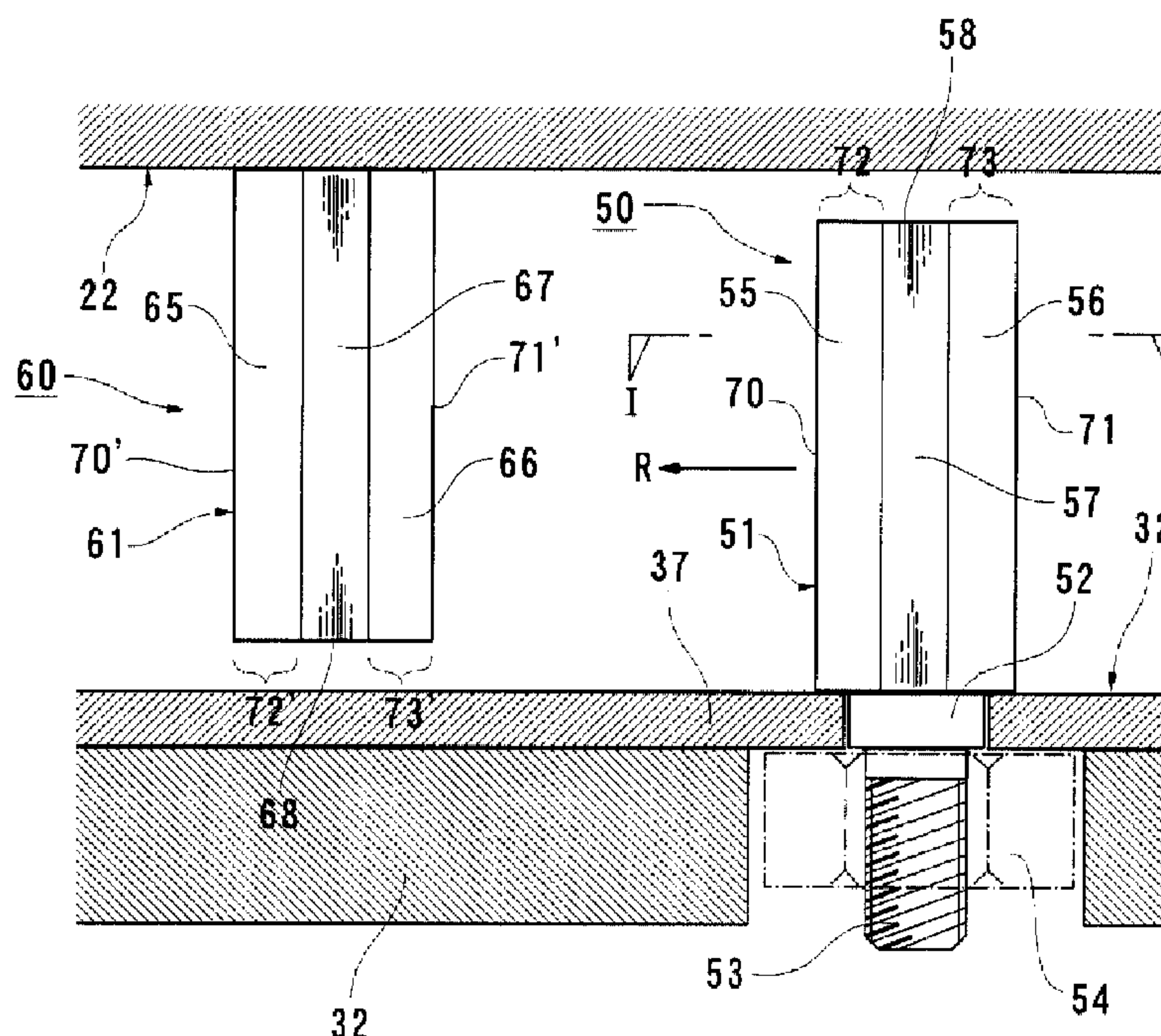




(86) Date de dépôt PCT/PCT Filing Date: 1999/05/31
(87) Date publication PCT/PCT Publication Date: 2000/09/28
(45) Date de délivrance/Issue Date: 2005/03/29
(85) Entrée phase nationale/National Entry: 2001/09/18
(86) N° demande PCT/PCT Application No.: JP 1999/002872
(87) N° publication PCT/PCT Publication No.: 2000/056435
(30) Priorité/Priority: 1999/03/19 (11/76848) JP

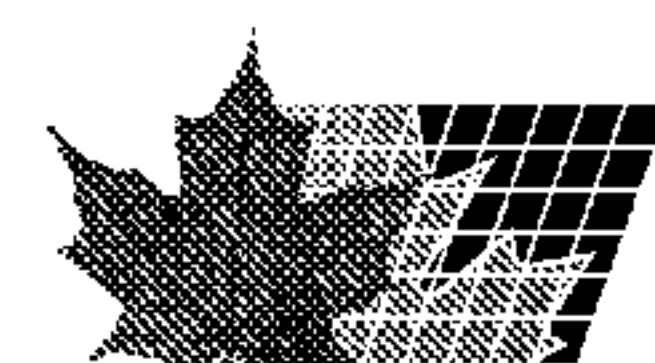
(51) Cl.Int.⁶/Int.Cl.⁶ B01F 7/26
(72) Inventeurs/Inventors:
MIURA, SATORU, JP;
HIROOKA, YUICHI, JP
(73) Propriétaire/Owner:
YOSHINO GYPSUM CO., LTD., JP
(74) Agent: SIM & MCBURNEY

(54) Titre : **MACHINE A MELANGER ET A AGITER**
(54) Title: **MIXER**



(57) **Abrégé/Abstract:**

The present invention provides a pin mixer which can surely prevent deposition of the solid mass of slurry on the pin or the toothed edge of the rotary disc, in spite of a simplified arrangement. The mixer comprises a housing into which a powdered material and a quantity of water is introduced, a rotary disc positioned within the housing. A peripheral edge of the disc is configured to be a circular profile concentric with a circumferential inside wall surface of an annular outer wall. Lower pins are provided with the rear bulged portions which extend rearward of the rotational direction R, and upper pins are provided with front bulged portions which extend frontward of the rotational direction R. The disc does not have a toothed formation on its peripheral edge zone so that the slurry can be prevented from depositing on the outer periphery of the disc. As the front and rear bulged portions are provided, retentive regions of the slurry are not formed in rear and front faces of the lower and upper pins, which may otherwise cause vortex or turbulent flow of the slurry, and therefore, deposition of the solid mass of slurry on the lower and upper pins can be prevented.



ABSTRACT

The present invention provides a pin mixer which can surely prevent deposition of the solid mass of slurry on the pin or the toothed edge of the rotary disc, in spite of a simplified arrangement. The mixer comprises a housing into which a powdered material and a quantity of water is introduced, a rotary disc positioned within the housing. A peripheral edge of the disc is configured to be a circular profile concentric with a circumferential inside wall surface of an annular outer wall. Lower pins are provided with the rear bulged portions which extend rearward of the rotational direction R, and upper pins are provided with front bulged portions which extend frontward of the rotational direction R. The disc does not have a toothed formation on its peripheral edge zone so that the slurry can be prevented from depositing on the outer periphery of the disc. As the front and rear bulged portions are provided, retentive regions of the slurry are not formed in rear and front faces of the lower and upper pins, which may otherwise cause vortex or turbulent flow of the slurry, and therefore, deposition of the solid mass of slurry on the lower and upper pins can be prevented.

SPECIFICATION

MIXER

5 Technical Field

The present invention relates to a mixer, and more specifically, to a mixer for mixing and agitating ingredients including calcined gypsum with a quantity of water and feeding gypsum slurry to a successive step, such as a step of pouring the slurry.

10 Technical Background

Various kinds of gypsum boards having a gypsum core covered with cover sheets of paper are practically and widely in use for architectural interior finish. In general, a process of producing such a gypsum board includes steps of admixing a quantity of water and foam with ingredients for the gypsum core, such as calcined gypsum, adhesion promoting agent, set accelerator, additives, intimate mixtures and the like, so as to produce a gypsum slurry; pouring the gypsum slurry between upper and lower cover sheets; generally shaping and setting the gypsum board material in a predetermined outline of a board; and severing and drying it, and finally cutting it in a predetermined size.

A thin, circular mixer is generally used as a mixer for admixing the aforementioned materials for the gypsum boards. This kind of mixer comprises a flattened cylindrical housing (or casing), and a rotary disc to be rotated within the housing in operation of rotary drive means. An upper cover plate of the housing is provided at its central area with a plurality of inlet ports for introducing the feedstock materials into the housing and the housing is provided in its peripheral zone with a slurry outlet port for discharging the gypsum slurry therethrough. In the conventional mixers, the rotary disc is formed with a serrated or toothed peripheral edge for displacing the gypsum slurry radially outward. On the rotary disc, a plurality of lower pins are fixed to project therefrom, which define movable pins, whereas a plurality of upper pins are

mounted on the upper cover or upper plate to depend therefrom, the upper pins defining stationary pins. The lower and upper pins are alternately arranged in a radial direction of the disc, and the lower pins (movable pins) are moved relative to the upper pins (stationary pins) during rotation of the disc so as to pass between the upper pins. The lower and upper pins cooperate with each other so as to agitate and admix the introduced ingredients with the water in the housing. The rotating disc allows the agitated gypsum slurry to be discharged through the slurry outlet port so as to be fed to the following slurry-pouring step.

This kind of pin mixer is disclosed, e.g., Japanese Patent Laid-Open Publication No.8-25342. FIG.9 is a fragmentary perspective view, partly broken away, generally illustrating an internal structure of the pin mixer, and FIG.10 includes side elevational and transverse cross-sectional views generally illustrating structure of lower and upper pins as shown in FIG.9.

As shown in FIG.9, the rotary disc D located within the housing H has the peripheral edge with a plurality of tooth elements G, the respective tooth elements G being circumferentially spaced apart an equal distance. The lower pin P1, which is fixed on the disc to protrude therefrom vertically upward, is configured in a form of round column with a uniform cross-sectional profile throughout its entire height. The upper cover C of the housing H is provided with the upper pins P2 fixed thereto and depending therefrom, which is configured in a form of round column substantially identical with that of the lower pin.

During rotation of the disc D, the lower pin P1 moves in the direction of rotation R, and the front surface thereof facing forward as seen in the rotational direction R propels and displaces the gypsum slurry so that the slurry or the ingredients moves relatively to the pin P1, backward of the rotational direction R. A vortex or turbulent flow zone in a transitional retention state of the slurry is formed in the rear face (backward face) of the pin P1 in the rotational direction, so that the slurry to be fluidized by mixing action tends to deposit on and adhere to the rear surface of the pin. The deposition of the slurry behind the pin P1

develops or grows gradually as the mixing and agitating operation is continuously in progress. The set accelerating action of the set accelerator contained in the ingredients affects and additionally promotes such a deposition of slurry, and thus, a relatively large solid mass S of the slurry is formed on the rear surface of the pin P1 as shown in
5 FIG. 10.

An analogous condition can be observed in the upper pin P2, and also, it appears on the toothed elements G in the toothed peripheral edge of the disc D. The recess or cavity formed between the respective tooth elements G, which is so-called
10 “dead space”, temporarily receives the slurry and acts to propel or displace the slurry into the slurry outlet port. The slurry retentively trapped in the dead space, however, tends to set therein and deposit on the tooth element G. The deposition of slurry in the dead space further develops or grows, owing to the set accelerating action of the set accelerator or the like, so that a relatively large solid mass of slurry adheres to the
15 tooth element G.

These kinds of solid mass deteriorate the fluidity of the ingredients and slurry within the mixer, and degrades the mixing performance of the mixer, and an excessive growth of the solid mass of slurry during continuous operation of the mixer may result
20 in an irregular load distribution of the disc, which may generates microvibration of the disc accompanied by partial removal or separation of the solid mass. The pieces or sections removed from the disc are fed to the following slurry-pouring step together with the gypsum slurry, so that they contaminate the gypsum core of the gypsum board. In the gypsum board containing such pieces or sections, a failure or
25 defectiveness of product quality, such as a local depression or recess on the gypsum board, is apt to appear on the surface of the board product. Therefore, this kind of failure results in a degradation of the production efficiency or actual yield of production. Thus, an approach for surely preventing such a failure is desired.

30 It is an object of an aspect of the present invention to provide a pin mixer which can surely prevent such deposition of the solid mass of slurry on the pin or the toothed edge of the rotary disc, in spite of a simplified arrangement.

In one aspect there is provided a mixer comprising a housing into which a powdered material and a quantity of water is introduced, a rotary disc positioned within the housing, a plurality of lower pins fixedly secured on the disc, and a plurality of upper pins fixedly secured on a lower surface of an upper cover of the housing, so as to admix and agitate the powdered material and the water to produce a gypsum slurry,

wherein a peripheral edge of said disc is configured to be a circular profile concentric with a circumferential inside wall surface of an annular outer wall of said housing.

10

According to an aspect of the present invention, the rotary disc of the mixer has the peripheral edge configured to be a circular profile, and does not have tooth elements. The slurry in the housing is radially urged toward a discharge port by coaction of the rotational and centrifugal forces of the disc and fluidization of the slurry resulting from admixing and agitating action of the intermeshing pins. A retention region of the slurry is not provided in the peripheral zone of the disc, and therefore, a solid mass of the slurry is not produced in the peripheral zone of the disc.

In another aspect, there is provided a mixer comprising a housing into which a powdered material and a quantity of water is introduced, a rotary disc positioned within the housing, a plurality of lower pins fixedly secured on the disc, and a plurality of upper pins fixedly secured on a lower surface of an upper cover of the housing, so as to admix and agitate the powdered material and the water to produce a gypsum slurry,

wherein said lower pin is provided with a rear bulged portion expanding rearward in a rotational direction, and said bulged portion extends rearward in the rotational direction, so as to allow the slurry moving backward along lateral surfaces of said lower pin to join together in a backward area of the lower pin in the rotational direction.

30

According to this arrangement of the present invention, the lower pin is provided with the rear bulged portion, and the flow zone adjacent to the rear face of

the lower pin, in which vortex or turbulent flow of slurry may be caused, is eliminated by provision of the bulged portion. Therefore, the slurry moving to the region behind the lower pin does not deposit on the lower pin, and the growth of the solid mass of the slurry on the rear face of the lower pin is avoidable.

5

In another aspect, there is provided a mixer comprising a housing into which a powdered material and a quantity of water is introduced, a rotary disc positioned within the housing, a plurality of lower pins fixedly secured on the disc, and a plurality of upper pins fixedly secured on a lower surface of an upper cover of the housing, so as to admix and agitate the powdered material with the water to produce a gypsum slurry,

wherein said upper pin is provided with a front bulged portion expanding frontward in a rotational direction of the disc, and said bulged portion extends frontward in the rotational direction, so as to allow the slurry moving forward along lateral surfaces of said upper pin to join together in a forward area of the upper pin in the rotational direction.

In accordance with this arrangement of the present invention, the upper pin is provided with the front bulged portion, and the flow zone adjacent to the front face of the upper pin, in which vortex or turbulent flow of slurry may be caused, is eliminated by provision of the bulged portion. Therefore, the slurry moving to the region in front of the upper pin does not deposit on the upper pin, and a solid mass of the slurry on the front face of the upper pin can be prevented from growing.

25

In a preferred embodiment of the present invention, the upper pin and/or the lower pin has left and right lateral surfaces defining planes substantially parallel to the rotational direction, and angled surfaces inclined to the lateral surfaces at a predetermined angle to extend rearward or frontward in the rotational direction, and the angled surfaces on both sides are jointed to each other at a predetermined angle to form the rear or front bulged portion. More preferably, the upper and/or lower pin has a cross-sectional profile formed in a hexagonal configuration which is elongated in the rotational direction of

30

the disc and symmetric with respect to the rotational direction.

In another preferred embodiment of the present invention, the upper and/or lower pin is provided with left and right curved surfaces having a predetermined
5 radius of curvature, the curved surface extending frontward or rearward from a part of the pin having a maximum dimension in a direction perpendicular to the rotational direction, and the cross-sectional profile of the curved surface is configured in a parabolic shape or streamlined shape. The curved surfaces are jointed to each other in the rear or front area of the pin in the rotational direction to form the rear or front
10 bulged portion. Preferably, the cross-sectional profile of the lower or upper pin is generally configured to be an ellipse that is elongated along the rotational direction and symmetric with respect to the rotational direction.

In a preferable embodiment of this invention, the rotary disc is a metallic disc,
15 preferably an iron or steel disc, an upper surface of which is covered with a wear-resistant material. More preferably, the pin comprises a metallic body in a form of column with the cross-sectional profile being uniform throughout the entire height, and securing means for fixedly securing the body on the rotary disc or the housing, such as a thread portion. The pin may be detachably secured on the disc or the
20 housing.

According to an aspect of the present invention, there is provided a movable pin for mixer admixing and agitating a powdered material and a quantity of water to produce a gypsum slurry, the mixer having a housing, into which the powdered
25 material and water is introduced, and a substantially horizontal rotary disc rotated within the housing, said movable pin fixed on said rotary disc substantially vertically and adapted to admix and agitate said powdered material and water in cooperation with a stationary pin fixed on said housing substantially vertically, comprising:

a rear bulged portion expanding rearward in a rotational direction, which
30 extends rearward in the rotational direction so as to allow the slurry moving backward along lateral surfaces of the movable pin to join together in an area backward of the movable pin in the rotational direction.

According to another aspect of the present invention, there is provided a

stationary pin for mixer admixing and agitating a powdered material and a quantity of water to produce a gypsum slurry, the mixer having a housing, into which the powdered material and water is introduced, and a substantially horizontal rotary disc rotated within the housing, said stationary pin fixed on said housing substantially vertically and adapted to admix and agitate said powdered material and water in cooperation with a movable pin fixed on said rotary disc substantially vertically, comprising:

a front bulged portion expanding frontward in a rotational direction, 15 which extends frontward in the rotational direction so as to allow the slurry moving forward along lateral surfaces of said stationary pin to join together in an area forward of the stationary pin in the rotational direction.

Brief Description of the Drawings

15 FIG.1 is a schematic illustration partially showing a process for producing gypsum boards;

FIGS. 2 and 3 are plan and perspective views generally illustrating a mixer as shown in FIG.1;

20

FIG 4 is a fragmentary perspective view, party broken away, which illustrates internal structural arrangements of the mixer shown in FIG. 1;

FIGS.5 and 6 are vertical and horizontal cross-sectional views of the mixer as shown in FIG. 1;

25

FIG.7 (A) is a side elevational view of the lower and upper pins as shown in FIGS. 4 to 6, and FIG. 7(B) is a cross-sectional view taken along line I-I of FIG.7 (A);

5 FIG.8 (A) is a side elevational view illustrating an alternative embodiment of the lower and upper pins, and FIG.8 (B) is a cross-sectional view taken along line II-II of FIG.8 (A);

FIG.9 is a fragmentary perspective view, partly broken away, which illustrates internal structural arrangements of a conventional mixer; and

10 FIG. 10 (A) is a side elevational view illustrating lower and upper pins arranged in the conventional mixer, and FIG.10 (B) is a cross-sectional view taken along line III-III of FIG.10 (A).

Best Mode for carrying out the Invention

15 With reference to the attached drawings, a preferred embodiment of the present invention is described hereinafter.

Referring now to FIG.1, there is generally illustrated a process for producing gypsum boards.

20 The process for producing gypsum boards comprises a mixing step of admixing ingredients of gypsum board core with a quantity of water and foam, the ingredients including calcined gypsum, adhesion promotion agent, set accelerator, additives, intimate mixtures and the like; a slurry feeding step of pouring a quantity of gypsum slurry between upper and lower cover sheets of paper for gypsum board; and
25 drying/cutting step of shaping and forming a continuous belt of gypsum board to be boards of a predetermined configuration. A mixer 10 is located above a conveyor line which successively transfers a continuous lower cover sheet of paper 1 for gypsum board. The powdered materials, such as calcined gypsum, adhesion promotion agent, set
30 accelerator, additives, intimate mixtures and the like; a quantity of foam and a liquid material (a quantity of water) are introduced into the mixer

10, which admixes and agitates these materials and discharge a gypsum slurry 3 onto the lower sheet 1 through a slurry feed conduit 12.

5 The slurry 3 is carried with the lower sheet 1 on the conveyor line and reaches a pair of forming rollers 16. An upper cover sheet of paper 2 for gypsum board is continuously fed to the rollers 16, the upper roller of which diverts the sheet 2 toward the conveying direction and allows the sheet 2 to be overlaid on the slurry 3. The continuous belt-like form of a three-layer formation, which comprises the lower sheet 1, slurry 3 and upper sheet 2, is shaped by guide members or the like while
10 transferred on the conveyor line, and a setting reaction of the slurry progresses during transfer on the conveyor line. The continuous form on the conveyor line is severed by a set of cutting rollers 18 to be an approximate preset length of board, whereby a board comprising a gypsum core covered with the cover sheets is formed as a green board
15 product for gypsum board. Further, the green board products are subjected to forced drying through a dryer (not shown), and thereafter, they are finally cut to have a predetermined product size, and delivered or transported as gypsum board products.

20 FIGS.2 through 6 are plan view, perspective view, fragmentary perspective view, vertical cross-sectional view and horizontal cross-sectional view of the mixer 10.

As shown in FIGS. 2 and 3, the mixer 10 has a relatively flat cylindrical housing (casing) 20, which is provided with an upper plate (top cover) 22, a lower plate (bottom cover) 24, and an annular outer wall
25 23. The upper and lower plates 22, 24 formed in a circular disc-like shape are vertically spaced apart a predetermined distance from each other, and the outer wall 23 is jointed to peripheral zones of the upper and lower plates 22, 24, respectively,

30 The upper plate 22 is formed in its center with a circular opening 21, through which an enlarged bottom portion 31 of a rotatable vertical shaft 30 extends. The shaft 30 is operatively connected with rotary drive means, such as an electric drive motor (not shown). If desired, a

speed regulator, such as a transmission gear mechanism, a transmission belt assembly or the like, is interposed between the shaft 30 and an output shaft of the drive means. There are connected to the upper plate 22 in predetermined positions, a powdered feedstock conduit 40 for feeding powdered materials to be mixed; a water supply conduit 42 for supplying a quantity of water to be mixed; pressure regulator means 43 for limiting increase of the internal pressure (shown by dotted lines in FIG.2); and a foam feed conduit 44 for introducing a quantity of foam into the mixed ingredients in order to regulate the volume of the slurry, respectively. A slurry discharge conduit 41, which is in communication with the slurry feed pipe 12 (FIG.1), is connected to the outer wall 23 by means of an outlet shute 45, which acts as slurry discharging means for receiving the slurry from the housing 20 and introducing it into the slurry discharge conduit 41.

As shown in FIGS. 4 through 6, a rotary disc 32 is rotatably mounted within the housing 20, and a center part of the disc 32 is fixedly secured to a lower surface of the enlarged bottom portion 31. A center axis of the disc 32 is coincident with a rotation axis of the shaft 30. During operation of the mixer 10, the disc 32 is rotated integrally with the shaft 30 in a clockwise direction as indicated by an arrow R.

An upper surface of the disc 10 is covered with an upper plane structural element 37 made of a wear-resistant material. The disc 32 coaxial with the shaft 30 has an outer peripheral edge 35 configured to be a true round circle about the shaft 30 as seen from its upper side. An outer circumferential surface of the edge 35 is slightly spaced apart from an inner circumferential surface 25 of the outer wall 23, so that a small gap is provided between the surfaces 35, 25 to permit a rotational motion of the disc 32.

A plurality of lower pins 50, which define movable pins, are vertically mounted on the upper surface of the disc 32. The lower pins 50 are arranged in rows between the periphery of the bottom portion 31 and the peripheral edge 35, spaced a predetermined distance from each other in a radial direction of the disc 32, so that rows of pins substantially

radially extend from the shaft 30. The respective rows of the lower pins 50 are positioned to be spaced a predetermined angle in the rotational direction R (the angle is set to be 90° in this embodiment). Further, a plurality of upper pins 60, which define stationary pins, depend from the upper plate 22. The upper pins 60 are arranged in a formation similar to the lower pins 50 so that the upper pins 60 form radial rows of pins which extend radially on the upper plate 22. The distance between the adjacent upper pins 60 is substantially identical with the distance between the adjacent lower pins 50, and therefore, the lower pins 50 are adapted to pass through the spaces between the upper pins 60 when the pins 50 are moved in the direction R by rotation of the disc 32.

FIG.7 includes a side elevational view and a transverse cross-sectional view showing the structures of the lower and upper pins 50, 60.

The lower pin 50 comprises a metallic pin body 51 upwardly projecting from the upper plane structural element 37 of the disc 32, a base portion 52 extending through the element 37, and a thread portion 53 extending downwardly from the base portion 52. A nut 54 as shown by phantom lines is fit on the thread portion 53 so that the lower pin 50 is fixedly secured on the structural element 37 by tightening the nut 54.

The body 51 molded in a form of a hexagonal column has an equal cross-section throughout its entire height, which is provided with left and right front angled surfaces 55 extending frontward in the rotational direction R, left and right rear angled surfaces 56 extending rearward in the direction R, left and right lateral surfaces 57 extending substantially parallel to the direction R, and a horizontal upper surface 58. The front and rear angled surfaces 55, 56 are inclined to the side surfaces 57 at predetermined angles α , β . These angles α , β are set to be a substantially equal angle in this embodiment, and therefore, the body 51 has a symmetrical configuration in both of its widthwise and lengthwise directions. The front angled surfaces 55 are joined together along a joint line 70 at a predetermined angle γ therebetween, and the rear angled surfaces 56 are joined together along a joint line 71 at a predetermined angle η therebetween. The joint lines 70, 71 are positioned on a

centerline of the body 51. In this embodiment, the angles α , β are set to be 135° , whereas the angles γ , η are set to be 90° .

The lower pin 50 has the maximum width between the lateral surfaces 57 and
 5 the cross-sectional profile converging frontward and rearward in the rotational
 direction, so that the pin 50 is generally configured in a streamlined shape which is
 elongated in the rotational direction R to represent a relatively low fluid-resistance.
 The joint line 70 and the front angled surfaces 55 constitute a frontward bulged
 portion 72 which is relatively sharp to divide or split the gypsum slurry into two
 10 discrete streams on both sides of the body 51, whereas the joint line 71 and the rear
 surfaces 56 constitute a rearward bulged portion 73 which is also relatively sharp to
 allow the slurry on both sides to smoothly join together.

Thus, the lower pins 50, which are fixed on the predetermined positions of the
 15 disc 32 as set forth above, have front and rear budged portions 72, 73 oriented in a
 tangential direction of a circle about the shaft 30.

The upper pins 60, which have substantially the same configuration as the
 lower pins 50 have, fix on a lower surface of the upper plate 22 in arrangements and
 20 positions similar to the lower pins 50, downwardly projecting therefrom within the
 housing 20.

In FIG. 7 (A), the upper pin 60 comprises a metallic pin body 61 formed in a
 hexagonal column with its cross-sectional profile being uniform over the entire
 25 height. The body 61 is provided with left and right front angled surfaces 65; left and
 right rear angled surfaces 66; left and right lateral surfaces 67; and a horizontal lower
 surface 68. The front angled surfaces 65 join to each other at the angle γ along a front
 joint line 70' and the rear angled surfaces 66 join to each other at the angle η along a
 rear joint 71'. The angled surfaces 65, 66 join to the lateral surfaces 67 at the angle
 30 α or β , respectively. The front surfaces 65 and the joint 70' define a frontward bulged
 portion 72', whereas the rear surfaces 66 and the joint 71' define a rearward bulged

portion 73'.

A mode of operation of the aforementioned pin mixer 10 with the disc 32 and the pins 50, 60 are described hereinafter.

5 In operation of the rotary drive means, the disc 32 is rotated in the rotational direction R. The powdered ingredients (calcined gypsum, adhesion promoting agent, set accelerator, additives, intimate mixtures and the like), a quantity of water and a quantity of foam are introduced onto the disc 32 through the conduits 40, 42, 44, respectively. The rotary action of the disc 32 and the mixing action of the intermeshing
10 pins 50, 60 allow the powdered materials, water and foam to be mixed together and agitated.

The lower pins 50 moves in the fluidized mixture of the powdered materials, water and foam so that the fluid is displaced and deviated to the opposite sides of the pin 50 by the front surfaces 55 of the bulged
15 portion 72. The fluid relatively moves along the lateral surfaces 57 and the rear surfaces 56 in the backward direction of the pin 50, until the fluid streams join together in the backward region behind the pin 50. Any retentive zone of the fluid, which may cause vortex or turbulent fluid flow, is not provided behind the pin 50, as the rear bulged portion 73
20 occupies such a zone, and therefore, deposition of the fluid on the rear face of the pin 50 is prevented from occurring.

The upper pin 60, which has substantially the same structure and configuration as the lower pin 50 has, acts or functions substantially in the same fashion of operation as that of the lower pin 50. However, the
25 rear bulged portion 73' of the pin 60 functionally corresponds to the front bulged portion 72 of the pin 50, and that the front bulged portion 72' of the pin 60 functionally corresponds to the rear bulged portion 73 of the pin 50. That is to say, the front bulged portion 72' of the pin 60 exists in the region forward of the pin 60 in the rotational direction R so as not
30 to form a retentive zone of fluid which may cause a vortex or turbulent fluid flow, and therefore, the fluid can be prevented from depositing on the forward face or front face of the pin 60.

The fluidic mixture of powdered materials, water and foam, which is admixed and agitated within the housing 20 with the rotation of the disc 32, moves radially outward on the disc 32 under the action of the centrifugal force. The slurry moved to the peripheral zone of the disc 32 moves to the outlet shute 45 and enters therethrough into the conduit 41 with mainly the rotation and the centrifugal force of the disc 32 acting on the slurry in radially outward and circumferential direction. As set forth above, the conduit 41 delivers the slurry through the conduit 12 for the slurry-pouring step.

The disc 32 is provided with the peripheral edge 35 having a circular profile, which is not provided with a toothed edge of a conventional rotary disc. Only the rotation and the centrifugal force of the disc 32 allow the slurry within the housing 20 to be introduced into the shute 45 and delivered through the conduit 41. Thus, any retention zone of the slurry is not formed in the peripheral zone of the disc 32, and therefore, the slurry does not deposit on the periphery of the disc 32.

An alternative embodiment of the pins 50, 60 is illustrated on FIG.8, which includes side elevational and cross-sectional views thereof. In FIG.8, the means or elements, which are substantially identical with or equivalent to those in the previous embodiment, are indicated by the same reference numerals as those of the previous embodiment.

The lower pin 50 as shown in FIG.8 comprises the pin body 51, which has a uniform cross-section over its entire height, the base portion 52 and the thread portion 53, and the body 51 is provided with the horizontal upper surface 58, left and right rear angled surfaces 56 and side surfaces 57, as in the aforementioned embodiment. However, the pin 50 shown in FIG.8 has a front round surface 80 smoothly curved in a predetermined radius of curvature, a frontmost part 81 of the surface 80 being positioned on a center line of the body 51.

The lower pins 50 move in the rotational direction R with the rotation of the disc 32. The powdered materials, water and foam, or the slurry are displaced and deviated toward both sides of the pin 50 along

the curved surface 80, and are relatively moved along the lateral surfaces 57 and the rear angled surfaces 56 in the backward direction of the pin 50, and then, are allowed to join together in the backward area of the pin 50. Similarly to the lower pin shown in FIG.7 of the aforementioned
5 embodiment, the retentive zone, which may cause vortex or turbulent flow of the fluidic matter, is not formed behind the pin 50, because of provision of the rear bulged portion 73, and therefore, deposition of the fluidic matter on the rear or back face of the pin 50 is avoidable.

Such a configuration of the pin is applicable to the upper pin 60
10 with the bulged portion 72' and the joint 70', in which a curved surface 80' of the upper pin 60 with an extremity (rearmost part) 81' is positioned on its rear side (backward side of the pin 60 as seen in the rotational direction R). The pin body 61 has the front angled surfaces 65 formed in front of the upper pin 60 (forward side in the rotational
15 direction R) and the lateral surfaces 67 formed on both sides of the pin 60.

According to the aforementioned embodiments of the mixer 10, the disc 32 has the peripheral edge 35 formed in the circular profile concentric with the inner circumferential surface 25 of the annular outer wall 23; the lower pins 50 are provided with the rear bulged portions 73
20 which extend rearward of the rotational direction R; and the upper pins 60 is provided with the front bulged portions 72' which extend forward of the rotational direction R. The disc 32 does not have a toothed formation on its peripheral edge zone, so that the slurry can be prevented from depositing on the peripheral zone of the disc 32. Further, the rear
25 and front bulged portions 73, 72' exist in the rearward area of the lower pin 50 and the forward area of the upper pin 60 so as not to form the retentive regions of the slurry therein, which may otherwise cause vortex or turbulent flow of the fluid (slurry). Accordingly, the deposition of the slurry on the lower and upper pins 50, 60 can be prevented from
30 occurring.

As modifications of the configuration of the pin, the angled surfaces 55, 56 may be shaped to be curved surfaces which are streamlined to be prolonged in the rotational direction R; or otherwise,

the lower and upper pins 50, 60 are shaped to generally have an ellipse, rhombus or streamline cross-section. In such modifications, the longitudinal axis of the ellipse, rhombus or streamline form is oriented in the rotational direction R so that the front and rear faces of the pins 50, 60 are provided with front and rear bulged portions, thereby eliminating the retentive regions of the fluidic matter.

If desired, the pins 50, 60 having the aforementioned structure may be positioned in a limited area of the disc 32 and the housing 20 so that the pins 50, 60 and conventional pins are appropriately intermingled in the housing 20.

Industrial Applicability

According to the mixer of the present invention, it is possible to prevent the solid mass of slurry from depositing on the pin or the toothed edge of the rotary disc.

WHAT IS CLAIMED IS:

1. A mixer comprising a housing into which a powdered material and a quantity of water is introduced, a rotary disc positioned within the housing, a plurality of lower pins fixedly secured on the disc, and a plurality of upper pins fixedly secured on a lower surface of an upper cover of the housing, so as to admix and agitate the powdered material and the water to produce a gypsum slurry,
- 5 wherein said lower pin is provided with a rear bulged portion expanding rearward in a rotational direction, and said bulged portion extends rearward in the rotational direction, so as to allow the slurry moving backward along lateral surfaces of said lower pin to join together in a backward area of the lower pin in the rotational direction.
- 10 2. A mixer comprising a housing into which a powdered material and a quantity of water is introduced, a rotary disc positioned within the housing, a plurality of lower pins fixedly secured on the disc, and a plurality of upper pins fixedly secured on a lower surface of an upper cover of the housing, so as to admix and agitate the powdered material and the water to produce a gypsum slurry,
- 15 wherein said upper pin is provided with a front bulged portion expanding frontward in a rotational direction of the disc, and said bulged portion extends frontward in the rotational direction, so as to allow the slurry moving forward along lateral surfaces of said upper pin to join together in a forward area of the upper pin in the rotational direction.
- 20 3. A mixer as defined in claim 2 wherein said lower pin is provided with a rear bulged portion expanding rearward in the rotational direction, and said bulged portion extends rearward in the rotational direction, so as to allow the slurry moving backward along lateral surfaces of said lower pin to join together in a backward area of the lower pin in the rotational direction.
- 25 4. A mixer as defined in any one of claims 1 to 3 wherein a peripheral edge of said disc is configured to be a circular profile concentric with a circumferential inside
- 30

wall surface of an annular outer wall of said housing.

5. A mixer as defined in any one of claims 1 to 3 wherein said pin has left and right lateral surfaces defining planes substantially parallel to the rotational direction, and angled surfaces inclined to said lateral surfaces at a predetermined angle to extend rearward or frontward in the rotational direction, and wherein the angled surfaces on both sides are jointed to each other at a predetermined angle to form the rear or front bulged portion.
6. A mixer as defined in claim 5 wherein a cross-sectional profile of the pin is configured to be a hexagon, which is elongated along the rotational direction and symmetric with respect to the rotational direction.
7. A mixer as defined in any one of claims 1 to 3 wherein said upper pin is provided with left and right curved surfaces which extend with a predetermined radius of curvature from a part of the pin having a maximum dimension in a direction perpendicular to the rotational direction, and wherein a cross-sectional profile of the curved surface is configured in a parabolic shape or streamlined shape and the curved surfaces are jointed to each other in an area rearward or frontward of the pin in the rotational direction, so as to form the rear or front bulged portion.
8. A mixer as defined in claim 7 wherein a cross-sectional profile of the pin is configured to be an ellipse, which is elongated along the rotational direction and symmetric with respect to the rotational direction.
9. A movable pin for mixer admixing and agitating a powdered material and a quantity of water to produce a gypsum slurry, the mixer having a housing, into which the powdered material and water is introduced, and a substantially horizontal rotary disc rotated within the housing, said movable pin fixed on said rotary disc substantially vertically and adapted to admix and agitate said powdered material and water in cooperation with a stationary pin fixed on said housing substantially vertically, comprising:

a rear bulged portion expanding rearward in a rotational direction, which extends rearward in the rotational direction so as to allow the slurry moving backward along lateral surfaces of the movable pin to join together in an area backward of the movable pin in the rotational direction.

5

10. A movable pin for mixer as defined in claim 9 comprising left and right lateral surfaces defining planes substantially parallel to the rotational direction, and angled surfaces inclined to said lateral surfaces at a predetermined angle to extend rearward in the rotational direction, the angled surfaces on both sides being jointed at a
10 predetermined angle in the area rearward of the movable pin in the rotational direction to form said rear bulged portion.

11. A movable pin for mixer as defined in claim 10 wherein a cross-sectional profile of the movable pin is configured to be a hexagon which is elongated along the
15 rotational direction and symmetric with respect to the rotational direction.

12. A movable pin for mixer as defined in claim 9 comprising left and right curved surfaces which extend with a predetermined radius of curvature from a part of the movable pin having a maximum dimension in a direction perpendicular to the
20 rotational direction, wherein a cross-sectional profile of the curved surface is configured in a parabolic shape or streamlined shape and the curved surfaces are jointed to each other in an area rearward of the movable pin

13. A movable pin for mixer as defined in claim 12 wherein said cross-sectional profile of the movable pin is configured to be an ellipse which is elongated along the
25 rotational direction and symmetric with respect to the rotational direction.

14. A stationary pin for mixer admixing and agitating a powdered material and a quantity of water to produce a gypsum slurry, the mixer having a housing, into which
30 the powdered material and water is introduced, and a substantially horizontal rotary disc rotated within the housing, said stationary pin fixed on said housing substantially vertically and adapted to admix and agitate said powdered material and water in

cooperation with a movable pin fixed on said rotary disc substantially vertically,
comprising:

5 a front bulged portion expanding frontward in a rotational direction, which
extends frontward in the rotational direction so as to allow the slurry moving forward
along lateral surfaces of said stationary pin to join together in an area forward of the
stationary pin in the rotational direction.

10 15. A stationary pin for mixer as defined in claim 14 comprising left and right
lateral surfaces defining planes substantially parallel to the rotational direction, and
angled surfaces inclined to said lateral surfaces at a predetermined angle to extend
frontward in the rotational direction, the angled surfaces on both sides being jointed at
a predetermined angle in an area frontward of the stationary pin in the rotational
direction to form said front bulged portion.

15 16. A stationary pin for mixer as defined in claim 15 wherein a cross-sectional
profile of the stationary pin is configured to be a hexagon which is elongated along
the rotational direction and symmetric with respect to the rotational direction.

20 17. A stationary pin for mixer as defined in claim 14 comprising left and right
curved surfaces which extend with a predetermined radius of curvature from a part of
the stationary pin having a maximum dimension in a direction perpendicular to the
rotational direction, wherein a cross-sectional profile of the curved surface is
configured in a parabolic shape or streamlined shape and the curved surfaces are
jointed to each other in an area frontward of the stationary pin in the rotational
25 direction so as to form the front bulged portion.

18. A stationary pin for mixer as defined in claim 17 wherein a cross-sectional
profile of the stationary pin is configured to be an ellipse which is elongated along the
rotational direction and symmetric with respect to the rotational direction.

FIG.1

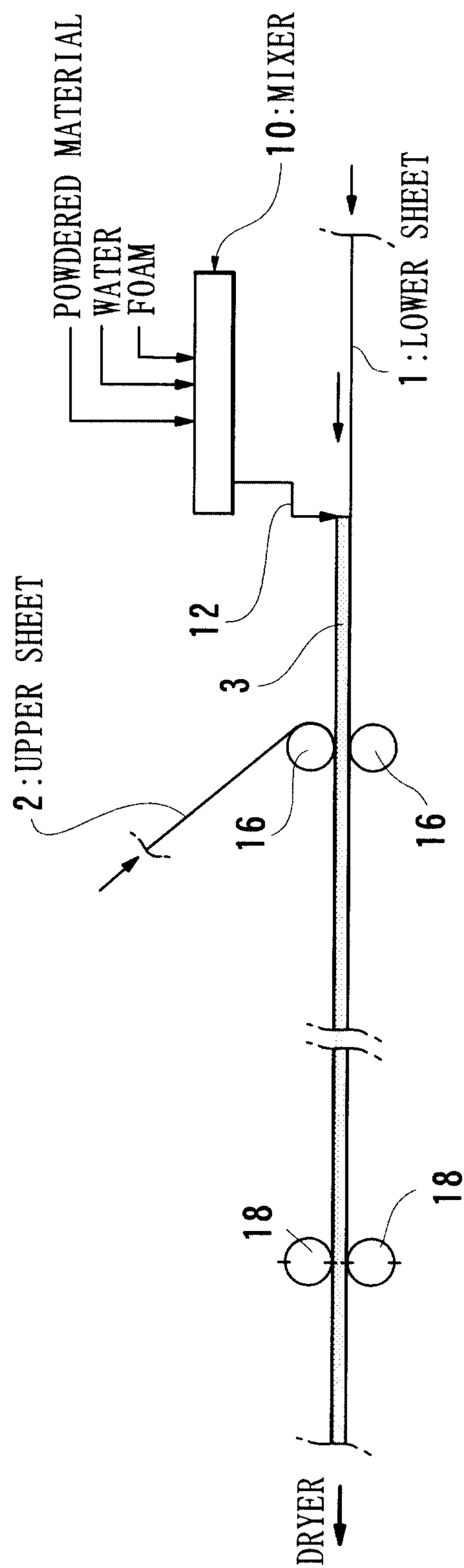


FIG.2

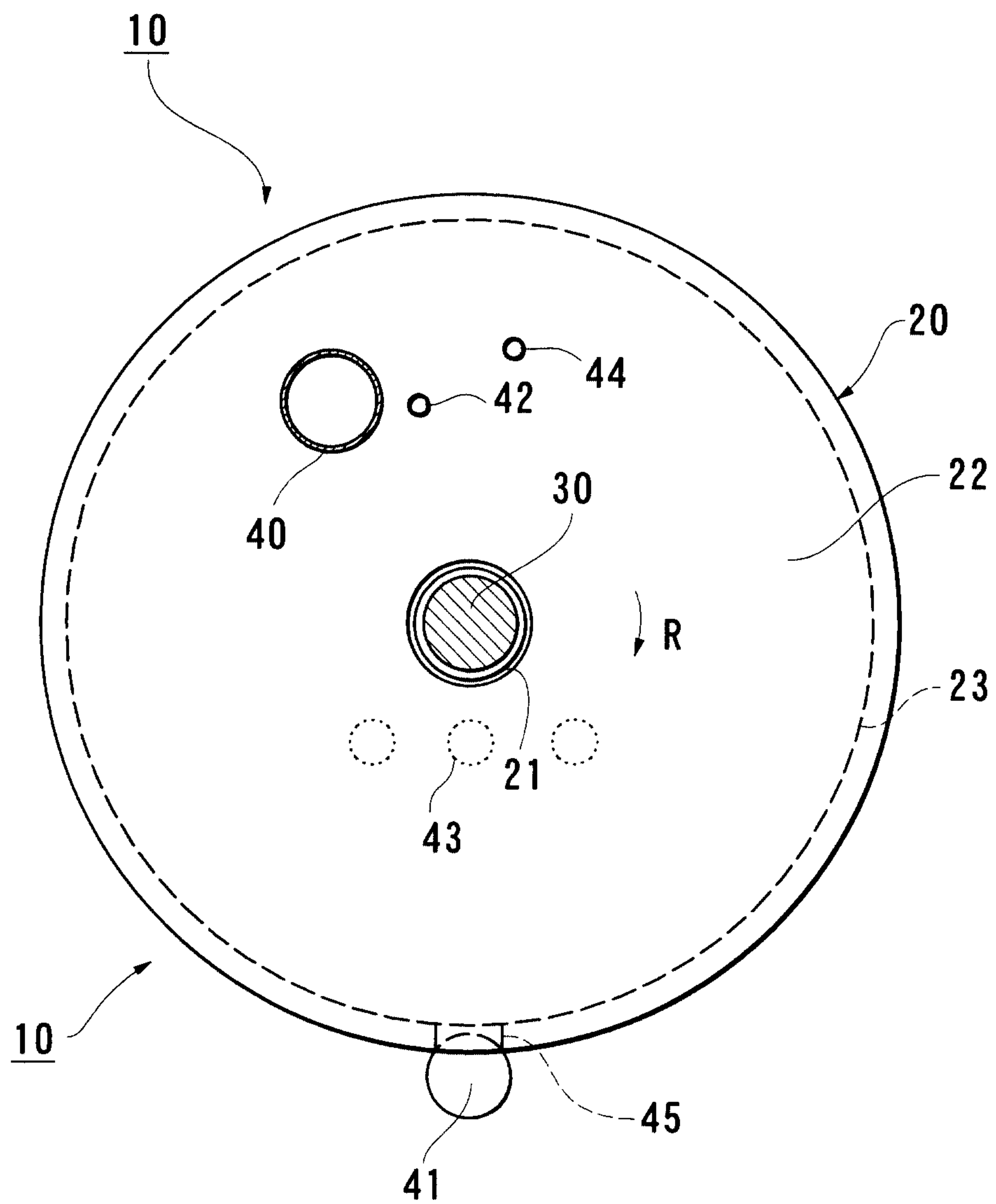


FIG.3

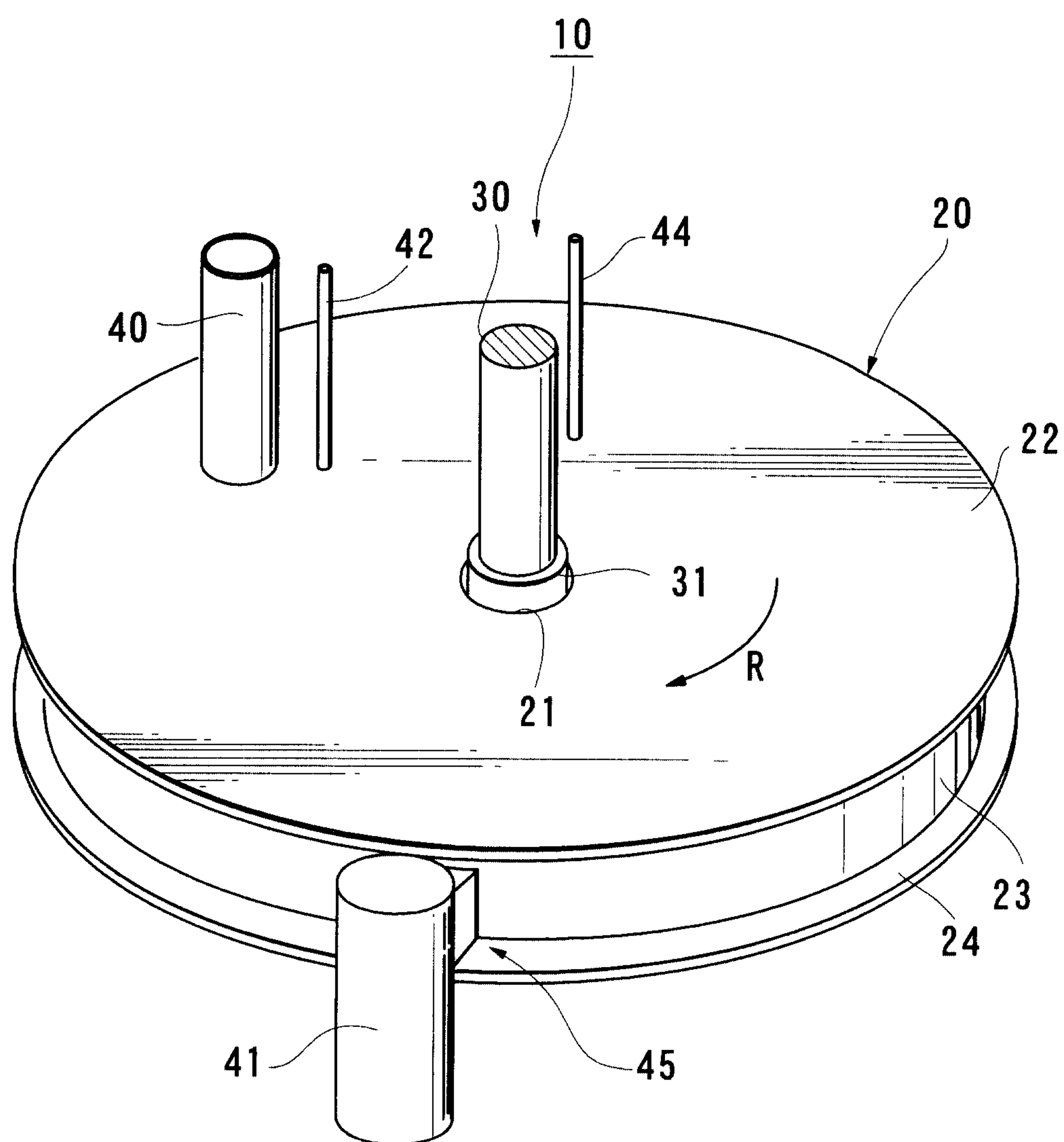


FIG.4

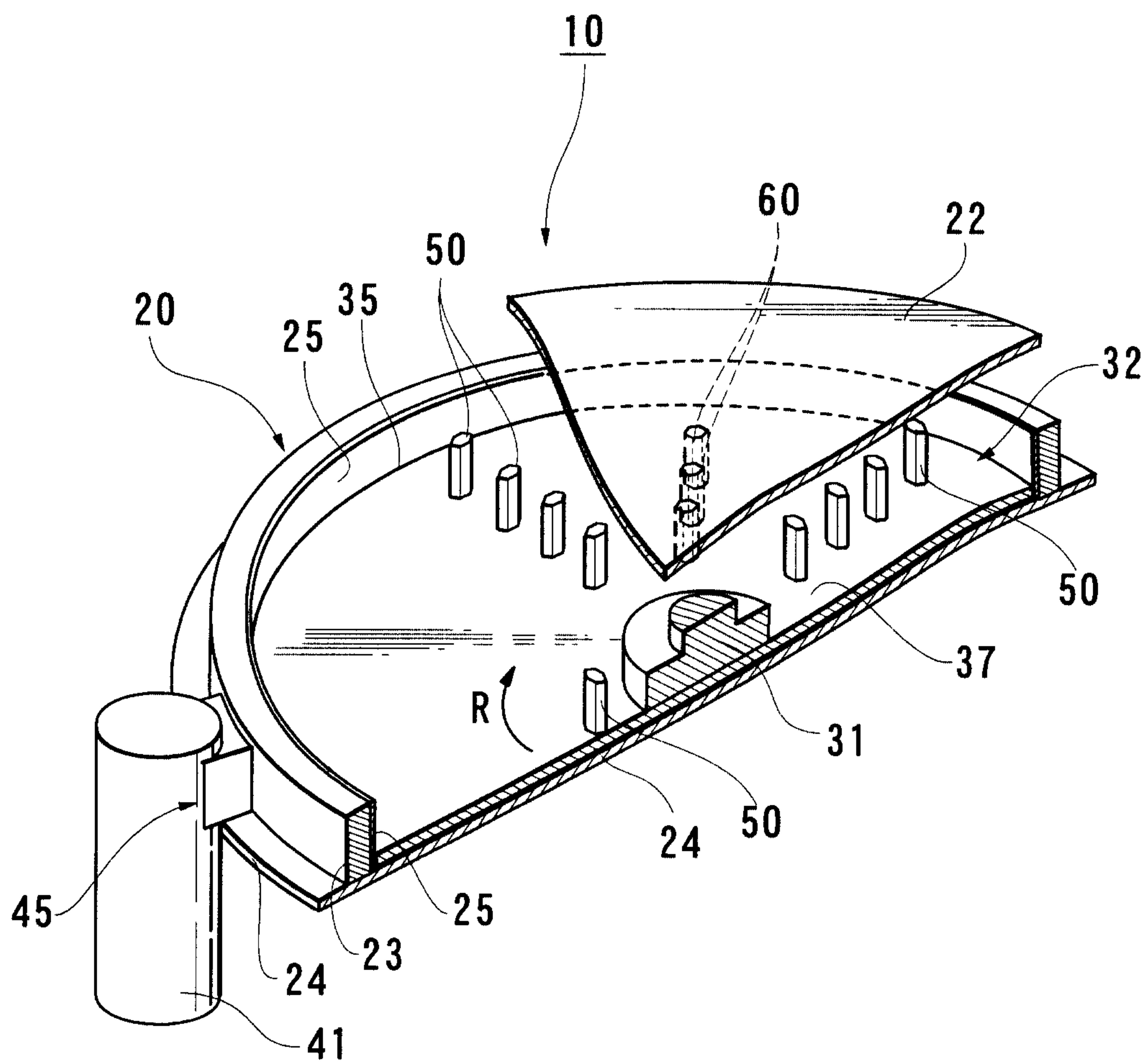


FIG.5

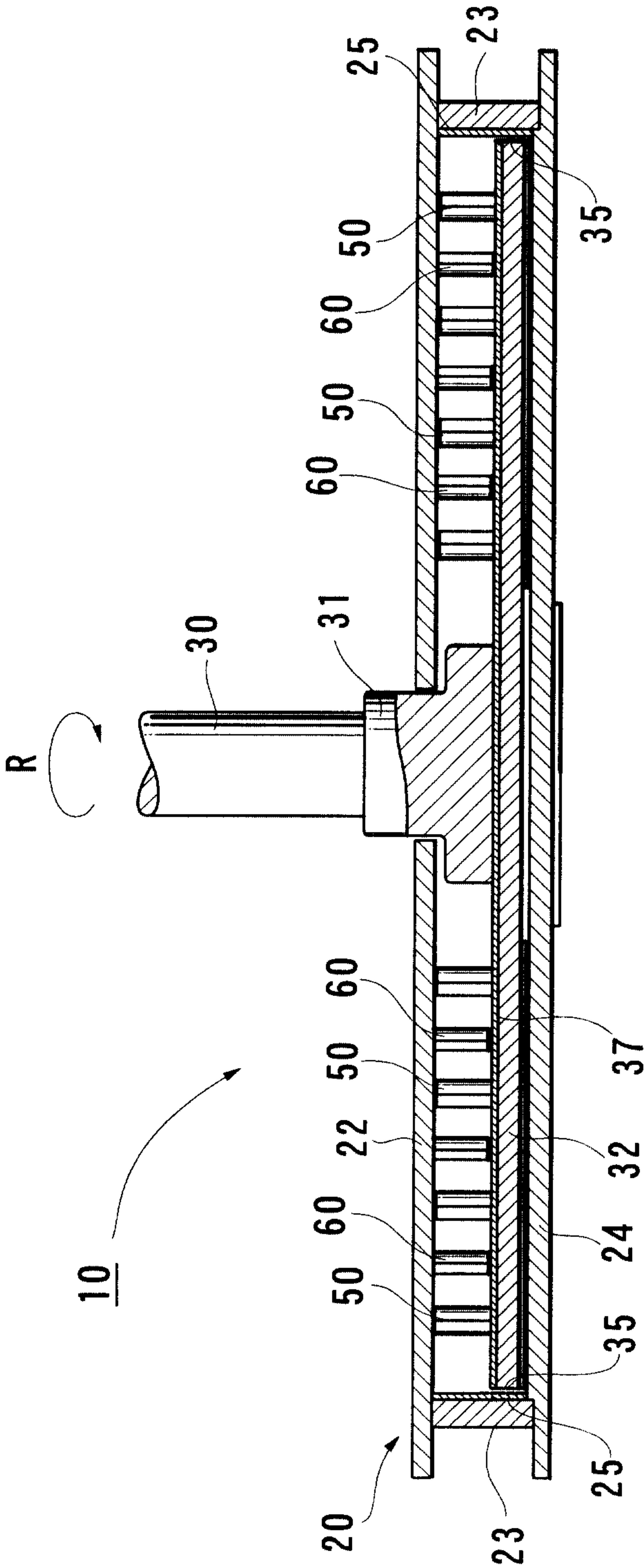


FIG.6

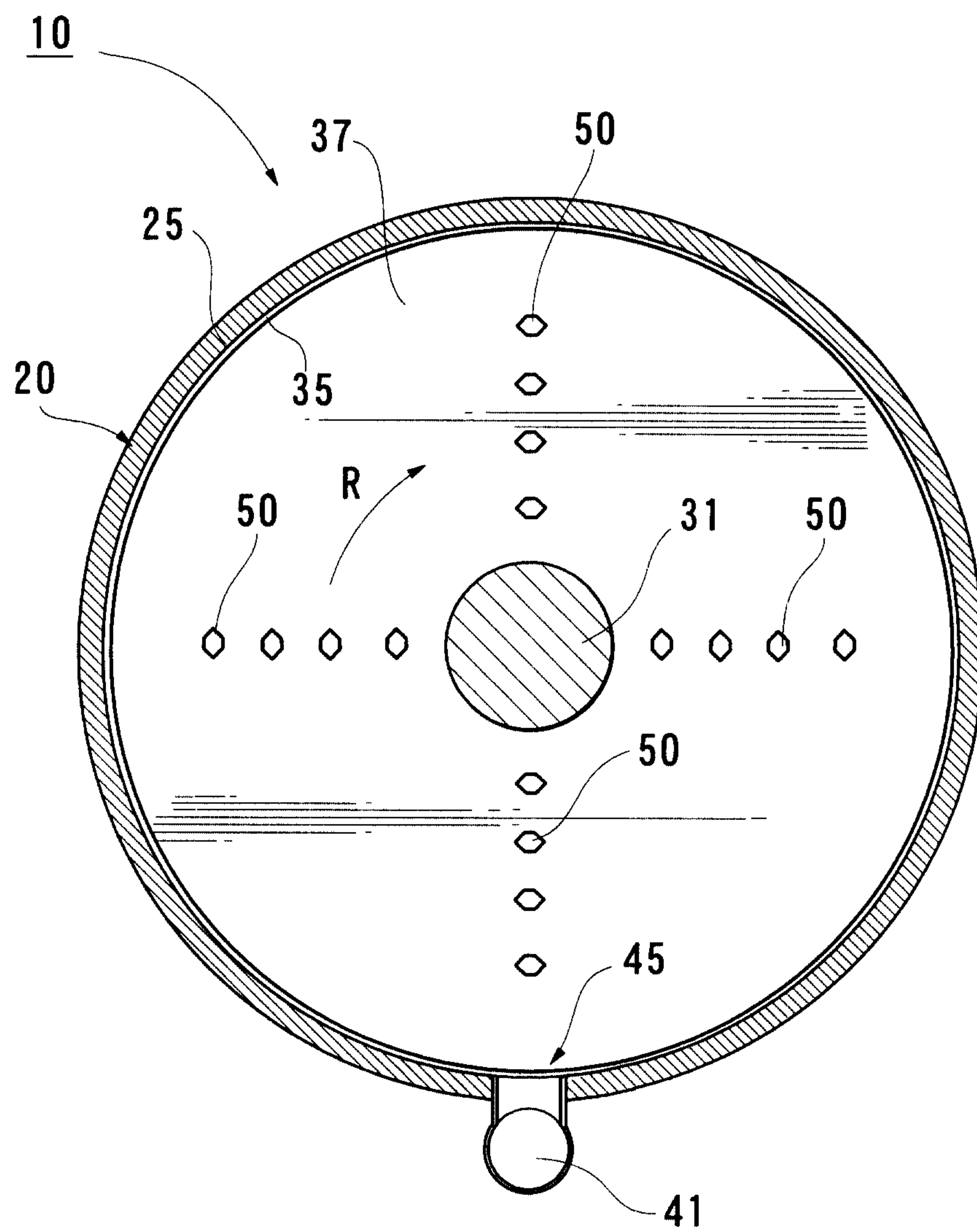


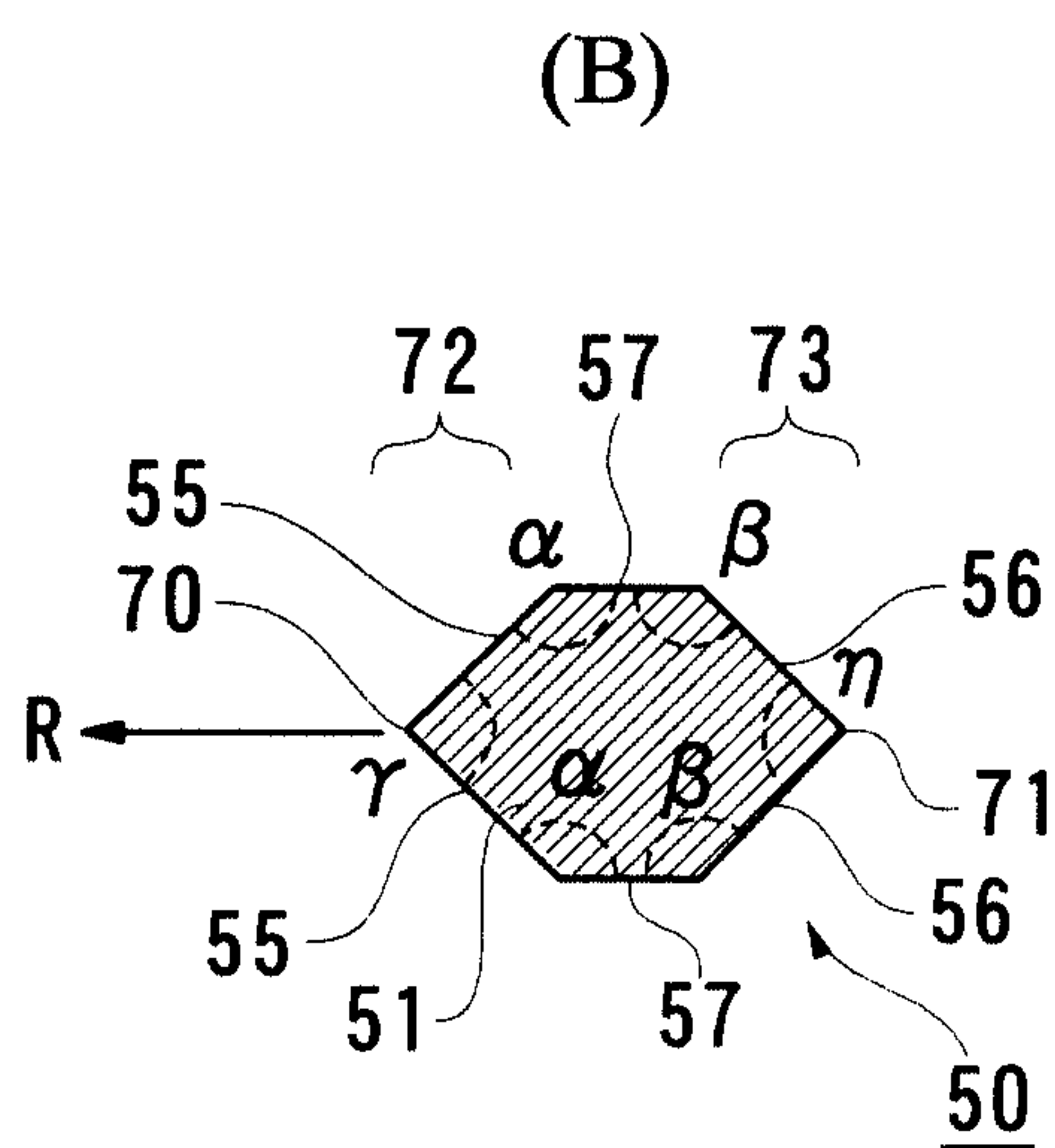
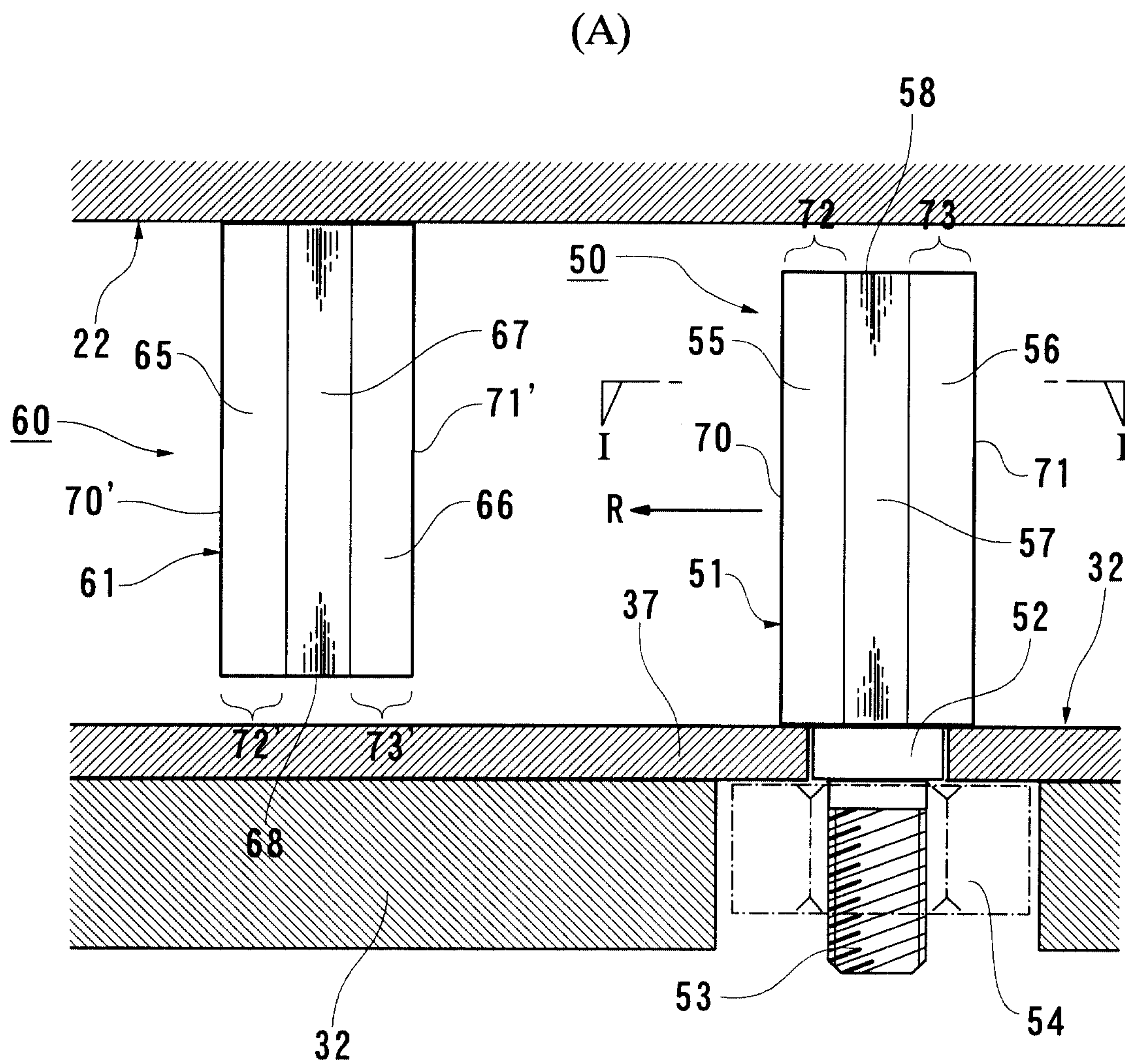
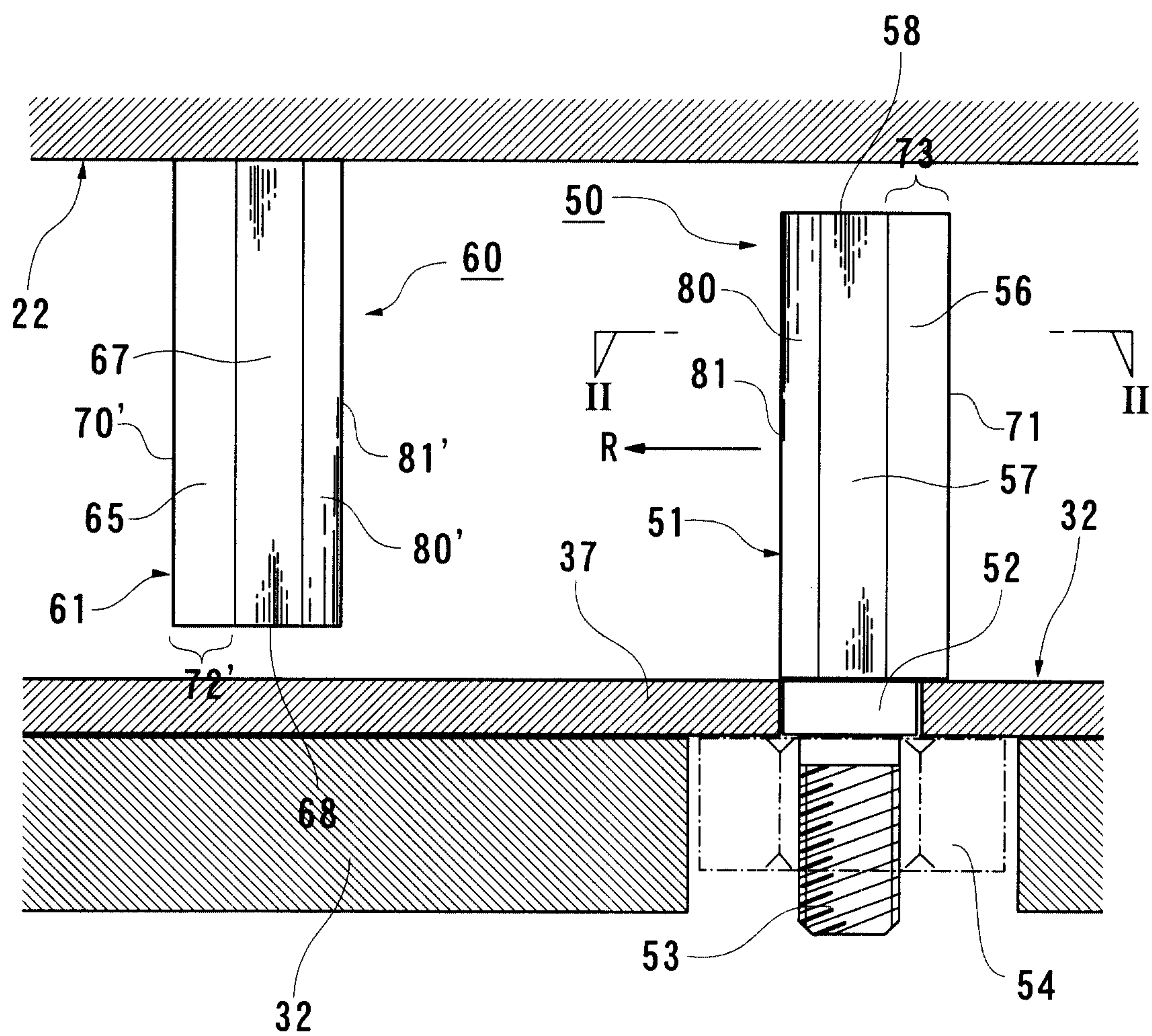
FIG.7

FIG.8

(A)



(B)

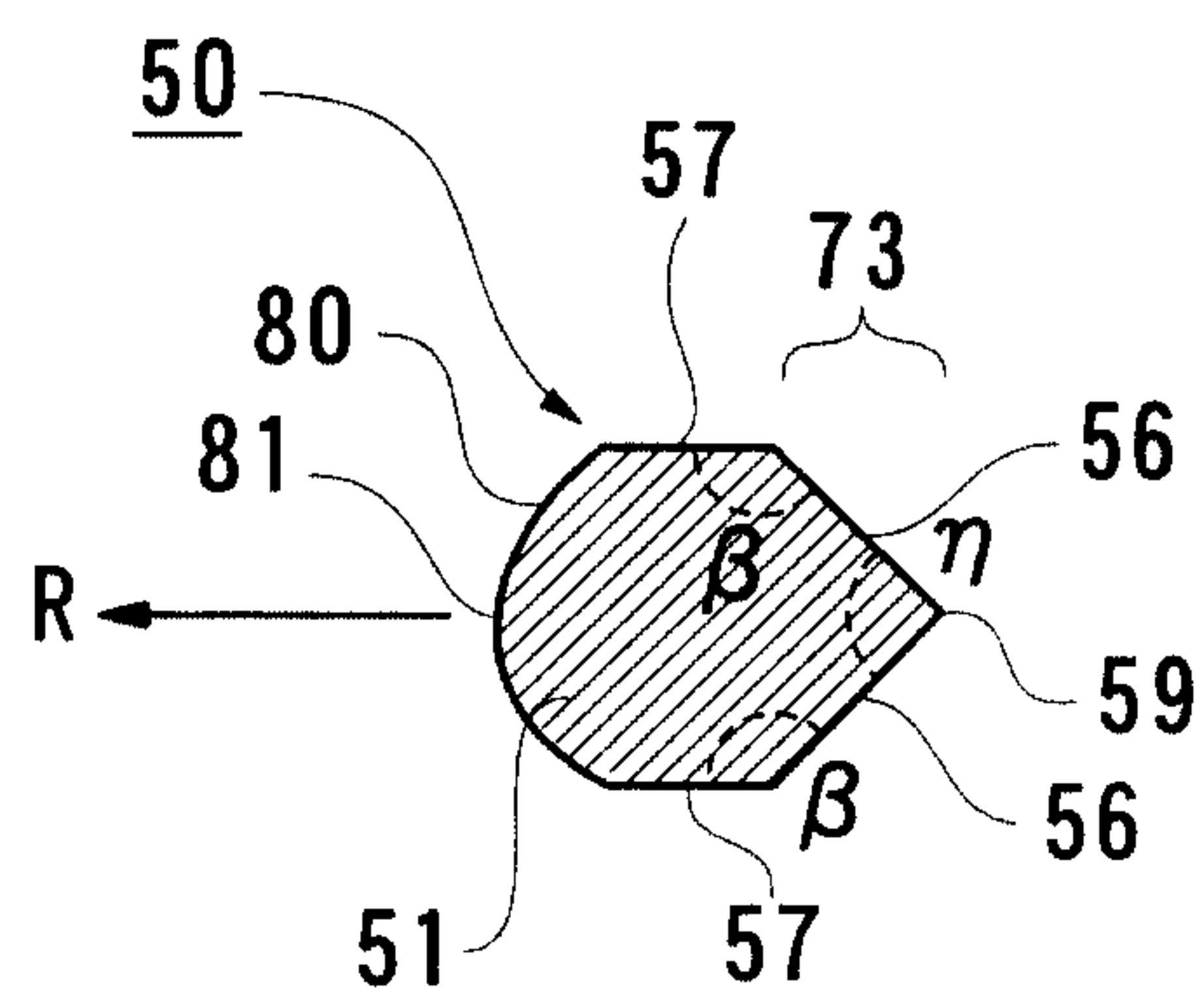


FIG.9

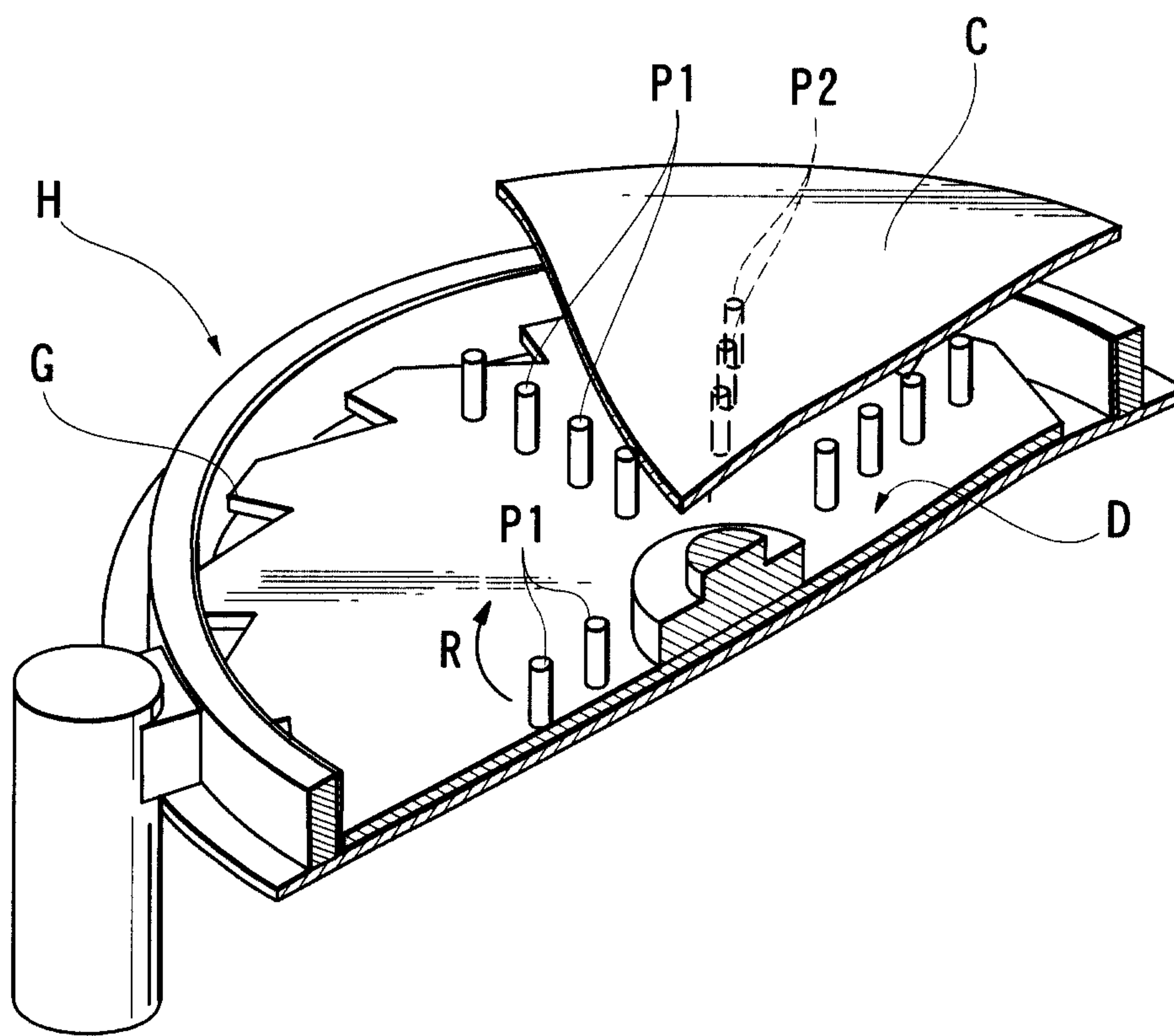
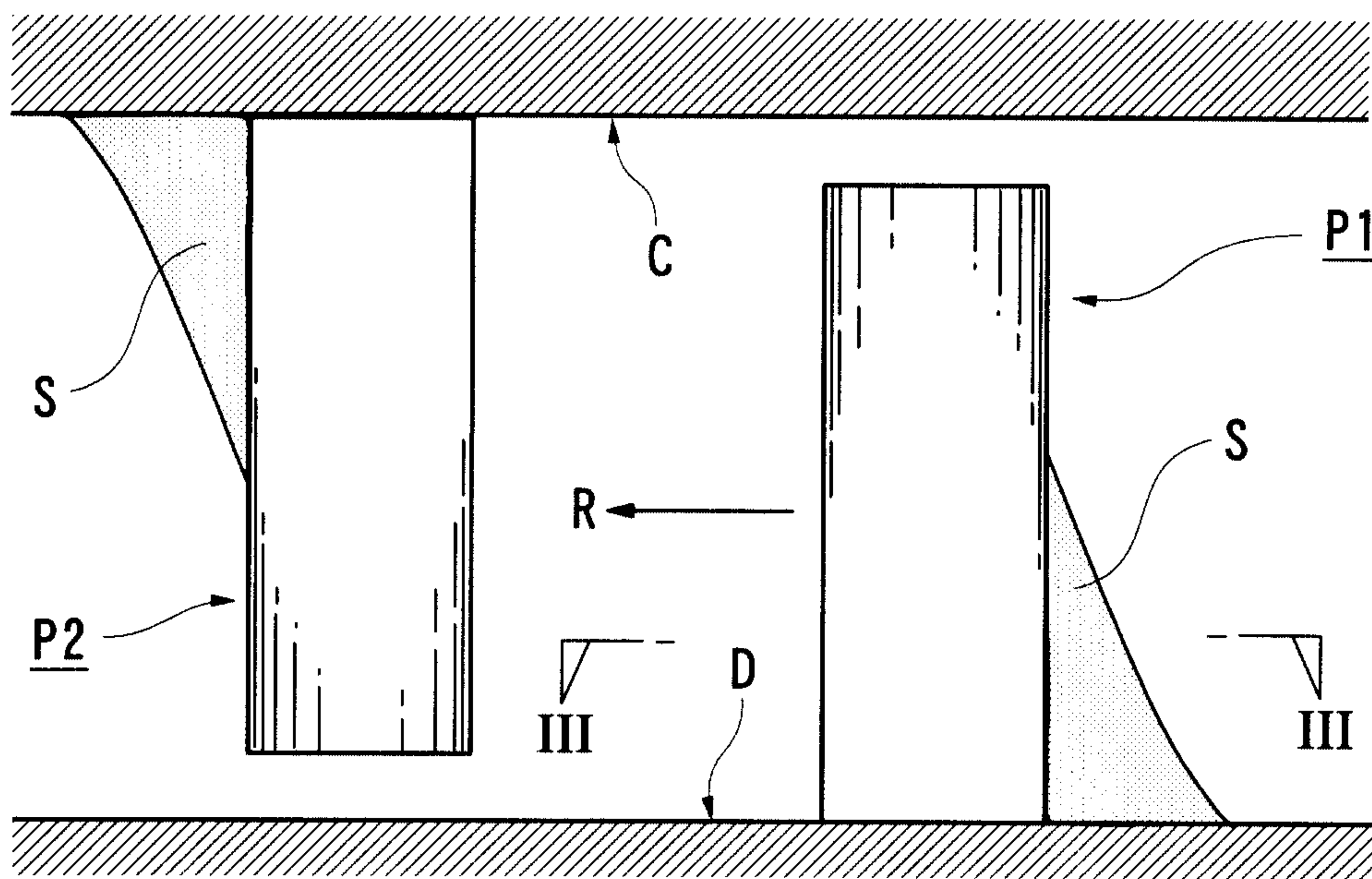


FIG.10

(A)



(B)

