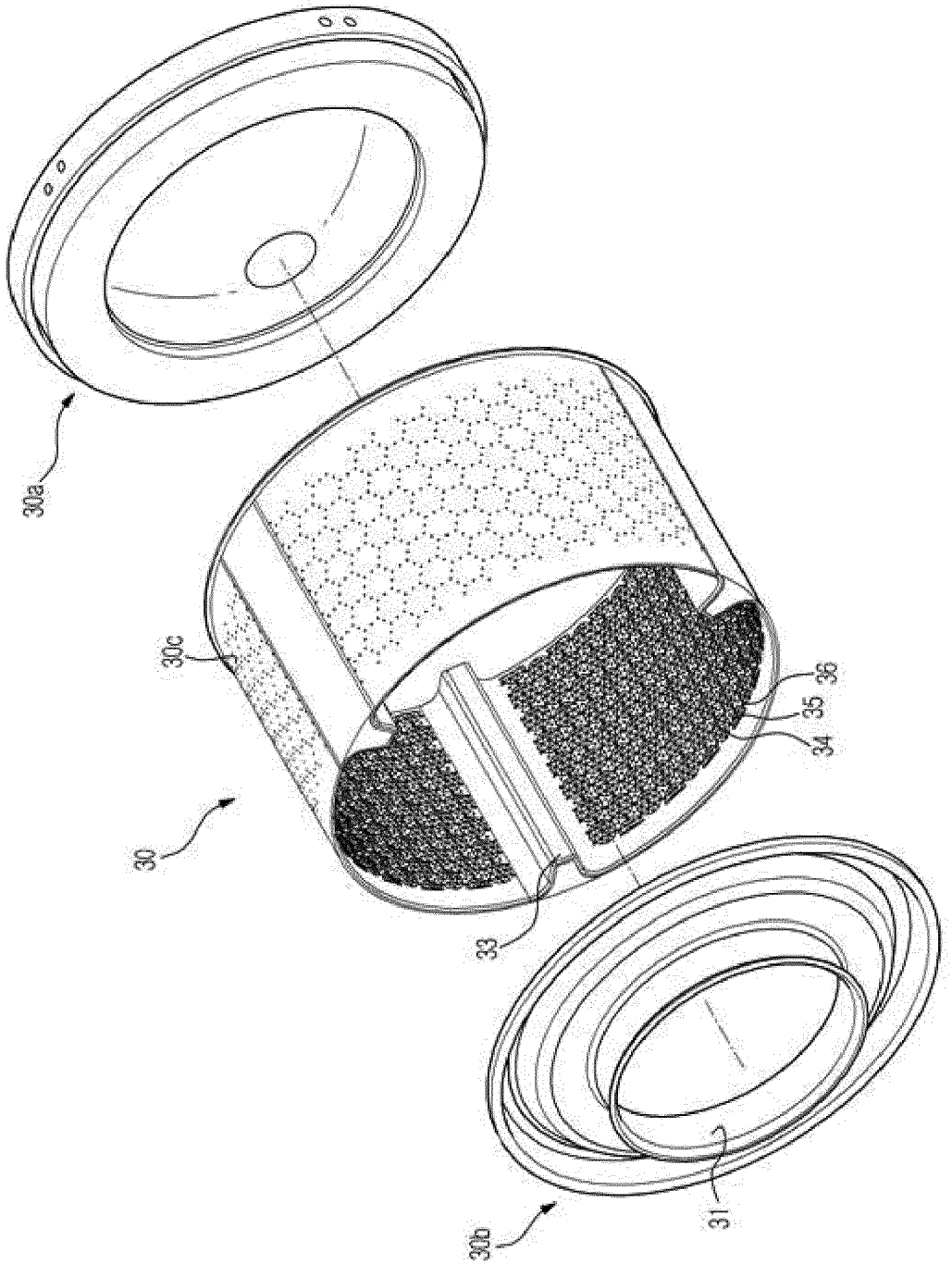

FIG. 3

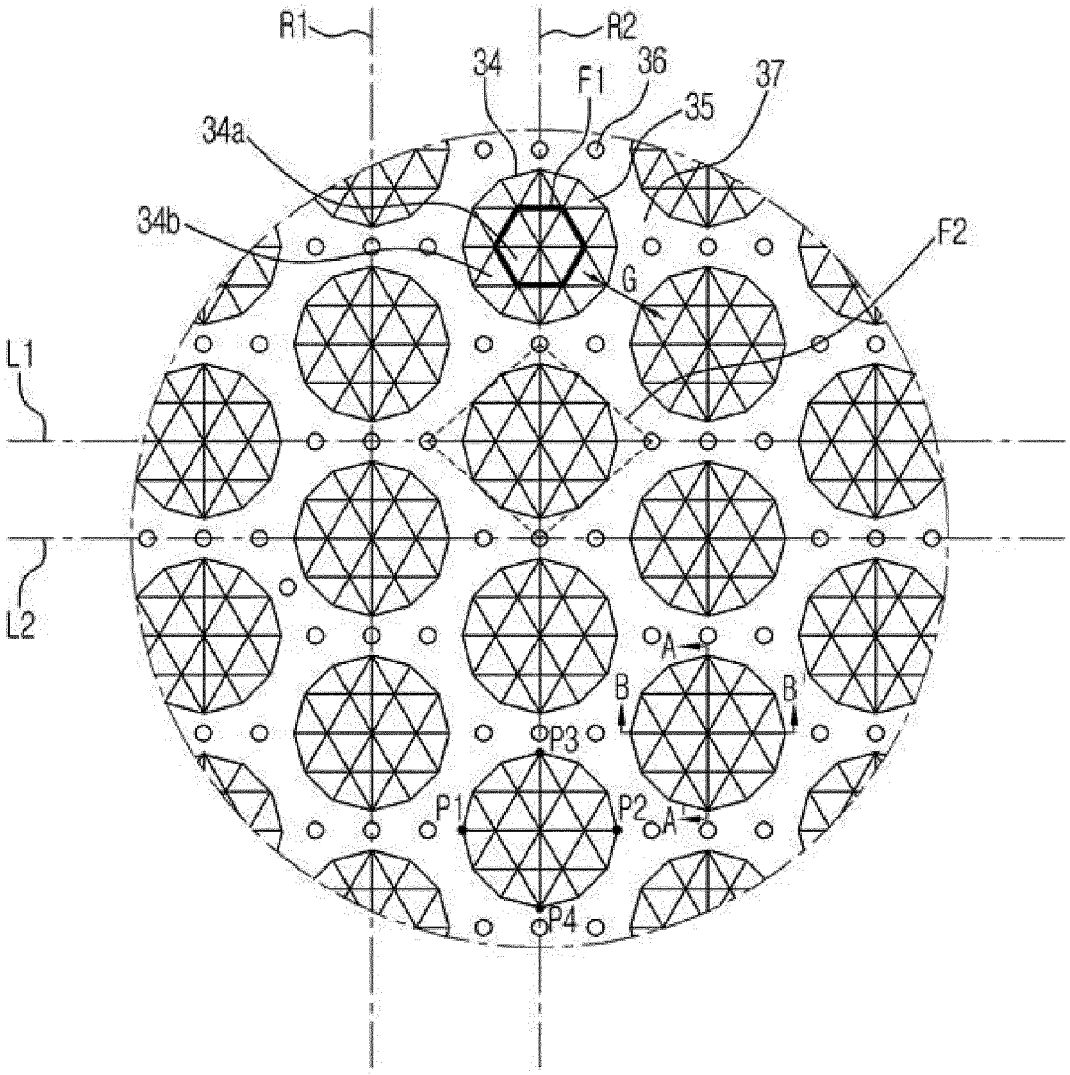

FIG. 4a

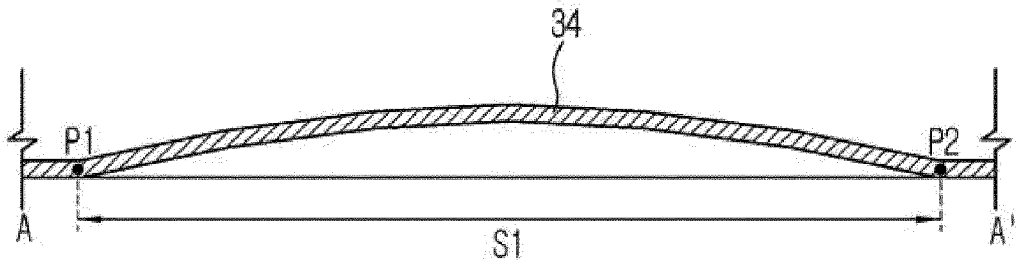

FIG. 4b

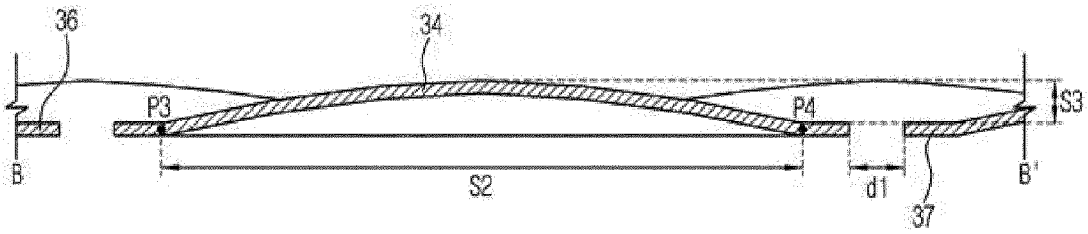

FIG. 5

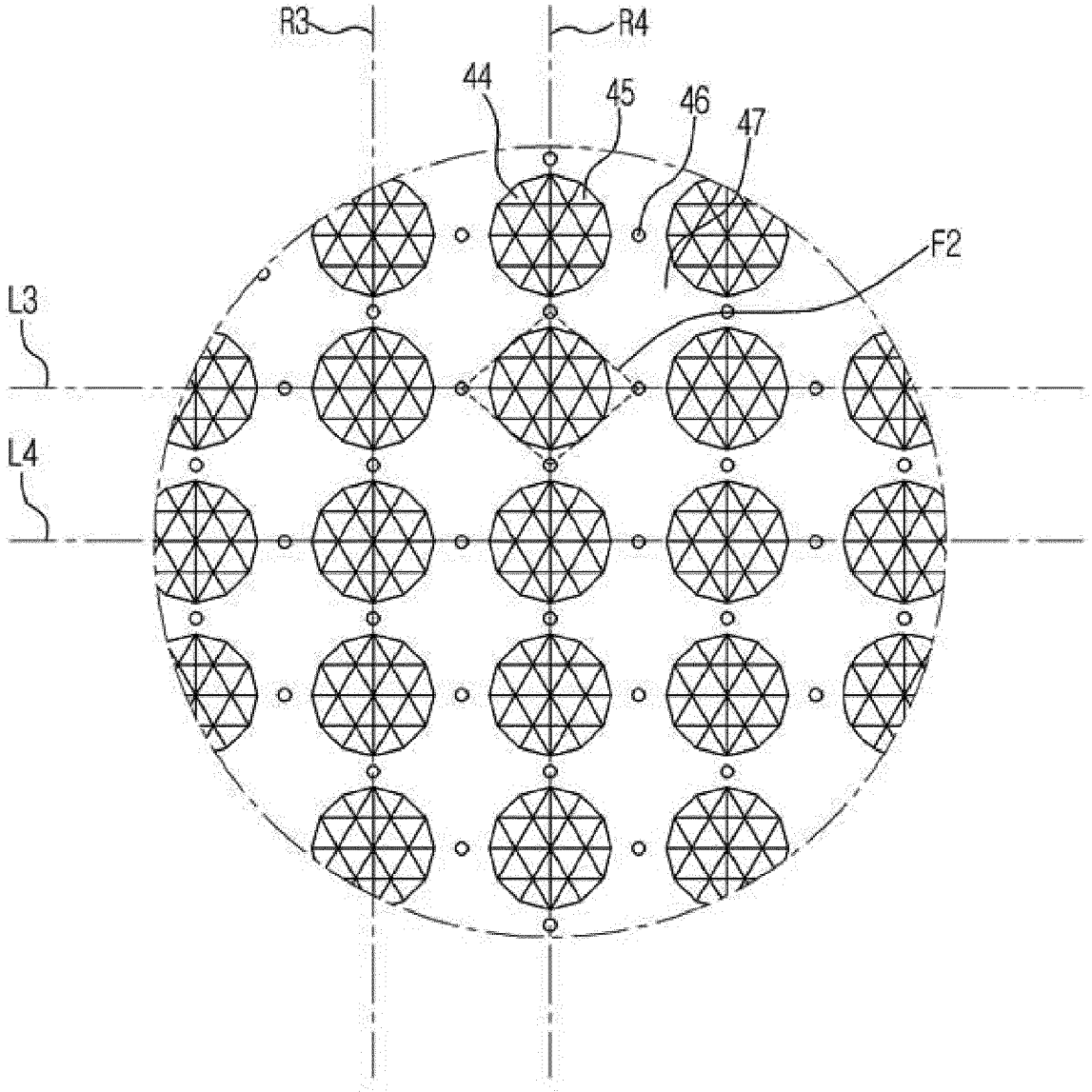

FIG. 6

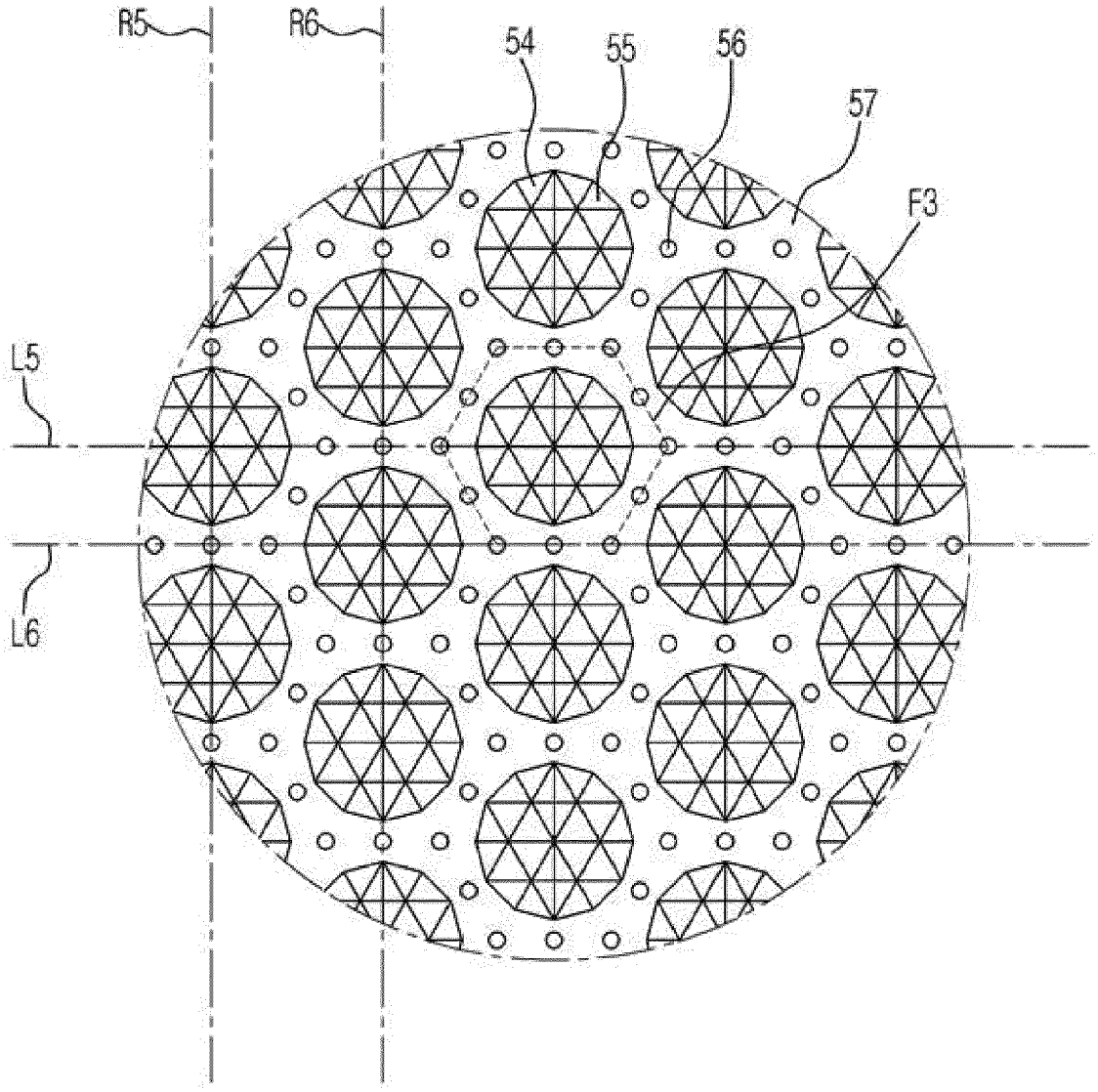

FIG. 7

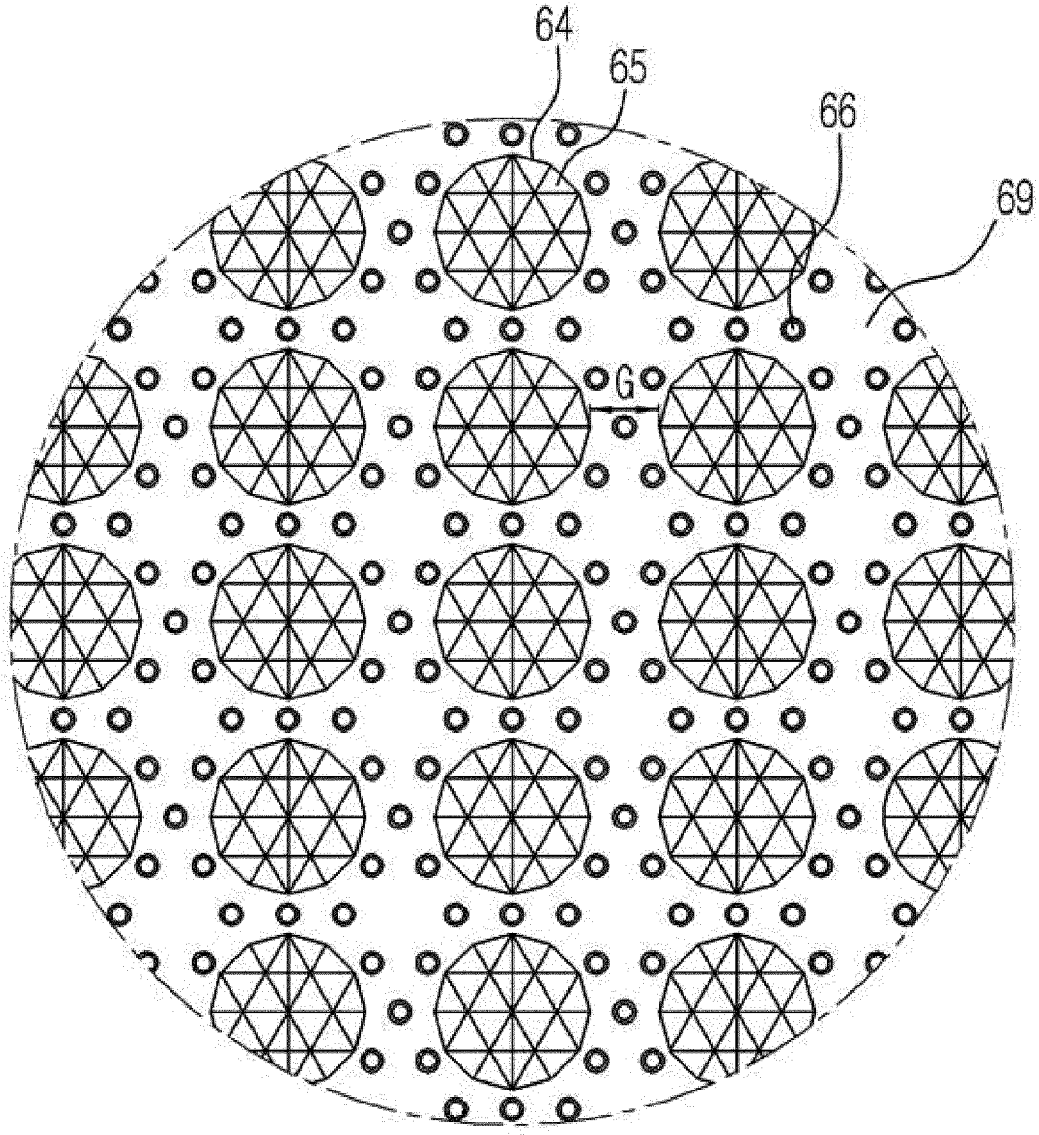

FIG. 8

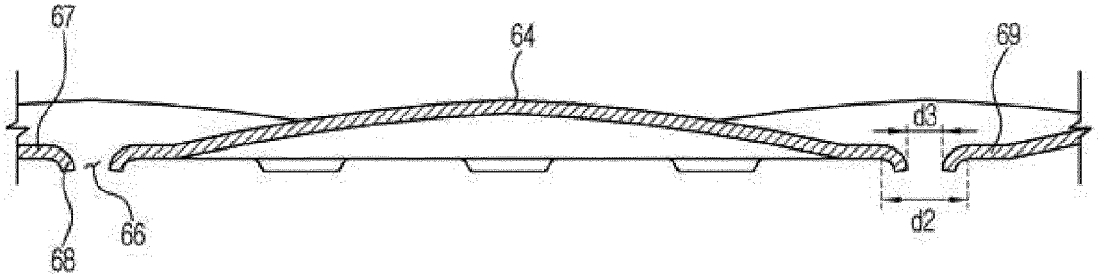

FIG. 9