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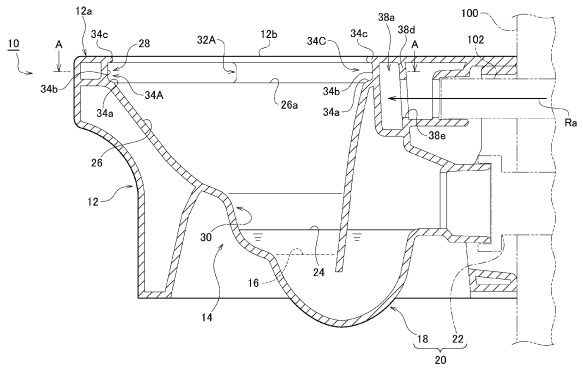
(54) FLUSH TOILET DEVICE

(57) A toilet main body 12 having a toilet bowl portion 14 and a water discharge portion 36 for discharging washing water to the inside of the toilet bowl portion 14 is provided. The toilet bowl portion 14 has a receiving surface portion 26 for receiving waste and a rim portion 28 that is connected to an upper edge 26a of the receiving surface portion 26. The water discharge portion 36 has three water discharge ports 32A-32C formed in the rim portion 28 and discharges washing water toward one side in a circumferential direction along the inner circumferential surface of the rim portion 28 from the three water discharge ports 32A-32C. The toilet bowl portion 14 has four divided regions Sr1-Sr4 sectioned by a lateral center line that bisects the lateral dimension of an outer surface portion of the toilet main body 12 and by a longitudinal center line that bisects the longitudinal dimension of an inner surface portion of the toilet bowl portion 14 in a planar view, and the three water discharge ports 32A-32C are separately formed respectively in three divided regions out of the four divided regions Sr1-Sr4.

FIG. 1



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Description

[TECHNICAL FIELD]

[0001] The present invention relates to flush toilets.

[BACKGROUND ART]

[0002]

1. Various studies have been done conventionally regarding washing techniques for washing the inside of a toilet bowl portion of a toilet. Patent document No. 1 suggests a toilet washing device formed such that three water discharge ports are provided at the rear side of the toilet bowl and such that a discharge mode for washing water discharged from the three water discharge ports is changeable by using a switching valve. The document discloses, as the discharge mode for washing water, a discharge mode where only one of the three water discharge ports is used and a mode where both of two water discharge ports are used.

[0003]

[Patent document No. 1] Japanese Patent Application Publication NO. 2006-9382
[Patent document No. 2] Japanese Patent No. 5553188
[Patent Document No. 3] Japanese Patent Application Publication No. 2015-67954.

[DISCLOSURE OF THE INVENTION]

[PROBLEM TO BE SOLVED BY THE INVENTION]

[0004] A toilet bowl portion usually has a receiving surface portion for receiving waste and a rim portion that is connected to the upper edge portion of the receiving surface portion. As a technique for washing this toilet bowl portion, a technique is known where the toilet bowl portion is washed by discharging washing water toward one side in a circumferential direction along the inner circumferential surface of the rim portion from a water discharge port formed on the rim portion. This washing technique allows a wider range inside the toilet bowl portion including the inner circumferential surface of the rim portion to be washed with washing water compared to a technique where the inside of the toilet bowl portion is washed by discharging washing water in a downward direction from the water discharge port of the rim portion and thus offers the advantage of being able to obtain preferable cleanliness.

[0005] As a result of studying such a washing technique, the present inventor has come to realize the following problem. In this washing technique, washing water flows down in a downward direction due to gravity while the washing water is flowing along the inner circumferential surface of the rim portion. Therefore, in order to obtain favorable rim washing performance, it is necessary to devise a means for allowing the washing water to reach the entire inner circumferential surface of the rim portion. In view of such perspective, no special devising is made for washing the inner circumferential surface of the rim portion in the toilet washing device according to Patent document No. 1, and there is room for improvement in terms of rim washing performance.

[0006] A first invention has been made in view of such a problem, and a purpose thereof is to provide a flush toilet that can obtain favorable rim washing performance.

[0007]

2. Various studies have been done conventionally regarding washing techniques for washing the inside of a toilet bowl portion of a toilet. Patent document No. 1 discloses a flush toilet provided with: a recessed portion that is formed on at a lower part of a waste receiving surface; a rim portion; and two water discharge ports, where a main flow of washing water discharged from the two water discharge ports flows into the recessed portion. Meanwhile, such a flush toilet is required to be able to wash with less water in order for the effective utilization of water resources.

[0008] Fig. 11 of Patent document No. 2 shows an inflow route of washing water from two rim water discharge ports . In this flush toilet, a main flow from these rim water discharge ports flows while being biased toward the front side and the right side inside a recessed portion in a planar view of the toilet. Therefore, washing power against waste that is attached deep inside or on the left side inside the recessed portion in a front view of the toilet may become insufficient. Also, although a downward flow toward a trap entrance is mainly formed of a main flow, a downward flow in a left back region of the recessed portion in the front view of the toilet is not likely to be formed, and floating waste may stay. In particular, there is concern that, when washing is performed with less water, effects by the bias in the water flow and the downward flow inside the recessed portion become prominent.

[0009] In other words, in such a flush toilet, it is necessary to devise a means to improve washing power by suppressing the bias in the water flow and the downward flow inside the recessed portion. In view of such a perspective, no special means is devised for improving the bias in the water flow and the downward flow inside the recessed portion in the flush toilet according to Patent document No. 2, and there is room for improvement in terms of washing performance for washing the recessed portion of the flush toilet.

[0010] A second invention has been made in view of such a problem, and a purpose thereof is to provide a flush toilet that is able to obtain favorable washing per-

formance for washing a recessed portion by suppressing a bias in a water flow and a downward flow inside a recessed portion.

[MEANS TO SOLVE THE PROBLEM]

[0011] To solve the problem above, a first embodiment of a first invention relates to a flush toilet. The flush toilet includes: a toilet main body that has a toilet bowl portion and a water discharge portion for discharging washing water to the inside of the toilet bowl portion, wherein the toilet bowl portion has a receiving surface portion for receiving waste and a rimportion that is connected to an upper edge portion of the receiving surface portion, wherein the water discharge portion has three water discharge ports formed in the rim portion and discharges washing water toward one side in a circumferential direction along the inner circumferential surface of the rim portion from the three water discharge ports, wherein the toilet bowl portion has four divided regions sectioned by a lateral center line that bisects the lateral dimension of an outer surface portion of the toilet main body and by a longitudinal center line that bisects the longitudinal dimension of an inner surface portion of the toilet bowl portion in a longitudinal direction in a planar view, and wherein the three water discharge ports are separately formed respectively in three divided regions out of the four divided regions. According to this embodiment, the separate water discharge ports are formed respectively in the three divided regions out of the four divided regions. Therefore, the circumferential length of the rim portion from each of the water discharge ports to another water discharge port that is adjacent on one side in the circumferential direction can be shortened in comparison with a case where separate water discharge ports are formed in two divided regions out of the four divided regions. Therefore, washing water can more easily reach the entire inner circumferential surface of the rim portion, and more favorable rim washing capability can be obtained.

[0012] To solve the problem above, a first embodiment of a second invention relates to a flush toilet. The flush toilet is provided with a toilet main body that has a toilet main body. The toilet bowl portion has a receiving surface portion for receiving waste, a rim portion that is connected to an upper edge portion of the receiving surface portion, and a recessed portion that is formed denting downward from a lower edge portion of the receiving surface portion. The recessed portion is sectioned by three standing walls consisting of: a left standing wall and a right standing wall that correspond to the left and right side edges of a triangle whose bottom edge is located behind the left and right side edges; and a rear standing wall that corresponds to the bottom edge, in a planar view. In the rim portion, three water discharge ports consisting of a first water discharge port provided on a lateral side of the recessed portion, a second water discharge port provided on the front side of the recessed portion, and a third water discharge port provided on the rear side of the recessed portion are provided. The three water discharge ports discharge washing water on one side in a circumferential direction along the rim portion.

[0013] According to this embodiment, each of three portions of washing water respectively discharged from the three water discharge ports toward one direction side in the circumferential direction along the inner circumferential surface of the rim portion washes the recessed portion as well as washing the inner circumferential surface of the rim portion.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0014]

Fig. 1 is a lateral cross-sectional view of a flush toilet according to a first embodiment;
Fig. 2 is a plan view of the flush toilet according to the first embodiment;
Fig. 3 is a cross-sectional view taken along a line A-A of Fig. 1;
Fig. 4 is a diagram for explaining a lateral center line of a toilet main body and a longitudinal center line of a toilet bowl portion according to the first embodiment;
Fig. 5 is a diagram showing the way washing water flows in an initial stage inside the toilet bowl portion according to the first embodiment;
Fig. 6 is a diagram showing the way washing water flows in an intermediate stage inside the toilet bowl portion according to the first embodiment;
Fig. 7 is another diagram showing the way washing water flows in an intermediate stage inside the toilet bowl portion according to the first embodiment;
Fig. 8 is a diagram showing the respective inner circumferential lengths of a first rim water leading passage through a third rim water leading passage of a rim portion according to the first embodiment;
Figs. 9 are diagrams showing the way urine travels: Fig. 9A is a diagram showing a toilet main body according to a first exemplary variation; and Fig. 9B is a diagram showing the toilet main body according to the first embodiment;
Fig. 10 is a diagram for explaining the centrifugal force applied to washing water;
Fig. 11A is a diagram showing the structure around a second water discharge port according to the first embodiment, and Fig. 11B is a diagram showing the structure around a second water discharge port according to a second exemplary variation;
Fig. 12 is a diagram showing the structure around a third water discharge port according to the first embodiment;
Figs. 13 are schematic diagrams showing examples of patterns for arranging water discharge ports that can achieve an operational effect (1);
Figs. 14 are schematic diagrams showing examples of patterns for arranging water discharge ports that

can achieve an operational effect (2);
Fig. 15 is a lateral cross-sectional view of a flush toilet according to a second embodiment;
Fig. 16 is a plan view of the flush toilet according to the second embodiment;
Fig. 17 is a cross-sectional view taken along a line A-A of Fig. 15;
Fig. 18 is a schematic diagram explaining water flows around a direction changing portion according to the second embodiment;
Fig. 19 is a diagram for explaining a central axis of a recessed portion according to the second embodiment;
Fig. 20 is a plan view showing, in an enlarged view, the inner edge of the recessed portion according to the second embodiment;
Fig. 21 is a diagram schematically showing the way washing water flows inside a toilet bowl portion according to the second embodiment; and
Fig. 22 is a diagram schematically showing a range where washing water flows inside a toilet bowl portion according to the second embodiment.

[MODE FOR CARRYING OUT THE INVENTION]

[0015] In the following embodiments and exemplary variations, same numerals represent same constituting elements, and duplicative explanations will be omitted. For the sake of ease of explanation, some constituting elements are appropriately enlarged, reduced, or omitted in the figures.

1. An explanation will be given regarding a preferred embodiment of the first invention.

[0016] Fig. 1 is a lateral cross-sectional view of a flush toilet 10 according to a first embodiment, and Fig. 2 is a plan view of the flush toilet 10. The flush toilet 10 is provided with a toilet main body 12 made of ceramics. The toilet main body 12 is a wall mounted type toilet that is mounted while being hung on a side wall surface 100 in a toilet room. Above the toilet main body 12, although not shown in the figure, a box that houses a warm water washing device such as a private part washing device or the like and a toilet lid and a toilet seat that are supported rotatably in the vertical direction by the box are arranged.

[0017] As shown in Fig. 1, the toilet main body 12 is provided with a toilet bowl portion 14 formed at a front part of the toilet main body 12 and a trap portion 18 that communicates with the inside of the toilet bowl portion 14 via an inlet 16 (also see Fig. 2) formed on the bottom of the toilet bowl portion 14. The trap portion 18 becomes a part of a water drain passage portion 20 for draining waste inside the toilet bowl portion 14 to a sewage side water channel (not shown) . In addition to the trap portion 18, the water drain passage portion 20 is provided with a connecting pipe 22 connected to a downstream end portion of the trap portion 18, and waste is discharged to the sewage side water channel via the inside of the trap portion 18 and the connecting pipe 22. Sealing water 24 for blocking an airflow in the water flow direction is stored in the trap portion 18, and a backward flow of odor from the sewage side water channel is prevented by the sealing water 24.

[0018] Fig. 3 shows a cross-sectional view taken along a line A-A of Fig. 1. As shown in Figs. 1 and 3, the toilet bowl portion 14 is formed in an ellipse shape such that the longitudinal dimension becomes larger than the lateral dimension in a planar view. The toilet bowl portion 14 is provided with a receiving surface portion 26 for receiving waste, a rim portion 28 that is connected to the upper edge portion of the receiving surface portion 26 and forms the upper edge portion of the toilet bowl portion 14, and a recessed portion 30 that is formed denting downward from the lower edge portion of the receiving surface portion 26.

[0019] The receiving surface portion 26 and the recessed portion 30 are provided in an annularly continuous manner. The receiving surface portion 26 is formed being inclined at a descending slope toward the center of the annulus. The recessed portion 30 is formed having a bottom, and an inlet 16 of the trap portion 18 is open at the bottom. A portion of the sealing water 24 is stored in the recessed portion 30.

[0020] At the rim portion 28, three water discharge ports 32A through 32C (described later) are formed. The rim portion 28 has three rim water leading passages 34A through 34C formed extending in the circumferential direction of the toilet bowl portion 14 from the three water discharge ports 32A through 32C, respectively. In the following, the water discharge ports 32A through 32C are generically referred to as "water discharge ports 32", and the rim water leading passages 34A through 34C are generically referred to as "rim water leading passages 34".

[0021] The rim water leading passages 34 are formed to guide washing water discharged from the water discharge ports 32 to swirl. As shown in Fig. 1, the rim water leading passages 34 are each provided with a shelf portion 34a extending toward the outside of the toilet bowl portion 14 from an upper edge 26a of the receiving surface portion 26, a standing wall portion 34b rising from an outer peripheral end portion of the shelf portion 34a, and an overhanging portion 34c extending toward the inside of the toilet bowl portion 14 from an upper end portion of the standing wall portion 34b. As shown in Fig. 3, the shelf portion 34a is formed such that the radial dimension of the shelf portion 34a becomes smaller as the distance from the water discharge ports 32 increases in a swirling flow swirling direction Da (described later). The same applies to the overhanging portions 34c. This allows washing water discharged from the water discharge ports 32 to gradually flow down to the receiving surface portion 26 as the distance from the water discharge ports 32 increases.

[0022] The three rim water leading passages 34 in-

clude a first rim water leading passage 34A through a third rim water leading passage 34C respectively corresponding to the three water discharge ports, a first water discharge port 32A through a third water discharge port 32C. The first rim water leading passage 34A is formed such that, in a planar view, the first rim water leading passage 34A extends in the swirling flow swirling direction Da from the first water discharge port 32A to an end position 34Aa, the end position 34Aa being located near and inward from the second water discharge port 32B. The second rim water leading passage 34B is formed such that the second rim water leading passage 34B extends in the swirling flow swirling direction Da from the second water discharge port 32B to an end position 34Ba, the end position 34Ba being located near and inward from the third water discharge port 32C. The third rim water leading passage 34C is formed such that the third rim water leading passage 34C extends from the third water discharge port 32C to an end position 34Ca, the end position 34Ca being located near and inward from the first water discharge port 32A. The rim water leading passages 34A-34C are formed such that the rim water leading passages 34A-34C extend over an angle range of at least one fourth of a round around a central point Cp (described later) of the toilet bowl portion 14.

[0023] Fig. 4 is a diagram for explaining a lateral center line La of the toilet main body 12 and a longitudinal center line Lb of the toilet bowl portion 14. The lateral center line La of the toilet main body 12 is a straight line extending along the longitudinal direction bisecting a lateral dimension Lx of the outer surface portion of the toilet main body 12 in a planar view. More specifically, a straight line that bisects the lateral dimension Lx of the outer surface portion of the toilet main body 12 from a left end position 12L to a right end position 12R is the lateral center line La. The longitudinal center line Lb of the toilet bowl portion 14 is a straight line extending along the lateral direction bisecting a longitudinal dimension Ly of the inner surface portion of the toilet bowl portion 14 in a planar view of a horizontal cross section that passes through the water discharge ports 32A-32C. More specifically, a straight line that bisects the longitudinal dimension Ly of the inner surface portion of the toilet bowl portion 14 from a front end position 14F to a rear end position 14R is the longitudinal center line Lb. The previously-described central point Cp of the toilet bowl portion 14 is an intersection point of the lateral center line La and the longitudinal center line Lb.

[0024] The toilet bowl portion 14 described above has four divided regions Sr1-Sr4 sectioned by the lateral center line La and the longitudinal center line Lb of the toilet bowl portion 14 in a planar view. In the following, out of the four divided regions, a divided region located on the rear side with respect to the longitudinal center line Lb and on the right side with respect to the lateral center line La is referred to as a first divided region Sr1. Further, out of the four divided regions, divided regions located in the counterclockwise direction from the first divided region Sr1 in a planar view are referred to as a second divided region Sr2, a third divided region Sr3, and a fourth divided region Sr4 in order. The second divided region Sr2 and the third divided region Sr3 are front-side divided regions, and the first divided region Sr1 and the fourth divided region Sr4 are rear-side divided regions.

[0025] Referring back to Fig. 3, the toilet main body 12 is further provided with a water discharge portion 36 having the three previously-described water discharge ports 32A-32C. In addition to the three water discharge ports 32A-32C, the water discharge portion 36 has a water passage portion 38 described later. The water discharge portion 36 is for discharging washing water in the swirling flow swirling direction Da along the inner circumferential surface of the rim portion 28 from the three water discharge ports 32A-32C. By discharging washing water inside the toilet bowl portion 14 from each of the water discharge ports 32A-32C, the water discharge portion 36 forms a swirling flow that swirls in one direction inside the toilet bowl portion 14. In the present embodiment, the water discharge portion 36 forms a swirling flow that swirls in one direction Da (in the counterclockwise direction) in the circumferential direction of the toilet bowl portion 14. Hereinafter, one direction Da in this circumferential direction is referred to as a swirling flow swirling direction Da.

[0026] The three water discharge ports 32A-32C are formed separately in three respective divided regions of the four divided regions Sr1-Sr4 of the toilet bowl portion 14. More specifically, the three water discharge ports 32A-32C include a first water discharge port 32A located in the first divided region Sr1, a second water discharge port 32B located in the third divided region Sr3, and a third water discharge port 32C located in the fourth divided region Sr4. All the water discharge ports 32A-32C are formed so as to be open in the swirling flow swirling direction Da.

[0027] The water passage portion 38 is a hollow structure portion arranged on the back side (outside the toilet bowl portion 14 in the radial direction) of the rimportion 28. The water passage portion 38 communicates with the water discharge ports 32A-32C and serves as a passage for washing water supplied to the water discharge ports 32A-32C. The water passage portion 38 has an inflow passage 38a, a right side water passage 38b (first water passage), and a left side water passage 38c (second water passage). The inflow passage 38a is arranged behind and on the back side of the rim portion 28. The right side water passage 38b is arranged on the back side of the a right side portion 28R, which is one of side portions on the left and right sides of the rim portion 28. The left side water passage 38c is arranged on the back side of the a left side portion 28L, which is the other one of the side portions on the left and right sides of the rim portion 28.

[0028] As shown in Fig. 1, washing water supplied from a water supply pipe 102, which is a part of a washing water supply device, flows into the inflow passage 38a.

Fig. 1 and Fig. 2 show a supply route Ra for washing water from the water supply pipe 102 to the inflow passage 38a. The washing water flows inside the inflow passage 38a through an introducing hole 38e arranged behind the rim portion 28 and formed in a rear wall portion 38d partitioning the inflow passage 38a. In the present embodiment, the washing water supply device supplies washing water using a water supply technique of a water supply direct pressure type where the water supply pressure of tap water is used. As shown in Fig. 3, the inflow passage 38a is formed such that the inflow passage 38a spreads out in the lateral direction from the front of the introducing hole 38e, which is at an inflow position Pa of washing water from the washing water supply device. The right side water passage 38b communicates with one end portion of the inflow passage 38a in the lateral direction, and the left side water passage 38c communicates with the other end portion in the lateral direction.

[0029] The right side water passage 38b is formed so as to extend along the longitudinal direction on the back side of the right side portion 28R of the rim portion 28. The first water discharge port 32A is formed at the downstream end of the right side water passage 38b.

[0030] The left side water passage 38c includes a turned-back portion 38ca formed at a downstream end portion of the left side water passage 38c and a longitudinally extending portion 38cb formed so as to communicate with the turned-back portion 38ca and extend along the longitudinal direction. At a downstream end of the turned-back portion 38ca as the downstream end of the left side water passage 38c, the second water discharge port 32B is formed. At the longitudinally extending portion 38cb of the left side water passage 38c, a branch portion 38cc is formed extending in the swirling flow swirling direction Da and inward in the radial direction from a midway position in the longitudinal direction. At a downstream end of the branch portion 38cc as the midway position of the left side water passage 38c, the third water discharge port 32C is formed. An inner bottom surface 38cd in a range from the midway position of the longitudinally extending portion 38cb to the branch portion 38cc is formed so as to rise toward the third water discharge port 32C.

[0031] Inside the right side water passage 38b, washing water supplied from the inflow passage 38a is guided such that the washing water flows to the first water discharge port 32A (see a direction Db) . Inside the longitudinally extending portion 38cb of the left side water passage 38c, a portion of the washing water supplied from the inflow passage 38a flows toward the side of the turned-back portion 38ca (see a direction Dc), and the rest flows being guided toward the side of the branch portion 38cc (see a direction Dd) . Inside the turned-back portion 38ca, washing water supplied from the longitudinally extending portion 38cb on the upstream side flows turning back inward in the radial direction and being guided toward the second water discharge port 32B (see a direction De) .

[0032] An explanation will be given next regarding a method of washing the toilet bowl portion 14 using the above flush toilet 10. The flush toilet 10 washes the inside of the toilet bowl portion 14 by a so-called wash down type washing technique where waste inside the toilet bowl portion 14 is washed away into the trap portion 18 with using the fall of water. By operating an operation member such as a switch, lever, or the like for starting the supply of washing water, washing water in a predetermined flow amount range is supplied from the washing water supply device into the water passage portion 38 of the flush toilet 10. An explanation will be given in the following on the condition that actions occurring from the start of the supply of the washing water in the predetermined flow amount range to the end of the supply are considered as a single washing action.

[0033] The washing water flows inside the inflow passage 38a of the water passage portion 38, and the washing water that has flowed in flows through each of the right side water passage 38b and the left side water passage 38c and is discharged from the water discharge ports 32A-32C. Once the inside of the water passage portion 38 is filled with the washing water, water pressure corresponding to water supply pressure is applied to the washing water inside the water passage portion 38 by the washing water supply device, and the washing water to which the water pressure has been applied is discharged from the water discharge ports 32A-32C.

[0034] Fig. 5 is a diagram showing the way washing water flows inside the toilet bowl portion 14. The figure shows an initial stage (first stage) where washing water starts flowing inside the toilet bowl portion 14. The figure shows, with arrows, the flow of washing water inside the toilet bowl portion 14. In the initial stage, washing water is discharged from each of the first water discharge port 32A and the third water discharge port 32C into the toilet bowl portion 14, and no washing water is discharged from the second water discharge port 32B. The washing water discharged from the first water discharge port 32A forms a flow Dwa swirling along the first rim water leading passage 34A. The washing water discharged from the third water discharge port 32C forms a flow Dwb swirling along the third rim water leading passage 34C. The washing water flowing along the rim water leading passages 34A and 34C gradually falls onto the receiving surface portion 26 from the shelf portion 34a of the rim water leading passages 34A and 34C and forms a flow Dwc swirling toward the lower side of the receiving surface portion 26.

[0035] As described, in order to adjust the timing for starting the discharging of washing water from each of the water discharge ports 32A-32C, the length of a water passage route from the inflow position Pa of washing water inside the water passage portion 38 to each of the water discharge ports 32A-32C of the water discharge portion 36 is set to satisfy a predetermined condition. More specifically, the lengths of respective water passage routes from the inflow position Pa of washing water inside the water passage portion 38 to the first water dis-

charge port 32A, the second water discharge port 32B, and the third water discharge port 32C are set as La1, La2, and La3, respectively. At this time, the length La2 of the water passage route of the second water discharge port 32B is set to be larger than the respective lengths La1 and La3 of the water passage routes of the first water discharge port 32A and the third water discharge port 32C.

[0036] The timing for starting the discharge of washing water from the first water discharge port 32A and that of washing water from the third water discharge port 32C are equal in the present embodiment. The expression "equal" used here means that subjects to be compared with each other are the same or almost the same. In this case, the expression means that the timings for starting the discharge of washing water are the same or almost the same. The same applies to the following regarding the interpretation of the expression "equal".

[0037] Figs. 6 and 7 are other diagrams showing the way washing water flows inside the toilet bowl portion 14. The figures show an intermediate stage (second stage) obtained after the elapse of time after the initial stage. Fig. 6 shows a cross-sectional view taken along a line A-A of the flush toilet 10 just like Fig. 3, and Fig. 7 shows a lateral partial cross sectional view of the flush toilet 10. An explanation will be given first in reference to Fig. 6. In the intermediate stage, washing water is also discharged from the second water discharge port 32B, as well as from the first water discharge port 32A and the third water discharge port 32C, into the toilet bowl portion 14. The way washing water discharged from the first water discharge port 32A and the third water discharge port 32C flows is the same as that in the initial stage.

[0038] The washing water discharged from the second water discharge port 32B forms a flow Dwd swirling along the second rim water leading passage 34B. The washing water flowing along the second rim water leading passage 34B gradually falls onto the receiving surface portion 26 from the shelf portion 34a of the second rim water leading passage 34B and forms a flow Dwe swirling toward the lower side of the receiving surface portion 26. Washing water discharged from each of the water discharge ports 32A-32C form the flows Dwa, Dwb, Dwc, Dwd, and Dwe as swirling flows that swirl in the swirling flow swirling direction Da inside the toilet bowl portion 14. Of these flows, the flows Dwc and Dwe swirl heading toward the lower side of the receiving surface portion 26 of the toilet bowl portion 14 and flow into the recessed portion 30 from the receiving surface portion 26.

[0039] The flow Dwc includes a flow Dwc (1) formed by a portion of washing water discharged from the second water discharge port 32B and a portion of washing water discharged from the third water discharge port 32C that merge with each other. The flow Dwc(1) is mainly formed on the receiving surface portion 26 behind the recessed portion 30. The flow Dwc includes a flow Dwc (2) formed by a portion of washing water discharged from the third water discharge port 32C and a portion of washing water discharged from the first water discharge port 32A that merge with each other. The flow Dwc (2) is mainly formed on the receiving surface portion 26 in the second divided region Sr2, which is a divided region on the upstream side out of the two front side divided regions Sr2 and Sr3.

[0040] A portion of washing water discharged from the second water discharge port 32B merges with a portion of washing water discharged from the first water discharge port 32A and forms a main flow Fw, which heads toward the inlet 16 of the trap portion 18. The main flow Fw is mainly formed on the receiving surface portion 26 in a range from the third divided region Sr3, which is a divided region in the downstream side out of the two front side divided regions Sr2 and Sr3, and to the fourth divided region Sr4, which is adjacent to the third divided region Sr3 in the swirling flow swirling direction Da. More specifically, the main flow Fw is formed on the receiving surface portion 26 in the third divided region Sr3 and the fourth divided region Sr4 (see a range Sa) on the side (left side) where the third divided region Sr out of the two front side divided regions Sr2 and Sr3 is located and on the front side, when viewed from the recessed portion 30 of the toilet bowl portion 14.

[0041] Due to the merging of washing water discharged from each of the first water discharge port 32A and the second water discharge port 32B, the main flow Fw becomes a water flow of a strong force and a large flow amount. As shown in Figs. 6 and 7, this main flow Fw flows in toward the inlet 16 of the trap portion 18 via the inside of the recessed portion 30 from the receiving surface portion 26. More specifically, the main flow Fw flows into the recessed portion 30 from the diagonally front side (left side and front side) with respect to the recessed portion 30 after flowing toward the fourth divided region Sr4 from the third divided region Sr3 on the receiving surface portion 26, that is, toward the rear side from the front side on the receiving surface portion 26. At this time, waste inside the recessed portion 30 of the toilet bowl portion 14 is washed away into the trap portion 18 through the inlet 16 with using the fall of washing water that is flowing as the previously-described swirling flows, particularly, the fall of washing water flowing as the main flow Fw. The expression "the fall of washing water that is flowing as the main flow Fw" used in this case means a difference Hd in height from a merging position of washing water discharged from the first water discharge port 32A and washing water discharged from the second water discharge port 32B to the inlet 16 of the trap portion 18 (see Fig. 7).

[0042] Inside the recessed portion 30, due to the main flow Fw flowing into the recessed portion 30, a flow Dwf heading forward after colliding with a right side wall portion 30a (first side wall portion) of the recessed portion 30 is formed in addition to a flow that heads toward the inlet 16 of the trap portion 18. After flowing along the right side wall portion 30a of the recessed portion 30, the flow Dwf flows in such a manner the flow Dwf collides with a left side wall portion 30b. Due to the momentum at the

time when the flow Dwf collides with the right side wall portion 30a or the left side wall portion 30b of the recessed portion 30, the flow Dwf flows while moving upward as if being pushed up. Merging with the flow Dwc(2) flowing from the front side toward the rear side on the receiving surface portion 26 into the recessed portion 30 (see a range Sb), this moving-upward flow Dwf forms a flow Dwg heading toward the inlet 16 of the trap portion 18. This flow Dwg also flows heading from the front side toward the rear side inside the toilet bowl portion 14 in the same way as in the flow Dwc(2).

[0043] An explanation will now be given regarding operational effects of the above flush toilet 10.

(1) According to the above flush toilet 10, the separate water discharge ports 32A-32C are formed respectively in three divided regions out of the four divided regions Sr1-Sr4. Therefore, the circumferential length of the rim portion 28 from each of the water discharge ports 32A-32C to another water discharge port that is adjacent in the swirling flow swirling direction Da can be shortened in comparison with a case where separate water discharge ports are formed in two divided regions out of the four divided regions Sr1-Sr4. A case is taken into consideration where water discharge ports are supposedly formed separately in two divided regions. Washing water flowing along the inner circumferential surface of the rim portion 28 flows down in a downward direction due to gravity. Therefore, in this case, the long inner circumferential length of the rimportion 28 from a water discharge port to another water discharge port makes it difficult for a sufficient amount of washing water to reach a position that is away from the water discharge ports. Regarding this point, according to the present embodiment, the inner circumferential length of the rimportion 28 from a water discharge port to another water discharge port can be set to be short in the entire rim portion 28, thus allowing washing water to easily reach the entire inner circumferential surface of the rim portion 28, and favorable washing performance can therefore be obtained.

(2) The main flow Fw heading to the inlet 16 of the trap portion 18 is formed by the merging of washing water discharged from the first water discharge port 32A and washing water discharged from the second water discharge port 32B. Since this second water discharge port 32B is in the third divided region Sr3 on the front side, the route of washing water flowing from the second water discharge port 32B to the inlet 16 of the trap portion 18 can be shortened in comparison with a case where the second water discharge port 32B is provided in a divided region on the rear side. As a result, the force of water of the main flow Fw formed by the washing water discharged from the second water discharge port 32B becomes strong, and by washing away waste inside the toilet bowl portion 14 to the inlet 16 of the trap portion 18 by the main flow Fw having a strong force of water, favorable waste discharging performance can be obtained.

[0044] The main flow Fw heading to the inlet 16 of the trap portion 18 is formed by the merging of washing water discharged from the first water discharge port 32A and washing water discharged from the second water discharge port 32B on the receiving surface portion 26, that is, on the inner circumferential surface of the toilet bowl portion 14. Thus, the receiving surface portion 26 can be washed by the main flow Fw having a strong force of water, and favorable toilet bowl washing performance can be obtained.

[0045] Also, in order to obtain favorable rim washing performance, waste discharging performance, and toilet bowl washing performance, a technique of increasing the total amount of washing water used for a single toilet wash or increasing the discharge amount of washing water by increasing the opening area of a water discharge port is also possible. Regarding this point, according to the present embodiment, the total amount of washing water used for a single toilet wash does not need to be increased, and favorable rim washing performance, waste discharging performance, and toilet bowl washing performance can thus be obtained while preventing an increase in the total amount of washing water. Further, since the opening area of a water discharge port does not need to be increased, favorable rim washing performance, waste discharging performance, and toilet bowl washing performance can be obtained while preventing an increase in the opening area of a water discharge port. In particular, since an increase in the opening area of a water discharge port can be prevented, favorable rim washing performance, waste discharging performance, and toilet bowl washing performance can be obtained while achieving a good appearance by reducing the size of a water discharging port.

[0046] In order for washing water to reach the entire inner circumferential surface of the rimportion 28, the discharge amount of washing water from a single water discharging port needs to be increased as the inner circumferential length of the rimportion 28 from the single water discharge port to another water discharge port becomes longer, and the size of a rim water leading passage 34 that connects to the single water discharge port also needs to be increased. Regarding this point, according to the present embodiment, the inner circumferential length of the rim portion 28 from a single water discharge port to another water discharge port can be shortened compared to a case where two water discharge ports are formed in the rim portion 28. Therefore, in order for washing water to reach the entire inner circumferential surface of the rim portion 28, the respective discharge amounts of washing water from the three water discharge ports 32A-32C can be reduced, and dimensions such as the respective widths of the shelf portions 34a and the respective heights of the standing wall portions 34b of the

respective rim water leading passages 34 can be also reduced.

[0047] Further, since the water discharge portion 36 is formed such that washing water is discharged from the second water discharge port 32B after washing water is discharged from the first water discharge port 32A and the third water discharge port 32C, the following advantages can be achieved. An increase in the ratio of the flow amount of the main flow, which is the flow amount of the main flow Fw, with respect to the total amount of washing water used for a single washing action allows the flow amount of the main flow to be increased without increasing the total amount of washing water, and the waste discharging capability and the toilet bowl washing capability can thus be improved due to an increase in the flow amount of the main flow. According to the present embodiment, the amount of washing water that is discharged from the second water discharge port 32B and then flows into the inlet 16 without merging can be reduced, and the ratio of the flow amount of the main flow with respect to the total amount of washing water can thus be increased. Therefore, without increasing the total amount of washing water, the waste discharging capability and the toilet bowl washing capability can be improved due to an increase in the ratio of the flow amount of the main flow.

[0048] An explanation will be given next regarding other features for the first water discharge port 32A through the third water discharge port 32C. The water discharge portion 36 is formed such that the discharge amount of washing water from the first water discharge port 32A is the highest, the discharge amount of washing water from the second water discharge port 32B is the second highest, and the discharge amount of washing water from the third water discharge port 32C is the lowest. In other words, the water discharge portion 36 is formed such that the discharge amount of washing water becomes smaller in the order of the first water discharge port 32A, the second water discharge port 32B, and the third water discharge port 32C. From another perspective, the water discharge portion 36 is formed such that the discharge amount of washing water from the first water discharge port 32A is more than those from the other two water discharge ports, the second water discharge port 32B and the third water discharge port 32C. The "discharge amount of washing water" used in this specification means the flow amount of washing water passing through a water discharge port per unit time (L/s).

[0049] In order to satisfy such a magnitude relationship in the respective discharge amounts of washing water from the water discharge ports 32A-32C, the water discharge portion 36 is formed as follows. Water passages routes, inside the water passage portion 38, to each of the water discharge ports 32A-32C from the inflow position Pa (see Fig. 3) of washing water from the washing water supply device are now considered. Regarding the water passage routes, it is assumed that there are water passage routes that correspond to the first water discharge port 32A through the third water discharge port 32C, respectively. The magnitude of the discharge amount of washing water from a water discharge port is proportional to the passage cross-sectional area of a part having the smallest passage cross-sectional area (hereinafter, referred to as a flow amount setting part) in a water passage route for supplying washing water to the water discharge port. In the present embodiment, the flow amount setting part of the first water discharge port 32A is the first water discharge port 32A itself, which is located at the downstream end of the water passage route of the first water discharge port 32A. The flow amount setting part of the second water discharge port 32B is the second water discharge port 32B itself as well, and the flow amount setting part of the third water discharge port 32C is also the third water discharge port 32C itself as well.

[0050] The water discharge portion 36 is formed such that the opening area, which is the passage cross-sectional area, of the first water discharge port 32A is the largest, the opening area of the second water discharge port 32B is the second largest, and the opening area of the third water discharge port 32C is the smallest. In other words, the water discharge portion 36 is formed such that the opening areas become smaller in the order of the first water discharge port 32A, the second water discharge port 32B, and the third water discharge port 32C. From another perspective, the water discharge portion 36 is formed such that the opening area of the first water discharge port 32A is larger than those of the second water discharge port 32B and the third water discharge port 32C. The word "opening area (passage cross-sectional area)" used in this specification means a cross-sectional area of a cross section that is perpendicular to the water flow direction. This allows the water discharge portion 36 to be formed such that a magnitude relationship in the respective discharge amounts of washing water from the water discharge ports 32A-32C is the same as a magnitude relationship in the respective opening areas of the water discharge ports 32A-32C.

[0051] Fig. 8 is a diagram showing the respective inner circumferential lengths Lb1-Lb3 of the rim water leading passages 34A-34C of the rim portion 28. The word "inner circumferential lengths" used in this specification means, in a horizontal cross section that passes through the rim portion 28, the respective lengths of inner circumferential surfaces in respective ranges from the water discharge ports 32A-32C located at the respective start positions of the rim water leading passages 34A-34C to the respective end positions 34Aa-34Ca of the rim water leading passages 34A-34C. For example, the inner circumferential length Lb1 of the first rim water leading passage 34A is the length of an inner circumferential surface in a range from the first water discharge port 32A to the end position 34Aa of the first rim water leading passage 34A.

[0052] The rim portion 28 is formed such that the inner circumferential length Lb1 of the first rim water leading passage 34A becomes the largest, the inner circumferential length Lb2 of the second rim water leading passage

34B becomes the second largest, and the inner circumferential length Lb3 of the third rim water leading passage 34C becomes the shortest. In other words, the rimportion 28 is formed such that the inner circumferential lengths become shorter in the order of the inner circumferential length Lb1, the inner circumferential length Lb2, and the inner circumferential length Lb3. The ratio of these inner circumferential lengths Lb1, Lb2, and Lb3 is, for example, Lb1:Lb2:Lb3 = 5:3:2.

[0053] The water discharge portion 36 is formed such that a magnitude relationship in the respective discharge amounts of washing water from the three water discharge ports 32A-32C is the same as a magnitude relationship in the respective inner circumferential lengths Lb1-L3 of the first rim water leading passage 34A through the third rim water leading passage 34C, which connect to the three water discharge ports 32A-32C, respectively. For example, the first water discharge port 32A connecting to the first rim water leading passage 34A with the longest inner circumferential length Lb1 discharges the largest discharge amount of washing water. Further, the third water discharge port 32C connecting to the third rim water leading passage 34C with the shortest inner circumferential length Lb3 discharges the smallest discharge amount of washing water.

[0054] More specifically, the water discharge portion 36 is formed so as to satisfy a relationship where the ratio of the respective discharge amounts of washing water from the three water discharge ports 32A-32C equals the ratio of the respective inner circumferential lengths Lb1-Lb3 of the first rim water leading passage 34A through the third rim water leading passage 34C, which connect to the three water discharge ports 32A-32C, respectively. For example, when the ratio of the inner circumferential lengths Lb1-Lb3 is 5:3:2, the water discharge portion 36 is formed so as to satisfy a relationship where the ratio of the respective discharge amounts of washing water from the three water discharge ports 32A-32C equals 5:3:2. The water discharge portion 36 is formed so as to satisfy a relationship where the ratio of the respective discharge amounts of washing water from the three water discharge ports 32A-32C equals the ratio of the respective opening areas of the three water discharge ports 32A-32C.

[0055] According to the previously-stated features, the discharge amount of washing water from the first water discharge port 32A is larger than those from the other water discharge ports, which are the second water discharge port 32B and the third water discharge port 32C, and the main flow Fw can therefore be easily formed inside the toilet bowl portion 14 by washing water discharged from the first water discharge port 32A. Thus, by adjusting, for example, the respective positions and the respective discharge directions of washing water of the water discharge ports 32A-32C, the way the main flow Fw flows inside the toilet bowl portion 14 can be set in various ways, and the degree of freedom of a washing mode by means of washing water can be increased.

[0056] Further, the water discharge portion 36 is formed such that a magnitude relationship in the respective discharge amounts of washing water from the three water discharge ports 32A-32C is the same as a magnitude relationship in the respective inner circumferential lengths of the first rim water leading passage 34A through the third rim water leading passage 34C, which connect to the three water discharge ports 32A-32C, respectively. Therefore, a large amount of washing water can flow through the first rim water leading passage 34A with a long inner circumferential length, and a sufficient amount of washing water can thus easily reach the entire first rim water leading passage 34A. Further, by allowing a small amount of washing water to flow through the third rim water leading passage 34C with a small inner circumferential length, the amount of washing water used in the third rim water leading passage 34C can be reduced. Therefore, while obtaining favorable rim washing capability by allowing a sufficient amount of washing water to reach the entire inner circumferential surface of the rimportion 28, the amount of washing water used for the washing of the entire inner circumferential surface of the rim portion 28 can be easily reduced.

[0057] Also, since the first water discharge port 32A, which discharges washing water in an amount that is larger than those from the other two water discharge ports 32B and 32C, is provided in the first divided region on the rear side, the following advantages can be achieved. It is necessary to ensure that the passage cross-sectional area of the right side water passage 38b, which supplies washing water to the first water discharge port 32A, is larger than that of the left side water passage 38c in order for the discharge amount of washing water from the first water discharge port 32A to be larger than those from the other water discharge ports 32B and 32C. According to the present embodiment, since the first water discharge port 32A with a large discharge amount of washing water is provided in the rear side divided region, the longitudinal dimension of the right side water passage 38b with a large passage cross-sectional area can be reduced compared to a case where the first water discharge port 32A is provided in the front side divided region, and the size of the water discharge portion 36 can thus be easily reduced. Therefore, while obtaining favorable rim washing capability, waste discharging capability, and toilet bowl washing capability, the size of the entire water discharge portion 36 can be easily reduced.

[0058] The water discharge portion 36 is formed such that the total amount of the respective discharge amounts of washing water (hereinafter, also referred to as a total discharge amount) from the first water discharge port 32A and the second water discharge port 32B is higher than the discharge amount of washing water from the third water discharge port 32C. Thereby, washing water in an amount that is equal to or more than half of the total amount of washing water used for a single washing action can be expected to be used for the formation of the main flow Fw. Thus, the flow amount of the main flow Fw having

a strong force of water can be increased, and, by washing the receiving surface portion 26 of the toilet bowl portion 14 with the main flow Fw having a strong force of water and a large flow amount, more favorable toilet bowl washing capability can be obtained. Further, by washing away waste inside the toilet bowl portion 14 to the inlet 16 of the trap portion 18 by the main flow Fw having a strong force of water and a large flow amount, particularly favorable waste discharging performance can be obtained. From a perspective of obtaining such operational effects, the water discharge portion 36 is preferably formed such that the ratio of the total discharge amount discharged from the first water discharge port 32A and the second water discharge port 32B with respect to the total amount of washing water used for a single washing action is 60 percent to 80 percent. The expression "the total amount of washing water" used in this specification means the same as the total amount of the respective discharge amounts of washing water from the first water discharge port 32A through the third water discharge port 32C.

[0059] Further, the water discharge portion 36 is preferably formed such that the ratio of the discharge amount of washing water from the first water discharge port 32A with respect to the total amount of washing water used for a single washing action is 40 percent to 60 percent.

[0060] An explanation will be given now regarding still other features for the first water discharge port 32A through the third water discharge port 32C. As shown in Fig. 3, the first water discharge port 32A through the third water discharge port 32C are separately formed respectively in the third divided region Sr3 located on the downstream side in the swirling flow swirling direction Da out of the second divided region Sr2 and the third divided region Sr3, which are the two front-side divided regions, and the first divided region Sr1 and the fourth divided region, which are the two rear-side divided regions. In other words, the first water discharge port 32A through the third water discharge port 32C are not formed in the second divided region Sr2 located on the upstream side in the swirling flow swirling direction Da out of the second divided region Sr2 and the third divided region Sr3, which are the two front-side divided regions.

[0061] An explanation will now be given regarding the advantages thereof. Fig. 9A is a diagram showing a toilet main body 12 according to a first exemplary variation. In the present exemplary variation, a second water discharge port 32B is formed in a second divided region Sr2. When a user urinates while sitting on a toilet seat of a flush toilet 10, urine that is received by a receiving surface portion 26 of a toilet bowl portion 14 may scatter around (see a direction Df). If scattered urine hits an inner circumferential surface region including a lateral center position 28a on the front side of a rim portion 28, it is possible that the urine enters the inside of a right side water passage 38b from the second water discharge port 32B due to the urine spreading in this inner circumferential surface region along the circumferential direction at this time.

[0062] Regarding this point, according to the present embodiment, as shown in Fig. 9A, when urine hits the inner circumferential surface region including the lateral center position 28a on the front side of the rimportion 28, it is difficult for the urine spreading in this inner circumferential surface region along the circumferential direction to enter the inside of a left side water passage 38c from the second water discharge port 32B. Therefore, the possibility of urine constituents remaining in the inside of the second water discharge port 32B (the inside of a water passage portion 38 of a water discharge portion 36) can be lowered, and the generation of dirt and odor can be prevented accordingly. Therefore, favorable cleanliness can be achieved while obtaining favorable rim washing capability.

[0063] According to the previously-described configuration, the following advantages can be also achieved. Fig. 10 is a diagram showing the toilet main body 12 according to the first exemplary variation of Fig. 9A. Centrifugal force Fc directed outward in the radial direction is applied to washing water flowing along the inner circumferential surface of the toilet bowl portion 14. This centrifugal force Fc becomes larger as the curvature radius of apart through which the washing water is flowing becomes smaller, and as this centrifugal force becomes larger, the force of water of a water flow flowing toward the inlet 16 of the trap portion 18 becomes weakened more easily.

[0064] A case is taken into consideration where the second water discharge port 32B is supposedly provided in the second divided region Sr2. In this case, washing water discharged from the water discharge port 32 flows via an inner circumferential surface region located at the lateral center position Pa on the front side of the rim portion 28. Usually, this inner circumferential surface region located at the lateral center position Pa is likely to have a curvature radius that is smaller than those at other positions since the toilet bowl portion 14 is formed in an elliptical shape where the longitudinal dimension is larger than the lateral dimension. Therefore, when the second water discharge port is provided in the second divided region Sr2, the force of washing water discharged from the second water discharge port 32B is easily weakened by the centrifugal force Fc.

[0065] Regarding this point, according to the present embodiment, the second water discharge port 32B is arranged in the third divided region Sr3, thus allowing washing water discharged from the second water discharge port 32B to flow toward the inlet 16 of the trap portion 18 without passing through the inner circumferential surface region with a small curvature radius located at the lateral center position Pa of the rim portion 28. Therefore, the force of water of the main flow Fw formed by the washing water discharged from the second water discharge port 32B is not likely to weakened by the centrifugal force Fc, and more favorable toilet bowl washing capability and waste discharging capability can be obtained compared to a case where the second water discharge port 32B is

arranged in the second divided region Sr2.

[0066] An explanation will now be given regarding other features of the flush toilet 10. Fig. 3 is referred back. The left side water passage 38c, which supplies washing water to the second water discharge port 32B, is formed so as to extend along the longitudinal direction on the back side of the left side portion 28L. This left side water passage 38c is formed on the back side of the left side portion 28L, out of the left side portion 28L and the right side portion 28R of the rim portion 28, on the side of the third divided region Sr3 in which the second water discharge port 32B is formed. This left side water passage 38c is formed such that the left side water passage 38c crosses the longitudinal center line Lb on the back side of the left side portion 28L in a planar view. From another perspective, the left side water passage 38c is not formed such that the left side water passage 38c crosses the longitudinal center line Lb on the back side of the right side portion 28R of the rim portion 28. An explanation will now be given regarding the advantages thereof.

[0067] According to the previously-described configuration, the left side water passage 38c can be arranged in a layout where the left side water passage 38c does not pass through the back side of the lateral center position Pb on the front side of the rimportion 28. Therefore, compared to a case where a water passage is arranged so as to pass through the back side of the lateral center position Pb of the rim portion 28, a water passage route from the inflow position Pa of washing water can be shortened, and washing water with a strong force of water can be discharged from the second water discharge port 32B. As a result of this, more favorable rim washing capability, toilet bowl washing capability, and waste discharging capability can be obtained. This effect can be obtained more effectively as the position of the second water discharge port 32B becomes closer to the rear side of the third divided region Sr3 of the toilet bowl portion 14.

[0068] If the water passage is arranged so as to pass through the back side of the lateral center position Pb of the rim portion 28, a water passage for the first water discharge port 32A and a water passage for the second water discharge port 32B need to be arranged next to each other in the lateral direction on the back side of the right side portion 28R of the rim portion 28. Regarding this point, according to the previously-described configuration, the right side water passage 38b for the first water discharge port 32A and the left side water passage 38c for the second water discharge port 32B do not need to be arranged next to each other in the lateral direction on the back side of the right side portion 28R of the rim portion 28. Therefore, the width dimension of a back side portion of the right side portion 28R of the rim portion 28 can be reduced. Thereby, as shown in Figs. 1 and 2, the width dimension of a side portion 12b, in an upper surface portion 12a of the toilet main body 12, extending laterally from the upper edge of the toilet bowl portion 14 can be reduced.

[0069] On the inner circumferential surface of the second rim water leading passage 34B, a straight line section 34Bb is formed extending in a linear fashion at a position away from the second water discharge port 32B in the swirling flow swirling direction Da. In a range continuing from the second water discharge port 32B to the straight line section 34Bb on the inner circumferential surface of the second rim water leading passage 34B, a curvature reduction section 34Bc is formed, which is formed such that the curvature becomes smaller as the distance from the second water discharge port 32B becomes increased. Also, on the inner circumferential surface of the third rim water leading passage 34C, a straight line section 34Cb is formed extending in a linear fashion at a position away from the third water discharge port 32C in the swirling flow swirling direction Da. In a range continuing from the third water discharge port 32C to the straight line section 34Cb on the inner circumferential surface of the third rim water leading passage 34C, a curvature reduction section 34Cc is also formed, which is formed such that the curvature becomes smaller as the distance from the third water discharge port 32C becomes increased.

[0070] As described, the curvature reduction sections 34Bc and 34Cb continuing from the water discharge ports 32B and 32C, respectively, are formed on the respective inner circumferential surfaces of the rim water leading passages 34B and 34C. Therefore, washing water with a strong force obtained immediately after having been discharged from the water discharge ports 32B and 32C flows in the respective sections with a large curvature radius in respective ranges from where the washing water has been discharged from the respective water discharge ports 32B and 32C to where the washing water passes through the straight line sections 34Cb and 34Ca. Therefore, a water flow heading toward the inlet 16 of the trap portion 18 after having been discharged from the water discharge ports 32B and 32C is hard to be weakened compared to the state of the water flow obtained immediately after having been discharged from the water discharge ports 32B and 32C with a strong force of water. As a result, waste is pushed down by a water flow having such a strong force of water, and more favorable waste discharging performance can thus be obtained.

[0071] Fig. 11A is a diagram showing the structure around the second water discharge port 32B according to the embodiment. The second water discharge port 32B is formed partially by a standing wall portion 34b located inside (hereinafter, also referred to as an inner standing wall portion 34b (1)) and a standing wall portion 34b located outside (hereinafter, also referred to as an outer standing wall portion 34b (2)) that are adjacent to each other in the radial direction of the toilet bowl portion 14. Of the two standing wall portions 34b, a circumferential end portion 34ba of the outer standing wall portion 34b (2) and a circumferential end portion 34bb of the inner standing wall portion 34b(1) are arranged being lined up on a virtual line Lc extending from a central point Cp of the toilet bowl portion 14. The expression "lined up" in

this specification includes a case where the two standing wall portions 34b are lined up overlapping with each other in an angle range of three degrees or less in the circumferential direction when viewed from the central point Cp of the toilet bowl portion 14. The two standing wall portions 34b can be also considered to be arranged overlapping with each other in an angle range of three degrees or less in the circumferential direction when viewed from the central point Cp of the toilet bowl portion 14. An explanation will now be given regarding the advantages thereof.

[0072] Fig. 11B is a diagram showing the structure around a second water discharge port 32B according to a second exemplary variation. Supposedly, a case is taken into consideration where, as shown in Fig. 11B, the circumferential end portions 34ba and 34bb are not lined up on the virtual line Lc such that the two standing wall portions 34b are overlapped with each other in a larger angle range in the circumferential direction. In this case, separate water passage portions 40 respectively connecting to the upstream end and the downstream end of a turned-back portion 38ca are formed being lined up in the radial direction. Since, for example, a rim water leading passage 34A is formed on the inward side in the radial direction with respect to the turned-back portion 38ca, two inner wall surfaces 38f facing each other in the radial direction at the turned-back portion 38ca are likely to be formed to become narrower toward an end position 38g at the turned-back portion 38ca. Therefore, the water passage portions 40 are also likely to be formed to have a narrower width dimension toward the turned-back portion 38ca. Therefore, a section with a passage cross-sectional area that is smaller than that of the second water discharge port 32B is likely to be formed on each side of the inner standing wall portion 34b in a route Rb from the longitudinally extending portion 38cb of the left side water passage 38c to the second water discharge port 32B via the turned-back portion 38ca (see a range Sc). As a result, it is difficult to design such that a part with the smallest passage cross-sectional area in a water passage route that connects to the second water discharge port 38B, that is, the previously-described flow amount setting part becomes the second water discharge port 32B.

[0073] On the other hand, as described previously, when the circumferential end portions 34ba and 34bb of the respective two standing wall portions 34b are formed to be lined up on the virtual lineLc, separate water passage portions 40 respectively connecting to the upstream end and the downstream end of the turned-back portion 38ca are unlikely to be formed being lined up in the radial direction. Thereby, a section with a passage cross-sectional area that is smaller than that of the second water discharge port 32B is unlikely to be formed in the previously-described route Rb, and a design is likely to be made where the second water discharge port 32B is the flow amount setting part.

[0074] The second water discharge port 32B is formed in the third divided region Sr3 on the front side of the toilet bowl portion 14 and is thus located at a position that is difficult for a user to visually recognize at the time of the normal use. Therefore, even in a case of a structure where the circumferential end portion 34ba and 34bb of the respective two standing wall portions 34b forming the second water discharge port 32B are arranged to be lined up and where, in some cases, the inside can be viewed through the second water discharge port 32B, a decrease in the design can be prevented by making it difficult to visually recognize the second water discharge port 32B itself. The expression "at the time of the normal use" used in this specification means a situation where a user approaches a flush toilet 10 from the front side and then sits on the toilet seat to use the toilet.

[0075] Fig. 12 is a diagram showing the structure around the third water discharge port 32C. In a planar view, the width dimension of the left side water passage 38c at a position where the left side water passage 38c and the longitudinal center line Lb overlap with each other is denoted as W1. In the left side water passage 38c, a width changing region 38h is formed such that the width dimension thereof becomes larger gradually toward the back side from the longitudinal center line Lb. In this width changing region 38h, when a position 38i where a width dimension W2, which is twice the size of the width dimension W1, is obtained is referred to as a reference position 38i, the third water discharge port 32C is formed on the back side of this reference position 38i. If the third water discharge port 32C is formed on the front side of the reference position 38i (for example, a range Sd), since it is necessary to secure a wall portion for guiding washing water to the third water discharge port 32C around the position, a water passage from around the position to the second water discharge port 32B is likely to become narrow. On the other hand, when the third water discharge port 32C is formed on the back side of the reference position 38i, the water passage to the second water discharge port 32B is unlikely to become narrow due to the wall portion for guiding washing water to the third water discharge port 32C, and a sufficient amount of washing water can be easily supplied to the second water discharge port 32B.

[0076] While the first invention has been described based on the embodiment, the embodiment is merely illustrative of the principles and applications of the first invention. Additionally, many variations and changes in arrangement may be made in the embodiment without departing from the spirit of the first invention as defined by the appended claims.

[0077] For the flush toilet 10, an example has been explained where a wash down type is used for the washing technique. Alternatively, the inside of the toilet bowl portion 14 may be washed by a washing technique of a combination of other techniques of a siphon type, a siphon jet type, and the like. For the flush toilet 10, an example has been explained where a water supply direct pressure type is used for the water supply technique. In

addition to this, a water supply technique of a gravity water supply type where the gravity is used, a flush valve type, or the like may be used. The toilet main body 12 has been explained with using a wall mounted type toilet as an example. Alternatively, the toilet main body 12 may be a floor mounted type toilet, which is installed on the floor of a toilet room. Also, other than ceramics, a resin, etc., may be used as a material of the toilet main body 12.

[0078] Further, the respective shelf portions 34a of the rim water leading passages 34 only need to be formed such that the slope of upper surface portions thereof connecting to the upper edge 26a of the receiving surface portion 26 is more gentle than the slope of an inner surface portion of the receiving surface portion 26 connecting to the upper edge 26a of the receiving surface portion 26. As long as such a condition is satisfied, the respective upper surface portions of the shelf portions 34a may be formed in a planar shape as shown in Fig. 1, etc., or may be formed in an arc-like shape. The rim water leading passages 34 may be formed such that the shape of a vertical cross section that is perpendicular to a swirling flow swirling direction D is a curved surface shape where the upper surface portions of the respective shelf portions 34a of the rim water leading passages 34 and lower surface portion of the respective overhanging portions 34c are continuous with each other. The rim water leading passages 34 may not be provided with the overhanging portion 34c. An example has been explained where the three rim water leading passages 34A-34C are formed in a divided manner at the end positions 34Aa, 34Ba, and 34Ca without being continuous with other rim water leading passages. Alternatively, the rim water leading passages 34A-34C maybe formed to be continuous with other rim water leading passages.

[0079] From a perspective of obtaining the previously-described operational effect (1), the three water discharge ports 32A-32C need to be separately formed respectively in three divided regions out of the four divided regions Sr1-Sr4. From this perspective, the respective positions of the three water discharge ports 32A-32C are not limited to the details in the embodiment.

[0080] Figs. 13 are schematic diagrams showing examples of patterns for arranging water discharge ports 32A-32C, which can achieve the operational effect (1). From a perspective of obtaining the operational effect (1), for example, as shown in Fig. 13A, the first water discharge port 32A, the second water discharge port 32B, and the third water discharge port 32C may be formed in the first divided region Sr1, the second divided region Sr2, and the fourth divided region Sr4, respectively. Further, as shown in Fig. 13B, the first water discharge port 32A, the second water discharge port 32B, and the third water discharge port 32C may be formed in the first divided region Sr1, the second divided region Sr2, and the third divided region Sr3, respectively. Also, as shown in Fig. 13C, the first water discharge port 32A, the second water discharge port 32B, and the third water discharge port 32C may be formed in the second divided region Sr2, the third divided region Sr3, and the fourth divided region Sr4, respectively. As described, the first water discharge port 32A, which discharges the largest discharge amount of washing water, may be formed in a divided region on the front side instead of a divided region on the rear side. In either case, a water discharge port is not formed in one of the four divided regions Sr1-Sr4, and the water discharge ports are separately formed in the other three divided regions.

[0081] The three water discharge ports 32A-32C need to be formed such that at least one of the water discharge ports 32A-32C is included in each of three divided regions of the four divided regions Sr1-Sr4, and the three water discharge ports 32A-32C may be formed so as to cross divided regions that are adjacent to each other. For example, while the second water discharge port 32B and the third water discharge port 32C are formed in the third divided region Sr3 and the fourth divided region Sr4, respectively, the first water discharge port 32A may be formed across the first divided region Sr1 and the second divided region Sr2. Alternatively, the second water discharge port 32B may be formed across an adjacent divided region, and the third water discharge port 32C may be formed across an adjacent divided region. From a perspective of obtaining the previously-described operational effect (1), the three water discharge ports 32A-32C may be arranged so as to be apart from one another in an angle range of one fourth or more of a round when viewed from the central point Cp of the toilet bowl portion 14. The respective discharge amounts of washing water from the three water discharge ports 32A-32C and the respective opening areas of the three water discharge ports 32A-32C are not limited to the details in the embodiment. For example, the respective discharge amounts of washing water from the three water discharge ports 32A-32C may be set to be the same, or the respective discharge amounts of washing water from two water discharge ports out of the three water discharge ports 32A-32C may be set to be the same.

[0082] From a perspective of obtaining the previously-described operational effect (2), the formation of the three water discharge ports 32A-32C is not essential, and at least two water discharge ports need to be formed. It is assumed that the toilet bowl portion 14 has two divided regions sectioned by the longitudinal center line Lb. In light of the example of Fig. 3, the two divided regions mentioned here are as follows: one is formed of the first divided region Sr1 and the fourth divided region Sr4; and the other one is formed of the second divided region Sr2 and the third divided region Sr3. In this case, the two water discharge ports need to include the first water discharge port 32A formed in either one of the two divided regions Sr1-Sr4 and the second water discharge port 32B formed in a divided region on the front side. In this case, the second water discharge port 32B may be formed in a divided region that is the same as a divided region in which the first water discharge port 32A is formed or may be formed in another divided region. The respective po-

sitions of these two water discharge ports 32A and 32B are not limited to the details in the embodiment.

[0083] Figs. 14 are schematic diagrams showing examples of patterns for arranging the water discharge ports 32A and 32B, which can achieve the operational effect (2). From a perspective of obtaining the operational effect (2), for example, as shown in Fig. 14A, the first water discharge port 32A and the second water discharge port 32B may be formed in the first divided region Sr1 and the third divided region Sr3, respectively. Also, as shown in Fig. 14B, the first water discharge port 32A and the second water discharge port 32B may be formed in the second divided region Sr2 and the third divided region Sr3, respectively. Alternatively, as shown in Fig. 14C, the third water discharge port 32C may be further formed in the fourth divided region Sr4.

[0084] Also, an example has been explained where the water discharge ports 32A-32C of the rim portion 28 of the toilet bowl portion 14 are arranged such that the respective positions of the water discharge ports 32A-32C overlap with one another in the vertical direction. Alternatively, the water discharge ports 32A-32C of the rimportion 28 maybe arranged at respective positions where any one of the water discharge ports 32A-32C or all of the water discharge ports 32A-32C do not overlap in the vertical direction and are shifted from one another in the vertical direction. In this case, the longitudinal center line Lb of the toilet bowl portion 14 is determined by a straight line extending along the lateral direction bisecting a longitudinal dimension of the inner surface portion of the toilet bowl portion 14 in a planar view of a horizontal cross section that passes through the lowest water discharge port.

[0085] As described previously, the water discharge portion 36 is formed such that washing water discharged from the first water discharge port 32A and washing water discharged from the second water discharge port 32B merge with each other so as to form the main flow Fw, which heads toward the inlet 16 of the water drain passage portion. The water discharge portion 36 is formed to form such a main flow Fw by adjusting the respective positions of the water discharge ports 32A and 32B and the respective discharge amounts and discharge directions of washing water from the water discharge ports 32A and 32B.

[0086] Also, an example has been explained where the timing for starting the discharge of washing water (hereinafter, referred to as discharge start timing) from the first water discharge port 32A and that of washing water from the third water discharge port 32C are equal. This discharge start timing needs to be earlier than the discharge start timing for washing water from the second water discharge port 32B, and the discharge start timing of the first water discharge port 32A and the discharge start timing of the third water discharge port 32C may be off from each other.

[0087] Also, an example has been explained where the water discharge portion 36 adjusts the respective passage cross-sectional areas of the water passage routes respectively corresponding to the water discharge ports 32A-32C in order to adjusts the respective discharge amounts of washing water from the water discharge ports 32A-32C. Alternatively, the respective discharge amounts of washing water may be adjusted by throttle valves or the like that are provided in the middle of the respective water passage routes for the water discharge ports 32A-32C. Further, in order to adjust the timing for starting the discharge of washing water from each of the water discharge ports 32A-32C, a valve mechanism such as an electricity-driven valve, etc., may be used.

[0088] The following technical ideas are derived by generalizing the first invention embodied according to the above embodiments and exemplary variations.

[0089] In a flush toilet according to a second embodiment of the first invention, in the first embodiment, the three water discharge ports may include a first water discharge port that discharges washing water in an amount that is larger than those from the other two water discharge ports. According to this embodiment, a main flow can be easily formed inside the toilet bowl portion by washing water discharged from the first water discharge port. Thus, by adjusting, for example, the respective positions and the respective discharge directions of washing water of the three water discharge ports, the way the main flow flows inside the toilet bowl portion can be set in various ways, and the degree of freedom of a washing mode by means of washing water can be increased.

[0090] In a flush toilet according to a third embodiment of the first invention, in the second embodiment, a first water discharge port may be provided in a divided region on the rear side out of four divided regions. It is necessary to ensure that the passage cross-sectional area of a water passage that supplies washing water to the first water discharge port is larger than those of the other water discharge ports in order for the discharge amount of washing water from the first water discharge port to be larger than those from the other water discharge ports. According to the present embodiment, since the first water discharge port with a large discharge amount of washing water is provided in a rear side divided region, the longitudinal dimension of the water passage with a large passage cross-sectional area can be reduced compared to a case where the first water discharge port is provided in a front side divided region, and the size of a water discharge portion can thus be easily reduced. Therefore, while obtaining favorable rim washing capability, the size of the entire water discharge portion can be easily reduced.

[0091] In a flush toilet according to a fourth embodiment of the first invention, in the second or third embodiment, in a divided region adjacent, on one side in the circumferential direction, to a divided region where a first water discharge port is formed out of four divided regions, the other two water discharge ports do not need to be formed.

[0092] A flush toilet according to a fifth embodiment of

the first invention, in any of the first embodiment through the fourth embodiment, may be formed such that a rim portion has three rim water leading passages formed so as to extend toward one side in the circumferential direction from three water discharge ports, respectively, and that, in a water discharge portion, the magnitude relationship in the respective discharge amounts of washing water from the three water discharge ports is the same as the magnitude relationship in the respective inner circumferential lengths of the three rim water leasing passages being respectively continuous with the three discharge ports. According to this embodiment, a large amount of washing water can flow through a rim water leading passage with a long inner circumferential length, and a sufficient amount of washing water can thus easily reach the entire rim water leading passage. Further, by allowing a small amount of washing water to flow through a rim water leading passage with a small inner circumferential length, the amount of washing water used in the rim water leading passage can be reduced. Therefore, while obtaining favorable rim washing capability by allowing a sufficient amount of washing water to reach the entire inner circumferential surface of the rim portion, the amount of washing water used for the washing of the entire inner circumferential surface of the rim portion can be easily reduced.

[0093] A flush toilet according to a sixth embodiment of the first invention, in any of the first embodiment through the fifth embodiment, may be formed such that in a water discharge portion, a magnitude relationship in the respective discharge amounts of washing water from the three water discharge ports is the same as a magnitude relationship in the respective opening areas of the three discharge ports.

[0094] In a flush toilet according to a seventh embodiment of the first invention, in any of the first embodiment through the sixth embodiment, three water discharge ports maybe separately formed respectively in a divided region on one side in the circumferential direction out of two front side divided regions and two rear side divided regions. According to this embodiment, when urine hits the inner circumferential surface region including the lateral center position on the front side of the rim portion, it is difficult for the urine spreading along this inner circumferential surface region to enter the inside through the second water discharge port. Therefore, the possibility of urine constituents remaining in the inside of the water discharge port can be lowered, and the generation of dirt and odor can be prevented accordingly.

[0095] A flush toilet according to an eighth embodiment of the first invention, in any of the first embodiment through the seventh embodiment, may be formed such that one of three water discharge ports is provided in a divided region on one side in the circumferential direction out of two front side divided regions, such that a water discharge portion has a water passage that supplies washing water to a single water discharge port, and such that the water passage extends along the longitudinal direction on the back side of a side portion on the side where a divided region on one side in the circumferential direction is present out of side portions on the left and right sides of a rim portion. According to this embodiment, the water passage can be arranged in a layout where the water passage does not pass through the back side of the lateral center position on the front side of the rim portion. Therefore, compared to a case where the water passage is arranged so as to pass through the back side of the lateral center position on the front side of the rim portion, a water passage route for supplying washing water to the single water discharge port can be shortened, and washing water with a strong force can be discharged from the single water discharge port. As a result of this, more favorable rim washing capability can be obtained.

[0096] In a flush toilet according to a ninth embodiment of the first invention, in the eighth embodiment, a turned-back portion that leads washing water supplied from the upstream side to make a turn toward a single water discharge port may be formed at a downstream end portion of the water passage, the single water discharge port may be formed partially by two wall portions that are adjacent to each other in the radial direction of the toilet bowl portion, and the respective circumferential end portions of the two wall portions may be arranged to be lined up on a virtual line extending from a central point of the toilet bowl portion. According to this embodiment, separate water passage portions that respectively connect to the upstream end and the downstream end of the turned-back portion on the inner side of the single water discharge port are not likely to be formed being lined up in the radial direction. Thereby, it is easy to design such that a part having the smallest passage cross-sectional area in a water passage route that supplies washing water to the water discharge port becomes the single water discharge port.

[0097] A flush toilet according to a tenth embodiment of the first invention, in any one of the first embodiment through the ninth embodiment, may be formed such that the toilet main body has a water drain passage portion that communicates with the inside of the toilet bowl portion via an inlet formed on the bottom of the toilet bowl portion, such that the three water discharge ports include a first water discharge port formed in any one of the divided regions and a second water discharge port formed in a divided region on the front side, and such that the water discharge portion is formed such that washing water discharged from the first water discharge port and washing water discharged from the second water discharge port merge with each other so as to form a main flow that heads toward the inlet. According to this embodiment, the main flow heading to the inlet of the water drain passage portion is formed by the merging of washing water discharged from the first water discharge port and washing water discharged from the second water discharge port. Since this second water discharge port is in a divided region on the front side, the route of washing water flowing from the second water discharge port

to the inlet of the water drain passage portion can be shortened in comparison with a case where the second water discharge port is provided in a divided region on the rear side. As a result, the force of water of the main flow formed by the washing water discharged from the second water discharge port becomes strong, and by washing away waste inside the toilet bowl portion to the inlet of the water drain passage portion by the main flow having a strong force of water, favorable waste discharging performance can be obtained.

[0098] In a flush toilet according to an eleventh embodiment of the first invention, in the tenth embodiment, a water discharge port may have a third water discharge port formed on the rim portion in a divided region on the rear side out of two divided regions, .

[0099] In a flush toilet according to a twelfth embodiment of the first invention, in the eleventh embodiment, the first water discharge port, the second water discharge port, and the third water discharge port may be arranged in order on one side in the circumferential direction, and the water discharge portion may be formed such that the total amount of the respective discharge amounts of washing water from the first water discharge port and the second water discharge port is higher than the discharge amount of washing water from the third water discharge port. According to this embodiment, washing water in an amount that is equal to or more than half of the total amount of washing water used for a single washing action can be expected to be used for the formation of the main flow. Therefore, by washing away waste inside the toilet bowl portion to the inlet of the water drain passage portion by the main flow having a strong force of water and a large flow amount, particularly favorable waste discharging performance can be obtained.

[0100] In a flush toilet according to a thirteenth embodiment of the first invention, in the eleventh or twelfth embodiment, the water discharge portion may be formed such that washing water is discharged from the second water discharge port after washing water is discharged from the first water discharge port and the third water discharge port. An increase in the ratio of the flow amount of the main flow with respect to the total amount of washing water used for a single washing action allows the waste discharging capability to be increased without increasing the amount of the entire washing water. According to the present embodiment, the amount of washing water that is discharged from the second water discharge port and then flows into the inlet without merging can be reduced, and the ratio of the flow amount of the main flow with respect to the total amount of washing water can thus be increased. Therefore, the waste discharging capability can be improved due to an increase in the ratio of the flow amount of the main flow.

[0101] In a flush toilet according to a fourteenth embodiment of the first invention, in any one of the tenth embodiment through the thirteenth embodiment, the toilet bowl portion may have four divided regions sectioned by a lateral center line that bisects the lateral dimension of an outer surface portion of the toilet main body and by a longitudinal center line in a planar view, and the second water discharge port may be formed in a divided region on one side in the circumferential direction out of two front side divided regions. The present embodiment allows washing water discharged from the second water discharge port to flow toward the inlet of the water drain passage portion without passing through an inner circumferential surface region with a small curvature radius located at a lateral center position of the toilet bowl portion. Therefore, the force of water of the main flow formed by the washing water discharged from the second water discharge port is not likely to be weakened by the centrifugal force, and more favorable waste discharging capability can be obtained compared to a case where the second water discharge port is formed in a divided region on the other side in the circumferential direction out of the two front side divided regions.

[0102] In a flush toilet according to a fifteenth embodiment of the first invention, the water discharge port may be formed such that washing water discharged from the first water discharge port and washing water discharged from the second water discharge port merge with each other on the inner circumferential surface of the toilet bowl portion so as to form a main flow that heads toward the inlet, in any one of the tenth embodiment through the fourteenth embodiment. According to the present embodiment, the inner circumferential surface of the toilet bowl portion can be washed by the main flow having a strong force of water, and favorable toilet bowl washing performance can be obtained.

[0103] Also, when the invention embodied according to the above embodiments and exemplary variations is generalized, it can be also considered that the invention according to the following item is included.

(First item)

[0104] A flush toilet comprising:

a toilet main body having: a toilet bowl portion; a water drain passage portion that communicates with the inside of the toilet bowl portion via an inlet formed on the bottom of the toilet bowl portion; and a water discharge portion for discharging washing water to the inside of the toilet bowl portion,

wherein the toilet bowl portion has a receiving surface portion for receiving waste and a rim portion that is connected to an upper edge portion of the receiving surface portion,

wherein the water discharge portion has two water discharge ports formed in the rim portion and discharges washing water on one side in a circumferential direction to the inside of the toilet bowl portion from the two water discharge ports,

wherein the toilet bowl portion has two divided regions sectioned by a longitudinal center line that bisects the longitudinal dimension of an inner surface

portion of the toilet bowl portion in a planar view,
wherein the two water discharge ports include a first water discharge port formed in any one of the two divided regions and a second water discharge port formed in a divided region on the front side, and
wherein the water discharge portion is formed such that washing water discharged from the first water discharge port and washing water discharged from the second water discharge port merge with each other so as to form a main flow that heads toward the inlet.

[0105] A problem that relates to the invention described in the first item is as follows.

[0106] Various studies have been done conventionally regarding washing techniques for washing the inside of a toilet bowl portion of a toilet. Patent document No. 2 suggests a flush toilet in which a first water discharge port is provided in a region on the rear side and on one of the left and right sides of a toilet bowl portion and in which a second water discharge port is provided on the rear side and on the other one of the left and right sides of the toilet bowl portion. In this flush toilet, washing water discharged from each of the water discharge ports flows into a recessed portion of the toilet bowl portion and agitates pooled water inside the recessed portion in a vertical direction. It is described that the agitation of pooled water inside the recessed portion allows waste inside the recessed portion to sink so that the waste can be easily discharged and that the waste discharging performance can be improved.

[0107] As a result of studying the structure according to Patent document No. 2, the present inventor has come to realize the following problem. The flush toilet according to Patent document No. 2 has a structure where a route through which washing water flows from each of the water discharge ports to an inlet of a drain pipeline is long. Therefore, washing water discharged from the water discharge ports reaches the inside of the recessed portion while the force of water thereof has been relatively weakened. Therefore, the force of water for pushing waste into the drain pipeline is likely to become insufficient, and there is room for improvement in the waste discharging performance.

[0108] The invention described in the first item has been made in view of such a problem, and a purpose thereof is to provide a flush toilet that achieves favorable waste discharging capability.

2. An explanation will be given regarding a preferred embodiment of a second invention.

(Second embodiment)

[0109] Fig. 15 is a lateral cross-sectional view of a flush toilet 300 according to a second embodiment, and Fig. 16 is a plan view of the flush toilet 300. Fig. 17 is a top view of the flush toilet 300 when the flush toilet 300 is cut at a horizontal plane along a line A-A of Fig. 15. In the following, as shown in Fig. 16, the lateral direction of the flush toilet 300 is set to be an X axis, the longitudinal direction of the flush toilet 300 is set to be a Y axis, and the height direction is set to be a Z axis. The positive direction in the X axis is referred to as "right direction", and the negative direction in the X axis is referred to as "left direction". Further, when one lateral direction is referred to as a first direction, the other lateral direction is referred to as a second direction. In the embodiment, the left direction is set as the first direction, and the right direction is set as the second direction.

(Flush toilet)

[0110] The flush toilet 300 is provided with a toilet main body 302 made of ceramics. The toilet main body 302 is a wall mounted type toilet that is mounted while being hung on a wall surface 210 in a toilet room. Above the toilet main body 302, although not shown in the figure, a box that houses a warm water washing device such as a private part washing device or the like and a toilet lid and a toilet seat that are supported rotatably in the vertical direction by the box are arranged.

(Toilet main body)

[0111] The toilet main body 302 has a toilet bowl portion 310, a drainage pipe portion 312, and a peripheral wall portion 314. The drainage pipe portion 312 is formed on the lower part of the toilet bowl portion 310. The peripheral wall portion 314 shields an internal structure such as the toilet bowl portion 310 and the drainage pipe portion 312.

[0112] The drainage pipe portion 312 forms a U-shaped water sealing portion 316e at a portion where the drainage pipe portion 312 is connected to the toilet bowl portion 310. Retained water remains all the time in the water sealing portion 316e, and thereby the smell of the drainage pipe portion 312 is shut off. Waste that has fallen into the water sealing portion 316e is pushed outside by washing water along with the retained water.

(Toilet bowl portion)

[0113] The toilet bowl portion 310 is formed in an ellipse shape such that the longitudinal dimension becomes larger than the lateral dimension in the planar view. The toilet bowl portion 310 is provided with a bowl-like receiving surface portion 330 for receiving waste, a rim portion 308 that is connected to an upper edge portion of the receiving surface portion 330 and forms an upper edge portion of the toilet bowl portion 310, and a recessed portion 316 that is formed denting downward from the lower edge portion of the receiving surface portion 330. The receiving surface portion 330 is formed being inclined at a descending slope toward the center. The recessed portion 316 is formed having a bottom, and an

inlet of the water sealing portion 316e is open at a bottom portion 316k thereof. A portion of the retained water is stored in the recessed portion 316. The recessed portion 316 will be described later.

[0114] Fig. 19 is a diagram for explaining a central axis M1 of the recessed portion 316 and the shape of the recessed portion 316. The recessed portion 316 has a front end portion 316f corresponding to a vertex shared by left and right side edges in a planar view. A straight line that extends in the longitudinal direction while bisecting a lateral range Lx of the recessed portion 316 into left and right equal halves is denoted as a central axis M1. Also, a straight line that extends in the lateral direction while passing through the front end portion 316f is denoted as a straight line N1. An intersection point of the central axis M1 and the straight line N1 is denoted as a point P. A left end 220a is located on a left standing wall 220 of the recessed portion 316, and a right end 222a is located on a right standing wall 222. In Fig. 19, the front end portion 316f is located on the central axis M1.

[0115] The toilet bowl portion 310 has four divided regions Sr1-Sr4 sectioned by the central axis M1 and the straight line N1 in a planar view. In the following, out of the four divided regions, a divided region located on the rear side with respect to the straight line N1 and on the left side with respect to the central axis M1 is referred to as a first divided region Sr1, and a divided region located on the rear side with respect to the straight line N1 and on the right side with respect to the central axis M1 is referred to as a fourth divided region Sr4. A divided region located on the front side with respect to the straight line N1 and on the left side with respect to the central axis M1 is referred to as a second divided region Sr2, and a divided region located on the front side with respect to the straight line N1 and on the right side with respect to the central axis M1 is referred to as a third divided region Sr3.

(Rim water leading passage)

[0116] As shown in Fig. 17, three water leading passages: a first rim water leading passage 324a provided mainly on the left side; a second rim water leading passage 324b provided mainly on the right side; and a third rim water leading passage 324c provided mainly on the left rear side, are formed in the rim portion 308. The three water leading passages: the first rim water leading passage 324a; the second rim water leading passage 324b; and the third rim water leading passage 324c, are generically referred to as "water leading passages 324".

(Water discharge port)

[0117] Three water discharge ports: a first water discharge port 322a; a second water discharge port 322b; and a third water discharge port 322c, are formed in the rim portion 308. The three water discharge ports: the first water discharge port 322a; the second water discharge port 322b; and the third water discharge port 322c, are generically referred to as "water discharge ports 322". The water discharge ports 322 will be described later. The water discharge ports 322 are formed in respective water leading passages 324 and are open toward respective rim water passages 320, which are described later, in such a way as to be continuous with the respective rim water passages 320.

[0118] The first water discharge port 322a is provided at a downstream end of the first rim water leading passage 324a, the second water discharge port 322b is provided at a downstream end of the second rim water leading passage 324b, and the third water discharge port 322c is provided at a downstream end of the third rim water leading passage 324c.

[0119] As shown in Fig. 15, washing water supplied from a water supply pipe 304, which is a part of a washing water supply device, is supplied to each one of the rim water leading passages 324 via an inflow passage 238a and a water leading passage 238b. Washing water supplied to the rim water leading passages 324 is discharged toward the rim water passages 320, which are described later, from the respective water discharge ports 322. The washing water that has been discharged swirls in the circumferential direction along the rim water passages 320. In the following, the direction in which washing water swirls in the circumferential direction is merely denoted as "swirling direction".

(Rim water passage)

[0120] In the rim portion 308, a first rim water passage 320a, a second rim water passage 320b, and a third rim water passage 320c, which are formed extending in the circumferential direction of the toilet bowl portion 310 respectively from the three water discharge ports 322, are formed. The three rim water passages 320a, 320b, and 320c are generically referred to as "rim water passages 320".

[0121] The first rim water passage 320a is provided extending in the circumferential direction from the first water discharge port 322a to the vicinity of the second water discharge port 322b on the downstream side in the swirling direction. The second rim water passage 320b is provided extending in the circumferential direction from the second water discharge port 322b to the vicinity of the third water discharge port 322c on the downstream side in the swirling direction. The third rim water passage 320c is provided extending in the circumferential direction from the third water discharge port 322c to the vicinity of the first water discharge port 322a on the downstream side in the swirling direction. The first rim water passage 320a, the second rim water passage 320b, and the third rim water passage 320c may be connected partially.

[0122] The rim water passages 320 are formed in such a manner that washing water discharged from the water discharge ports 322 swirls. As shown in Figs. 15 and 17, the rim water passages 320 are each provided with a

shelf portion 326b extending toward the outside of the toilet bowl portion 310 from an upper edge 326c of the receiving surface portion 330, a side wall portion 326a rising from an outer peripheral end portion of the shelf portion 326b, an overhanging portion 318 extending toward the inside of the toilet bowl portion 310 from an upper end portion of the side wall portion 326a, and a direction changing portion 332, which bends a portion of a washing water flow inwardly. The direction changing portion 332 will be described later.

[0123] As shown in Fig. 17, the width in the radial direction of each shelf portion 326b of the rim water passages 320 is formed to become smaller toward the downstream side. This structure allows washing water discharged from the water discharge ports 322 to gradually flow down to the receiving surface portion 330 as the washing water flows toward the downstream side.

(Overhanging portion)

[0124] An inner edge 318a of the overhanging portion 318 is formed at an upper end of the toilet bowl portion 310 such that the inner edge 318a protrudes inwardly. The upper surface of the overhanging portion 318 is flattened so as to become a supporting surface for a toilet seat. On the lower surface of the overhanging portion 318, the rim water passages 320 serving as passages for a swirling water flow are formed.

(Shape of recessed portion)

[0125] An explanation will be given next regarding the shape of a recessed portion in a planar view. From a perspective of washing a standing wall of the recessed portion efficiently using a small amount of washing water, it is more advantageous if the area of the standing wall to be washed is small. The area of the standing wall is determined by the length of the contour of the periphery of the recessed portion and the height dimension of the standing wall in the planar view, and it is therefore possible to reduce the area of the standing wall by reducing the length of the contour of the periphery of the recessed portion. In other words, it is advantageous in washing the recessed portion efficiently to form the recessed portion such that the length of the contour of the periphery is small.

[0126] In order to facilitate the discharge of waste, it is desirable to form the recessed portion such that the lateral and longitudinal dimensions of the recessed portion are equal to or more than predetermined dimensions. Possible shapes for the recessed portion in the planar view mainly include a rectangular shape, an elliptical shape, a shape obtained by combining these shapes in the longitudinal direction, and a shape obtained by modifying these shapes. As a result of study, under the condition where the lateral and longitudinal dimensions are constant, when the recessed portion has a triangle shape in the planar view, the length of the contour of the periphery of the recessed portion is shorter compared to a case where the recessed portion has a rectangular or elliptical shape. Therefore, from a perspective of washing the standing wall of the recessed portion efficiently, it is more advantageous if the contour of the periphery of the recessed portion is a triangle shape.

[0127] The shape of the recessed portion of the toilet bowl portion being an approximately triangle shape means that each of the edges forming a triangle is formed by a curved line with a curvature radius of 100 mm or more in the planar view or by a straight line. As a result, the respective angles of three corners can be formed to be acute angles of 90 degrees or less in the planar view.

[0128] An explanation will be given regarding the shape of the recessed portion 316 of the flush toilet 300 according to the embodiment based on the previously-stated perspective. Fig. 20 is a plan view showing, in an enlarged view, the inner edge of the recessed portion 316. The recessed portion 316 has an approximately triangle shape sectioned by three standing walls that correspond to three edges of a triangle 230 where a bottom edge 230u is located behind left and right side edges 230h and 230m in a planar view. A left standing wall 220 and a right standing wall 222 correspond to the left and right side edges 230h and 230m, and a rear standing wall 224 corresponds to the bottom edge 230u. The three standing walls: left standing wall 220; the right standing wall 222; and the rear standing wall 224, are generically referred to as "standing walls 226".

[0129] The recessed portion 316 has a front end portion 316f corresponding to a vertex 230a shared by the left and right side edges 230h and 230m, a left corner portion 316h corresponding to a vertex 230c on the left rear side, and a right corner portion 316m corresponding to a vertex 230b on the right rear side. In particular, the three corner portions consisting of the front end portion 316f, the left corner portion 316h, and the right corner portion 316m are formed to pass through the three vertices of the triangle 230, respectively. The three corner portions: the front end portion 316f; the left corner portion 316h; and the right corner portion 316m, are generically referred to as "corner portions 228".

[0130] If the curvature radius of the front end portion 316f is excessively large, the body of water in the recessed portion 316 may swirl without getting lowered, and a downward flow cannot be fully formed thus lowering the discharging performance in this case. If the curvature radius of the front end portion 316f is excessively small, mold-releasing work of removing a material that has been injected into a mold from the mold may become difficult.

[0131] A water flow that has fallen onto the standing walls of the recessed portion effectively washes the corner portions by colliding with the corner portions of the recessed portion along the standing walls. Therefore, if the respective curvature radii of the standing walls of the recessed portion are excessively small, the force of water colliding with the cornerportions of the recessed portion may become lowered, possibly causing insufficient

washing at the corner portions of the recessed portion. In response to this perspective, the recessed portion 316 is formed in a curved or straight line shape where the respective curvature radii of the left standing wall 220, the right standing wall 222, and the rear standing wall 224 are 100 mm or more. If the standing walls of the recessed portion are convex surfaces that project inwardly in a planar view, a flow along the standing walls is unlikely to collide with the corner portions. In response to this perspective, the recessed portion 316 is formed to have a recessed surface bulging outwardly in a planar view.

[0132] The recessed portion 316 is formed such that the respective curvature radii of the left standing wall 220, the right standing wall 222, and the rear standing wall 224 are larger than the curvature radius of the front end portion 316f.

(Arrangement of water discharge ports)

[0133] An explanation will be given next regarding the arrangement of the water discharge ports. In the case of having three water discharge ports, from a perspective of effectively washing the inside of the toilet bowl using a small amount of washing water, it is more advantageous to spread, in a wide range, washing water discharged from respective three water discharge ports compared to a case where washing water portions gather in a small range. In order to widely spread each of the washing water portions, the three water discharge ports are desirably arranged at even intervals around the recessed portion. From the previously-stated perspective, it is effective to have a structure where the three water discharge ports are formed at intervals of a quarter round or more and a half round or less in the circumferential direction around the point P.

[0134] In the flush toilet 300 according to the embodiment, the three water discharge ports 322 are separately formed respectively in three divided regions out of the four divided regions Sr1-Sr4. For example, the first water discharge port 322a, the second water discharge port 322b, and the third water discharge port 322c may be arranged in the first divided region Sr1, the third divided region Sr3, and the fourth divided region Sr4, respectively. According to another example, one of the first water discharge port 322a and the second water discharge port 322b may be arranged in the second divided region Sr2. With this configuration, the three water discharge ports 322 can be arranged at intervals of a quarter round or more and a half round or less.

[0135] In particular, in the flush toilet 300, the three water discharge ports 322 are formed such that the first water discharge port 322a, the second water discharge port 322b, and the third water discharge port 322c are formed respectively on the left side of the recessed portion 316, on the front side of the recessed portion 316, and on the right side of the recessed portion 316 and behind a rear standing wall 224, in a planar view.

[0136] In the flush toilet 300, the front end portion 316f of the recessed portion 316 is located inside a triangle formed by connecting the three water discharge ports 322, in the planar view. The second water discharge port 322b is located inside the lateral range Lx of the recessed portion 316, and the third water discharge port 322c is located outside the lateral range Lx of the recessed portion 316. With this arrangement, the three water discharge ports 322 surround the recessed portion 316, and washing water can thus wash the recessed portion 316 efficiently.

[0137] From a perspective of washing the three standing walls of the recessed portion effectively, the three water discharge ports desirably discharge washing water in correspondence to the respective standing walls. In the flush toilet 300 according to the present embodiment, each of the three water discharge ports discharges water in correspondence to a standing wall that is next to a standing wall closest to the water discharge port in a direction in which washing water flows. In other words, in the flush toilet 300, the first water discharge port 322a, the second water discharge port 322b, and the third water discharge port 322c are provided in correspondence to the right standing wall 222, the rear standing wall 224, and the left standing wall 220, respectively.

[0138] As described later in reference to Fig. 21, a first main flow 362 from the first water discharge port 322a, a first main flow 372 from the second water discharge port 322b, and a first main flow 382 from the third water discharge port 322c respectively fall onto the right standing wall 222, the rear standing wall 224, and the left standing wall 220. The first main flows 362, 372, and 382 are each formed so as to go around about half the receiving surface portion 330 and then fall into the recessed portion 316.

(Water flow)

[0139] An explanation will be given next regarding the water flow of washing water in reference to Fig. 21. Fig. 21 is a diagram schematically showing the way washing water flows inside the toilet bowl portion 310. As described previously, washing water supplied from the water supply pipe 304 is supplied to the three rim water leading passages 324 via the water leading passage 238b. Washing water 358, washing water 368, and washing water 378 supplied to the respective rim water leading passages 324 are discharged from the respective water discharge ports 322 to the respective rim water passages 320 and respectively form the first main flows 362, 372, and 382, which curve inwardly from the rim water passages 320, and second main flows 364, 374, and 384, which swirl along the rim water passages 320. The main flow of washing water means a main flow in which a large portion of washing water flows in the same way, and the flow of discharged water from a single water discharge port can form a plurality of main flows.

(Direction changing portion)

[0140] The flow of washing water is affected by the shape of the rim portion 308 and the shape of the toilet bowl portion 310. Thus, forming a target first main flow and a target second main flow is not easy. First, in reference to Figs. 17 and 18, the direction changing portion 332, which controls the first main flows and the second main flows, will be explained.

[0141] The side wall portion 326a, which curves in an arc-like shape in a planar view, is formed in the rim water passages 320 so as to surround the recessed portion 316. Due to the action of such a curve of the side wall portion 326a, washing water is bent along the side wall portion 326a, and a water flow that swirls in the circumferential direction is thus formed.

[0142] In the flush toilet 300, the direction changing portion 332, which bends inwardly a portion of the flow of washing water swirling in the circumferential direction along the side wall portion 326a, is provided in the side wall portion 326a of the rim water passages 320. Different from the action of the curve of the side wall portion 326a, the direction changing portion 332 bends a portion of the flow of washing water inwardly. By providing the direction changing portion 332, the position for changing the direction of a main flow can be determined, and the first main flows and the second main flows can be controlled minutely by changing the flow of washing water.

[0143] As shown in Fig. 17, the direction changing portion 332 has a first convex surface portion 334a, a second convex surface portion 334b, and a third convex surface portion 334c each in which a portion of the side wall portion 326a projects inwardly from both sides in the circumferential direction. The first convex surface portion 334a, the second convex surface portion 334b, and the third convex surface portion 334c are generically referred to as "convex surface portions 334". The convex surface portions 334 are provided in the rim water passages 320 at the downstream side of the respective water discharge ports 322.

[0144] The first convex surface portion 334a is provided between the first water discharge port 322a and the second water discharge port 322b, while being closer to the first water discharge port 322a. The second convex surface portion 334b is provided between the second water discharge port 322b and the third water discharge port 322c, while being closer to the second water discharge port 322b. The third convex surface portion 334c is provided between the third water discharge port 322c and the first water discharge port 322a, while being closer to the third water discharge port 322c.

[0145] Fig. 18 is a schematic diagram showing, in an enlarged view, the surroundings of the first convex surface portion 334a. For comparison purposes, a contour 354a of the side wall portion obtained when the side wall portion does not have a convex surface portion is shown by a broken line. In the first convex surface portion 334a, a leading portion 334as, a projecting portion 334at, and a downstream portion 334au are formed in this order from the upstream side. The projecting portion 334at is a portion projecting inwardly from the leading portion 334as and the downstream portion 334au, which are located on the sides of the projecting portion 334at.

[0146] Washing water discharged from the first water discharge port 322a forms a first water flow 360. A water flow 360s, which is an outer portion of the first water flow 360, collides with the leading portion 334as and flows inwardly along the leading portion 334as. A water flow 360u, which is an inner portion of the first water flow 360, passes through the projecting portion 334at without colliding with the leading portion 334as and flows while swirling in the circumferential direction along the downstream portion 334au and the side wall portion 326a, which connects to the downstream side of the downstream portion 334au. To facilitate understanding, Fig. 18 shows that the water flow 360s and the water flow 360u intersect with each other. The water flow 360s and the water flow 360u form a desired first main flow 362 and a desired second main flow 374 while being mutually affected.

[0147] In this manner, the first convex surface portion 334a is able to form, from the first water flow 360, the swirling water flow 360s and the water flow 360u, which curves inwardly from the swirling water flow 360s. By providing a desired water amount, a desired force of water, and a desired direction to the water flow 360s and the water flow 360u by adjusting the shape of the first convex surface portion 334a, an intended first main flow 362 and an intended second main flow 374 can be generated. The respective shapes and actions of the second convex surface portion 334b and the third convex surface portion 334c are the same as those described in Fig. 18 and the explanation thereof used regarding the first convex surface portion 334a, and duplicative explanations will be omitted.

[0148] As explained above, by providing the direction changing portion 332, the flow of washing water can be minutely controlled. In particular, since a position for changing the direction of a main flow can be determined, the flow of washing water is unlikely to be affected by the shape of the shelf portion 326b of the rim portion 308 and the shape of the toilet bowl portion 310, and a target washing water flow can thus be easily formed.

[0149] Fig. 21 is referred back. The first main flow 362 falls toward the right standing wall 222 while widely washing the receiving surface portion 330, flows along the right standing wall 222, and collides with the right corner portion 316m. After having collided, the first main flow 362 forms a downward flow 362a and an upward flow and also forms, after changing the direction inside the recessed portion 316, a lateral flow flowing along the rear standing wall 224. The first main flow 362 flowing to the rear standing wall 224 merges with the first main flow 372 described later and then forms a whirl 388, which swirls laterally in a counterclockwise direction. Water falling toward the right standing wall 222 may include a portion of discharged water discharged from another water

discharge port.

[0150] By flowing along the right standing wall 222, the first main flow 362 effectively washes the wall surface of the right standing wall 222. By colliding with the right corner portion 316m, the first main flow 362 effectively washes the corner portion. By flowing along the rear standing wall 224, the first main flow 362 effectively washes the wall surface of the rear standing wall 224. By forming the downward flow 362a, the first main flow 362 facilitates the discharge of waste from the water sealing portion 316e to the drainage pipe portion 312.

[0151] Washing water 368 supplied to the second rim water leading passage 324b is discharged toward the second rim water passage 320b from the second water discharge port 322b and forms the second water flow 370. The second water flow 370 forms the first main flow 372, which curves inwardly from the second rim water passage 320b, and the second main flow 374, which swirls along the second rim water passage 320b.

[0152] The first main flow 372 falls toward the rear standing wall 224 while widely washing the receiving surface portion 330, flows along the rear standing wall 224, and collides with the left corner portion 316h. After having collided, the first main flow 372 forms a downward flow 372a and an upward flow and also forms, after changing the direction in the counterclockwise direction inside the recessed portion 316, a lateral flow flowing along the left standing wall 220. The first main flow 372 flowing to the left standing wall 220 merges with the first main flow 382 described later and then forms the whirl 388, which swirls laterally in the counterclockwise direction. Water falling toward the rear standing wall 224 may include a portion of discharged water discharged from another water discharge port.

[0153] By flowing along the rear standing wall 224, the first main flow 372 effectively washes the wall surface of the rear standing wall 224. By colliding with the left corner portion 316h, the first main flow 372 effectively washes the corner portion. By flowing along the left standing wall 220, the first main flow 372 effectively washes the wall surface of the left standing wall 220. By forming the downward flow 372a, the first main flow 372 forms a vertical swirl in the whirl 388 and facilitates the discharge of waste from the water sealing portion 316e to the drainage pipe portion 312.

[0154] Washing water 378 supplied to the third rim water leading passage 324c is discharged toward the third rim water passage 320c from the third water discharge port 322c and forms the third water flow 380. The third water flow 380 forms the first main flow 382, which curves inwardly from the third rim water passage 320c, and the second main flow 384, which swirls along the third rim water passage 320c.

[0155] The first main flow 382 falls toward the left standing wall 220 while widely washing the receiving surface portion 330, flows along the left standing wall 220, and collides with the front end portion 316f. After having collided, the first main flow 382 forms a downward flow 382a and an upward flow and also forms, after changing the direction in the counterclockwise direction inside the recessed portion 316, a lateral flow flowing along the right standing wall 222. The first main flow 382 flowing to the right standing wall 222 merges with the first main flow 362 and then forms the whirl 388, which swirls laterally in the counterclockwise direction. Water falling toward the left standing wall 220 may include a portion of discharged water discharged from another water discharge port.

[0156] By flowing along the left standing wall 220, the first main flow 382 effectively washes the wall surface of the left standing wall 220. By colliding with the front end portion 316f, the first main flow 382 effectively washes the corner portion. By flowing along the right standing wall 222, the first main flow 382 effectively washes the wall surface of the right standing wall 222. By forming the downward flow 382a, the first main flow 382 forms a vertical swirl in the whirl 388 and facilitates the discharge of waste from the water sealing portion 316e to the drainage pipe portion 312.

[0157] By forming the whirl 388 by the first main flows 362, 372, and 382, waste is gathered powerfully in the center of the water sealing portion 316e and discharged from the drainage pipe portion 312 (also see Fig. 15). By also flowing in a downward direction on the left standing wall 220, the right standing wall 222, and the rear standing wall 224, the first main flows 362, 372, and 382 form a vertical swirl in the whirl 388 and facilitate the discharge of waste from the water sealing portion 316e to the drainage pipe portion 312.

[0158] Reference is also made to Fig. 22. Fig. 22 is a diagram schematically showing the range in which washing water flows inside the toilet bowl portion 310. The second main flow 364 swirls along the first rim water passage 320a and overlaps with the second water flow 370 discharged from the second water discharge port 322b. The second main flow 374 swirls along the second rim water passage 320b and overlaps with the third water flow 380 discharged from the third water discharge port 322c. The second main flow 384 swirls along the third rim water passage 320c and overlaps with the first water flow 360 discharged from the first water discharge port 322a.

[0159] As shown in Fig. 17, the shelf portion 326b of the rim water passage 320 is formed such that the width of the shelf portion 326b in the radial direction becomes gradually smaller toward the swirling direction. Thus, the second main flows 364, 374, and 384 (also see Fig. 21) gradually fall onto the receiving surface portion 330 while swirling and form sheet-like falling water flows 390, 392, and 394 toward the recessed portion 316. The falling water flows 390, 392, and 394 widely wash the receiving surface portion 330 while flowing, in a film like manner, on the surface of the receiving surface portion 330.

[0160] Although Fig. 22 shows the falling water flows 390, 392, and 394 separately from the first main flows 362, 372, and 382, the falling water flows 390, 392, and

394 include portions of washing water split from the first main flows 362, 372, and 382.

[0161] As shown in Fig. 22, the falling water flow 390 forms a region 396 where the falling water flow 390 overlaps with the falling water flow 392, the falling water flow 392 forms a region 398 where the falling water flow 392 overlaps with the falling water flow 394, and the falling water flow 394 forms a region 400 where the falling water flow 394 overlaps with the falling water flow 390. For example, in the overlapping region 400, a water flow is formed that falls down the receiving surface portion 330 while rising up in a stripe shape.

[0162] As described, the shape of the toilet bowl portion 310 is formed such that respective washing water discharged from the three water discharge ports 322 form such first main flows 362, 372, and 382. Such first main flows 362, 372, and 382 mean those that fall toward the three standing walls 220, 222, and 224 and then flow along the standing walls 220, 222, and 224. Further, as described previously, the shape of the toilet bowl portion 310 is formed such that such first main flows 362, 372, and 382 merge with one another in the region of the recessed portion 316 (inside the recessed portion 316).

[0163] Also, the shape of the toilet bowl portion 310 is formed such that respective washing water discharged from the three water discharge ports 322 form such second main flows 364, 374, and 384. Such second main flows 364, 374, and 384 mean those that flow along the inner circumferential surface of the rim portion 308 and overlap with respective washing water discharged from other water discharge ports 322 that are adjacent in the swirling direction (in the counterclockwise direction in the figure) respectively to the three water discharge ports 322.

[0164] In order to achieve the above configuration, as the shape of the toilet bowl portion 310, the respective shapes of the rim portion 308, the receiving surface portion 330, the recessed portion 316, and the water discharge ports 322 are formed. The respective shapes of the rim portion 308, the receiving surface portion 330, and the recessed portion 316 include, for example, respective curvatures, slopes, and the like of the rim portion 308, the receiving surface portion 330, and the recessed portion 316. By forming these shapes in such a manner that the previously-described conditions are satisfied, the way water flows inside the toilet bowl portion 310 is mainly adjusted. Also, the respective shapes of the water discharge ports 322 include, for example, the respective positions, sizes, directions, and the like of the water discharge ports 322. By forming these shapes in such a manner that the previously-described conditions are satisfied, the discharge direction, the discharge amount, and the like of washing water is mainly adjusted.

[0165] An explanation will be given next regarding the operation of the flush toilet 300. In the flush toilet 300, by operating an operation member such as a predetermined switch, lever, or the like, a predetermined amount of washing water is supplied from the water supply pipe 304 to the rim water leading passages 324 via the inflow passage 238a and the water leading passage 238b. The washing water that has been supplied is discharged toward the water passages 320 from the water discharge ports 322 and widely washes the inside of the toilet bowl portion 310 while washing away waste inside the toilet bowl portion 310 into the water sealing portion 316e at the bottom part of the recessed portion 316 with using the fall of the washing water.

[0166] An explanation will be given next regarding the features of the flush toilet 300 according to the present embodiment. By flowing along the wall surface of the standing walls 226 of the recessed portion 316, the first main flows 362, 372, and 374 of respective washing water discharged from the water discharge ports 322 can powerfully wash away waste attached to the wall surface. The first main flows flow toward the respective corner portions 228 (also see Fig. 20), collide with the respective wall surfaces of the corner portions 228, and mainly dispersed in a lateral swirling direction, a downward direction, and an upward direction. Since the corner portions 228 have acute angles, a flow in the lateral swirling direction is suppressed, and a flow in the upward direction is also suppressed in accordance with the gravity and the first main flows flowing toward a lower portion of the toilet bowl from an upper portion of the toilet bowl. Thus, relatively powerful downward flows are formed.

[0167] These powerful downward flows being formed in three directions that correspond to the respective corner portions 228 along with the flow of the whirl 388 allow waste to be washed away powerfully from the water sealing portion 316e to the drainage pipe portion 312.

[0168] Further, the rim portion 308 through the receiving surface portion 330 can be widely washed by the second main flows, the toilet bowl portion 310 can thus be washed thoroughly.

[0169] For example, in a case where the recessed portion is formed in a circular shape or a polygon having four or more edges, although a powerful laterally swirling whirl can be formed in the recessed portion, a downward flow becomes weakened. Thus, this is disadvantageous in waste discharging. In contrast, in the flush toilet 300, since the recessed portion 316 is sectioned by the three standing walls corresponding to the respective edges of a triangle, a downward flow can be enhanced so as to effectively discharge waste. Also, a lateral swirling flow is weakened so as to suppress the whirl 388.

[0170] If the three water discharge ports gather on one side, the bias in water flows increases, and a region where washing is insufficient may be created inside the toilet bowl portion. In contrast, in the flush toilet 300, since the three water discharge ports 322 are formed at intervals in a range of a quarter round or more and a half round or less, the bias in water flows is suppressed, and favorable washing capability can be obtained.

[0171] If the three water discharge ports are arranged with being biased with respect to the recessed portion, the washing power for the standing walls of the recessed

portion may become biased. In contrast, in the flush toilet 300, since the first water discharge port 322a is provided on the left side of the recessed portion 316, the second water discharge port 322b is provided on the front side of the recessed portion 316, and the third water discharge port 322c is provided on the rear side of the recessed portion 316 so as to surround the recessed portion 316, the bias in washing power for the standing walls of the recessed portion can be suppressed.

[0172] In a configuration where main washing water forms only a main flow that falls while swirling, it is possible that the force of the water at the time of falling into the recessed portion may be lowered such that washing power for the standing walls of the recessed portion becomes lowered. In contrast, in the flush toilet 300, since the water discharge ports 322 discharge the first main flows 362, 372, and 382 falling toward the respective standing walls 226 and then flowing along the standing walls 226, a decrease in the force of the water can be suppressed, and the standing walls 226 can be washed effectively.

[0173] When the first main flows 362, 372, and 382 discharged from the respective water discharged ports 322 merge with one another mainly on the receiving surface portion 330, it is possible that the force of water and direction thereof at the time of falling into the recessed portion 316 become affected. In contrast, in the flush toilet 300, since the merging of the first main flow 362 and the first main flow 382, the merging of the first main flow 382 and the first main flow 372, and the merging of the first main flow 372 and the first main flow 362 each occur in a region of the recessed portion 316, effects on the force of water and direction thereof at the time of falling into the recessed portion 316 can be suppressed.

[0174] The merging of the first main flows 362, 372, and 382 with one another allows for the formation of a whirlpool in the lateral direction and a downward direction that are stronger, and waste can thus be washed away powerfully.

[0175] In border regions of main flows of respective washing water discharged from the three discharge ports, the washing water may not flow sufficiently, and the washing power may become insufficient. In contrast, since the flush toilet 300 is formed such that each of the second main flows 364, 374, and 384 flows in the circumferential direction along the side wall portion 326a of a rim water passage 320 and overlaps with washing water discharged from a water discharge port 322 on the side of the swirling direction out of the three water discharge ports 322, insufficient water flow in the border regions of the main flows can be suppressed, and the toilet bowl portion 310 can be widely and favorably washed.

[0176] If the entire shape of the toilet bowl portion is changed in order to achieve a desired water flow in washing water, other performance may be impaired, restricting the achievement of the desired water flow. In contrast, in the flush toilet 300, since the direction changing portion 332 for bending a portion of washing water inwardly is provided in the rim water passage 320, the flow of the washing water can be changed to become close to the desired flow by providing the direction changing portion 332, separately from the action of the curve of the side wall portion 326a.

[0177] In the flush toilet 300, since the direction changing portion 332 has the convex surface portions 334 each in which a portion of the side wall portion 326a projects inwardly from both sides in the circumferential direction, changes in the shape of the shelf portion 326b and the shape of the toilet bowl portion 310 can be minimized.

[0178] Described above is an explanation of the second invention based on the embodiments. These embodiments are intended to be illustrative only, and it will be obvious to those skilled in the art that various modifications and changes can be developed within the scope of the claims of the second invention and that such modifications and changes are also within the scope of the claims of the second invention. Therefore, the descriptions and figures in the specification should be treated demonstratively instead of being treated in a limited manner.

[0179] For the flush toilet 300, an example has been explained where a wash down type is used for the washing technique. Alternatively, the inside of the toilet bowl portion 310 may be washed by a washing technique of a combination of other techniques of a siphon type, a siphon jet type, and the like. For the flush toilet 300, an example has been explained where a water supply direct pressure type is used for the water supply technique. In addition to this, a water supply technique of a gravity water supply type where the gravity is used, a flush valve type, or the like may be used. The toilet main body 302 has been explained using a wall mounted type toilet as an example. Alternatively, the toilet main body 302 may be a floor mounted type toilet, which is installed on the floor of a toilet room. Also, other than ceramics, a resin, etc., may be used as a material of the toilet main body 302.

[0180] In the embodiment of the second invention, an example has been explained where a water discharge port creates a swirling water flow in a counterclockwise direction. However, this is non-limiting. For example, by vertical interchange, a configuration where a water flow in a clockwise direction is created may be employed.

[0181] In the embodiment of the second invention, an example has been explained where three water discharge ports are present in the rim portion. Alternatively, another water discharging means may be provided supplementary in addition to the three water discharge ports.

[DESCRIPTION OF THE REFERENCE NUMERALS]

[0182]

10 flush toilet, 12 toilet main body, 14 toilet bowl portion, 16 inlet, 20 water drain passage portion, 26 receiving surface portion, 28rim portion, 28L left side

portion, 28R right side portion, 32Afirst water discharge port, 32B second water discharge port, 32C third water discharge port, 36 water discharge portion, 38b right side water passage (first water passage), 38c left side water passage (second water passage), Sr1-Sr4 divided region, La lateral center line, Lb longitudinal center line, 210 wall surface, 220 right standing wall, 222 right standing wall, 224 rear standing wall, 226 standing wall, 228 corner portion, 230 triangle, 300 flush toilet, 302 toilet main body, 308 rim portion, 310 toilet bowl portion, 316 recessed portion, 322 water discharged port, 330 receiving surface portion, 332 direction changing portion, 334 convex surface portion

[INDUSTRIAL APPLICABILITY]

[0183] The present invention relates to flush toilets.

Claims

1. A flush toilet comprising:

a toilet main body that has a toilet bowl portion and a water discharge portion for discharging washing water to the inside of the toilet bowl portion,
wherein the toilet bowl portion has a receiving surface portion for receiving waste and a rim portion that is connected to an upper edge portion of the receiving surface portion,
wherein the water discharge portion has three water discharge ports formed in the rim portion and discharges washing water toward one side in a circumferential direction along the inner circumferential surface of the rim portion from the three water discharge ports,
wherein the toilet bowl portion has four divided regions sectioned by a lateral center line that bisects the lateral dimension of an outer surface portion of the toilet main body and by a longitudinal center line that bisects the longitudinal dimension of an inner surface portion of the toilet bowl portion in a planar view, and
wherein the three water discharge ports are separately formed respectively in three divided regions out of the four divided regions.

2. The flush toilet according to claim 1, wherein the three water discharge ports include a first water discharge port that discharges washing water in an amount that is larger than those from the other two water discharge ports.

3. The flush toilet according to claim 2, wherein the first water discharge port is provided in a rear-side divided region out of the four divided regions.

4. The flush toilet according to claim 2 or 3, wherein the other two discharge ports are not formed in a divided region that is adjacent, on one side in the circumferential direction, to the divided region in which the first water discharge port is formed, out of the four divided regions.

5. The flush toilet according to any one of claims 1 through 4,
wherein the rim portion has three rim water leading passages formed extending toward one side in the circumferential direction from the three water discharge ports, respectively, and
wherein the water discharge portion is formed such that a magnitude relationship in the respective discharge amounts of washing water from the three water discharge ports is the same as a magnitude relationship in the respective inner circumferential lengths of the three rim water leading passages, which connect to the three water discharge ports, respectively.

6. The flush toilet according to any one of claims 1 through 5, wherein the water discharge portion is formed such that a magnitude relationship in the respective discharge amounts of washing water from the three water discharge ports is the same as a magnitude relationship in the respective opening areas of the three water discharge ports, respectively.

7. The flush toilet according to any one of claims 1 through 6, wherein the three water discharge ports are separately formed respectively in a divided region located on one side in the circumferential direction, out of the two divided regions that are located on the front side, and the two divided regions that are on the rear side.

8. The flush toilet according to any one of claims 1 through 7,
wherein a single water discharge port out of the three water discharge ports is formed in a divided region on one side in the circumferential direction out of the two front side divided regions,
wherein the water discharge portion has a water passage that supplies washing water to the single water discharge port, and
wherein the water passage is formed extending along a longitudinal direction on the back side of a side portion on the side where a divided region on one side in the circumferential direction is present out of side portions on the left and right sides of the rim portion.

9. The flush toilet according to claim 8,
wherein a turned-back portion that leads washing water supplied from the upstream side to make a turn toward the single water discharge port is formed

at a downstream end portion of the water passage, wherein the single water discharge port is formed partially by two wall portions that are adjacent to each other in the radial direction of the toilet bowl portion, and
wherein respective circumferential end portions of the two wall portions are arranged to be lined up on a virtual line extending from a central point of the toilet bowl portion.

10. The flush toilet according to any one of claims 1 through 9,
wherein the toilet main body has a water drain passage portion that communicates with the toilet bowl portion via an inlet formed on the bottom of the toilet bowl portion,
wherein the three water discharge ports include a first water discharge port formed in any one of the divided regions and a second water discharge port formed in a divided region on the front side, and
wherein the water discharge portion is formed such that washing water discharged from the first water discharge port and washing water discharged from the second water discharge port merge with each other so as to form a main flow that heads toward the inlet.

11. The flush toilet according to claim 10, wherein the three water discharge ports include a third water discharge port formed in a divided region on the rear side.

12. The flush toilet according to claim 11,
wherein the first water discharge port, the second water discharge port, and the third water discharge port are arranged in order on one side in the circumferential direction, and
wherein the water discharge portion is formed such that the total amount of the respective discharge amounts of washing water from the first water discharge port and the second water discharge port is higher than the discharge amount of washing water from the third water discharge port.

13. The flush toilet according to claim 11 or 12, wherein the water discharge portion is formed such that washing water is discharged from the second water discharge port after washing water is discharged from the first water discharge port and the third water discharge port.

14. The flush toilet according to any one of claims 10 through 13, wherein the second water discharge port is formed in a divided region on one side in the circumferential direction out of the two front side divided regions.

15. The flush toilet according to any one of claims 10 through 14, wherein the water discharge portion is formed such that washing water discharged from the first water discharge port and washing water discharged from the second water discharge port merge with each other on the inner circumferential surface of the toilet bowl portion so as to form a main flow that heads toward the inlet.

16. A flush toilet comprising:

a toilet main body that has a toilet bowl portion, wherein the toilet bowl portion has a receiving surface portion for receiving waste, a rim portion that is connected to an upper edge portion of the receiving surface portion, and a recessed portion that is formed denting downward from a lower edge portion of the receiving surface portion,
wherein the recessed portion is sectioned by three standing walls consisting of: a left standing wall and a right standing wall that correspond to the left and right side edges of a triangle whose bottom edge is located behind the left and right side edges; and a rear standing wall that corresponds to the bottom edge, in a planar view,
wherein, in the rim portion, three water discharge ports consisting of a first water discharge port provided on a lateral side of the recessed portion, a second water discharge port provided on the front side of the recessedportion, and a third water discharge port provided on the rear side of the recessed portion are provided, and
wherein the three water discharge ports discharge washing water toward one direction in a circumferential direction along the rim portion.

17. The flush toilet according to claim 16, wherein the toilet bowl portion is formed such that washing water discharged from the three water discharge ports fall toward the three respective standing walls so as to respectively form first main flows flowing along the respective standing walls.

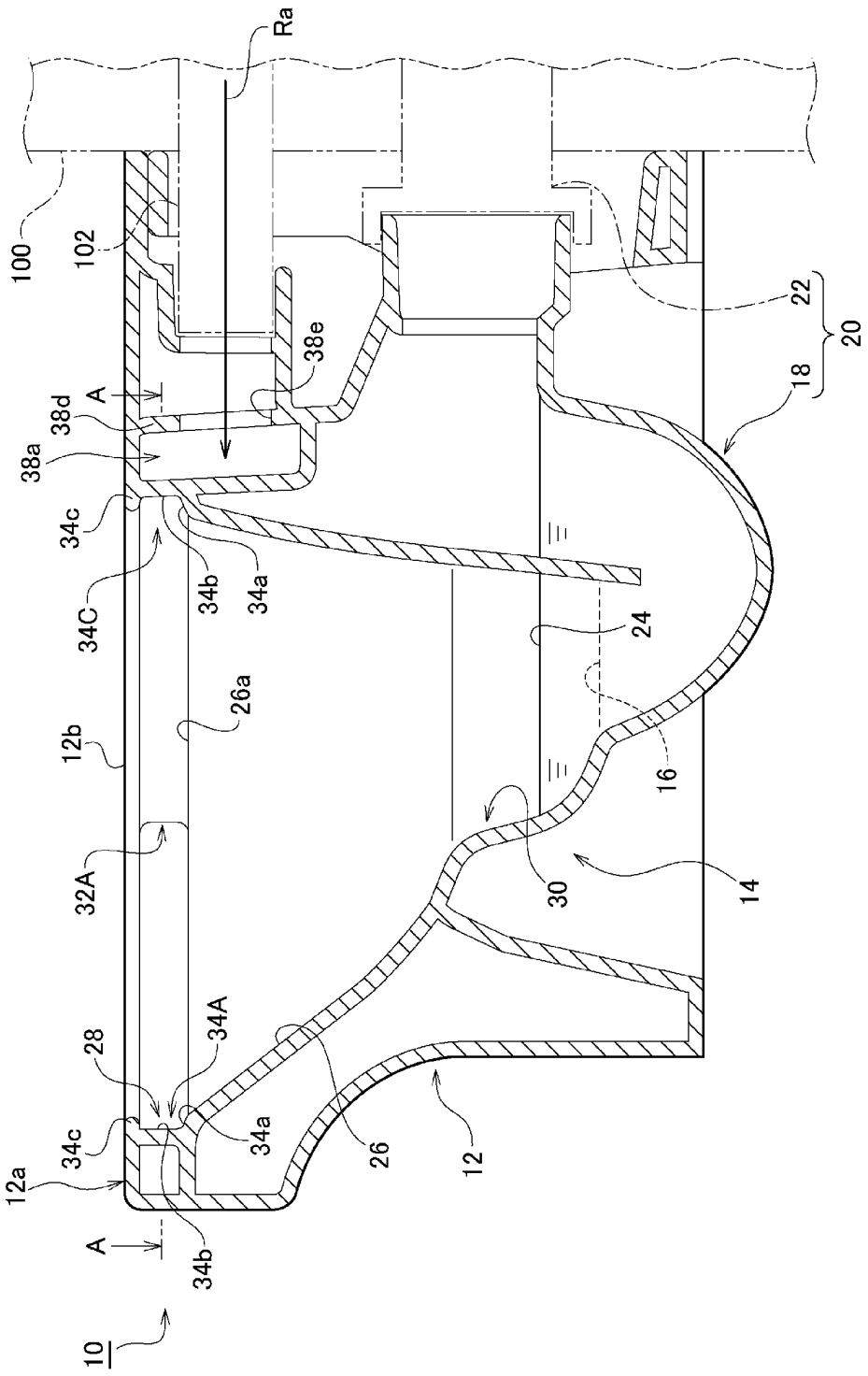
18. The flush toilet according to claim 17, wherein the shape of the toilet bowl portion is formed such that washing water discharged from the three water discharge ports each form a second main flow flowing in a circumferential direction along the inner circumferential surface of the rim portion and such that the second main flow overlaps with washing water discharged from a water discharge port located on one direction side out of the three water discharge ports.

19. The flush toilet according to claim 17 or 18, wherein the first main flow of washing water discharged from the first water discharge port merges with the first main flow of washing water discharged from the third water discharge port, the first main flow of washing

water discharged from the third water discharge port merges with the first main flow of washing water discharged from the second water discharge port, and the first main flow of washing water discharged from the second water discharge port merges with the first main flow of washing water discharged from the first water discharge port each in a region of the recessed portion.

20. The flush toilet according to any one of claims 16 through 19, wherein, on the inner circumferential surface of the rimportion, a direction changing portion that bends inwardly a portion of the flow of washing water swirling in the circumferential direction along the inner circumferential surface is provided.

21. The flush toilet according to claim 20, wherein the direction changing portion has a convex surface portion in which a portion of the inner circumferential surface of the rim portion projects inwardly from both sides in the circumferential direction .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38d
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38a
34c
34b
34a
34C
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26
12
12a
A
34b
10

FIG. 1

FIG. 2

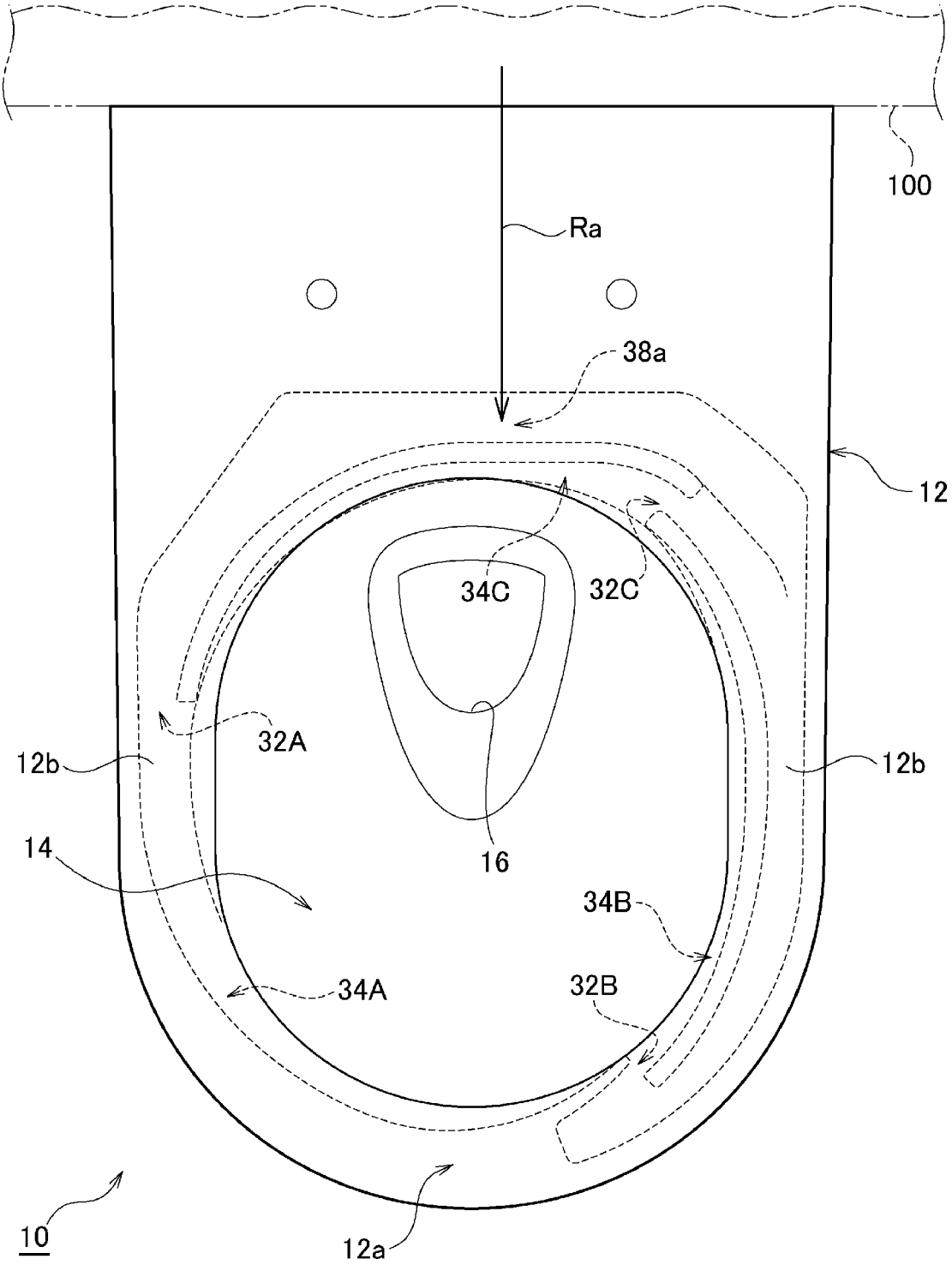
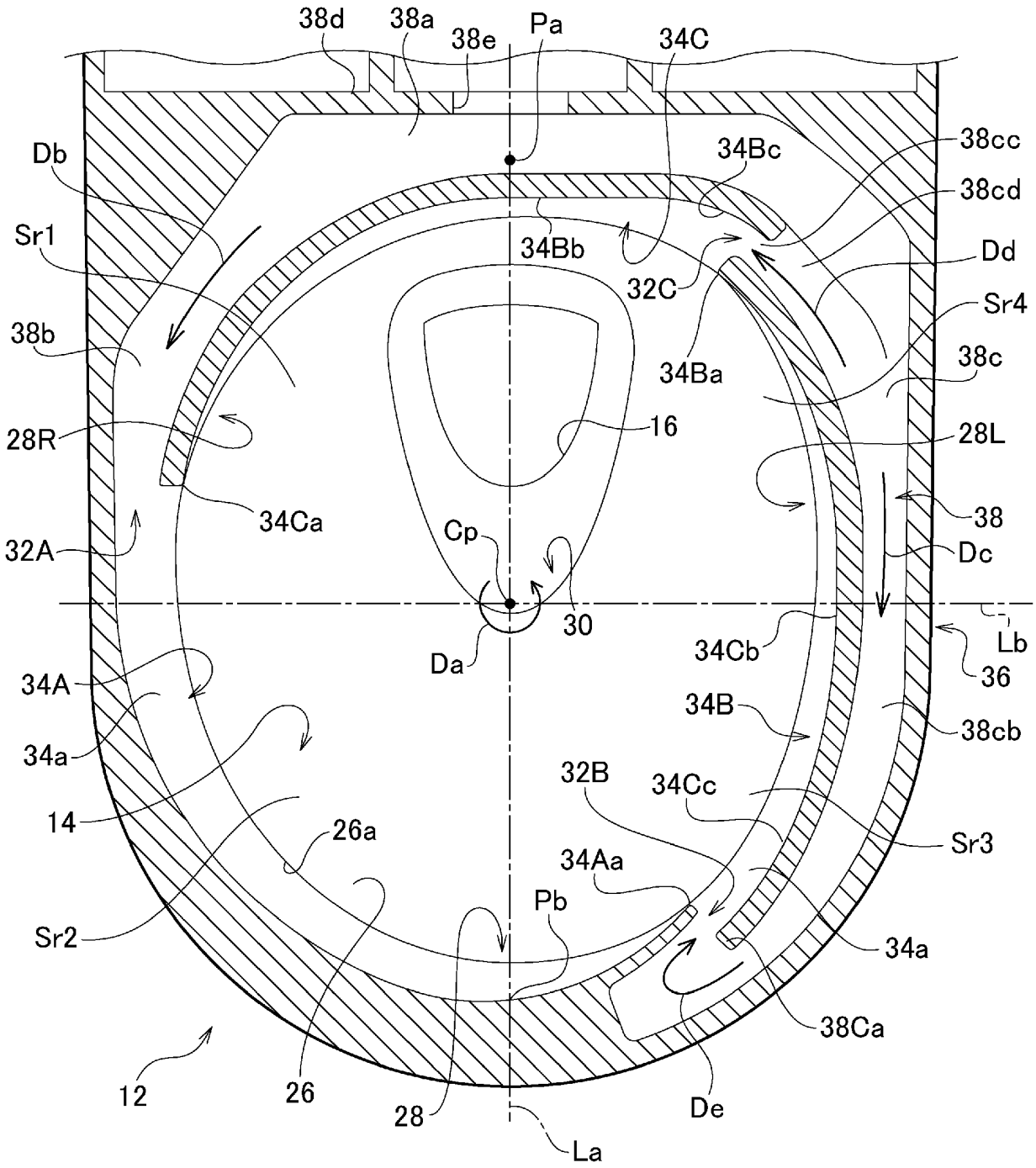


FIG. 3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Pa
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Db
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38cc
38cd
Sr1
34Bb
Dd
32C
Sr4
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34Ba
38c
28R
16
28L
34Ca
38
32A
Cp
Dc
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Lb
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34B
38cb
34a
32B
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Pb
Sr2
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26
28
De
La

FIG. 4

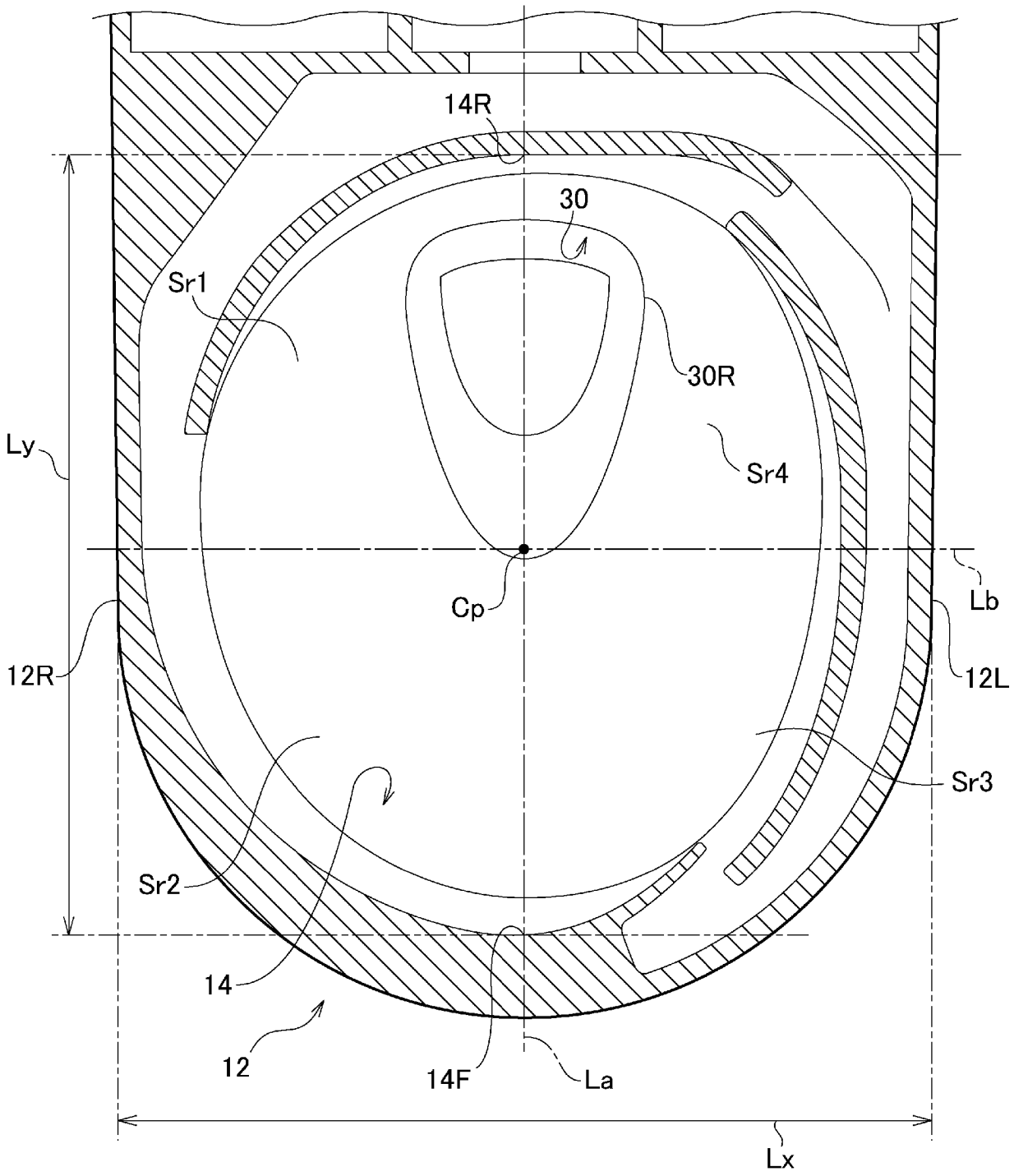
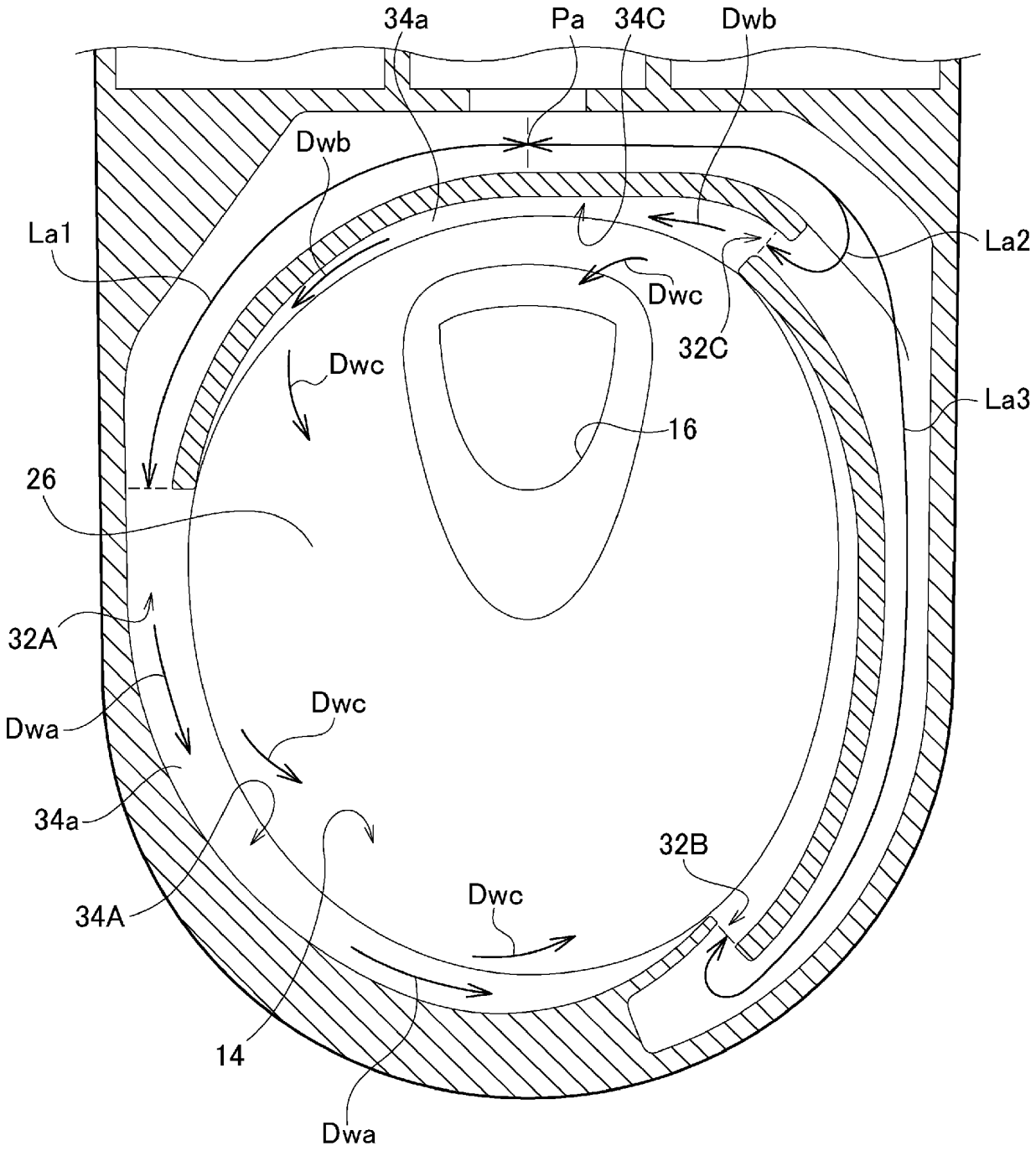


FIG. 5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Dwc
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Dwc
La3
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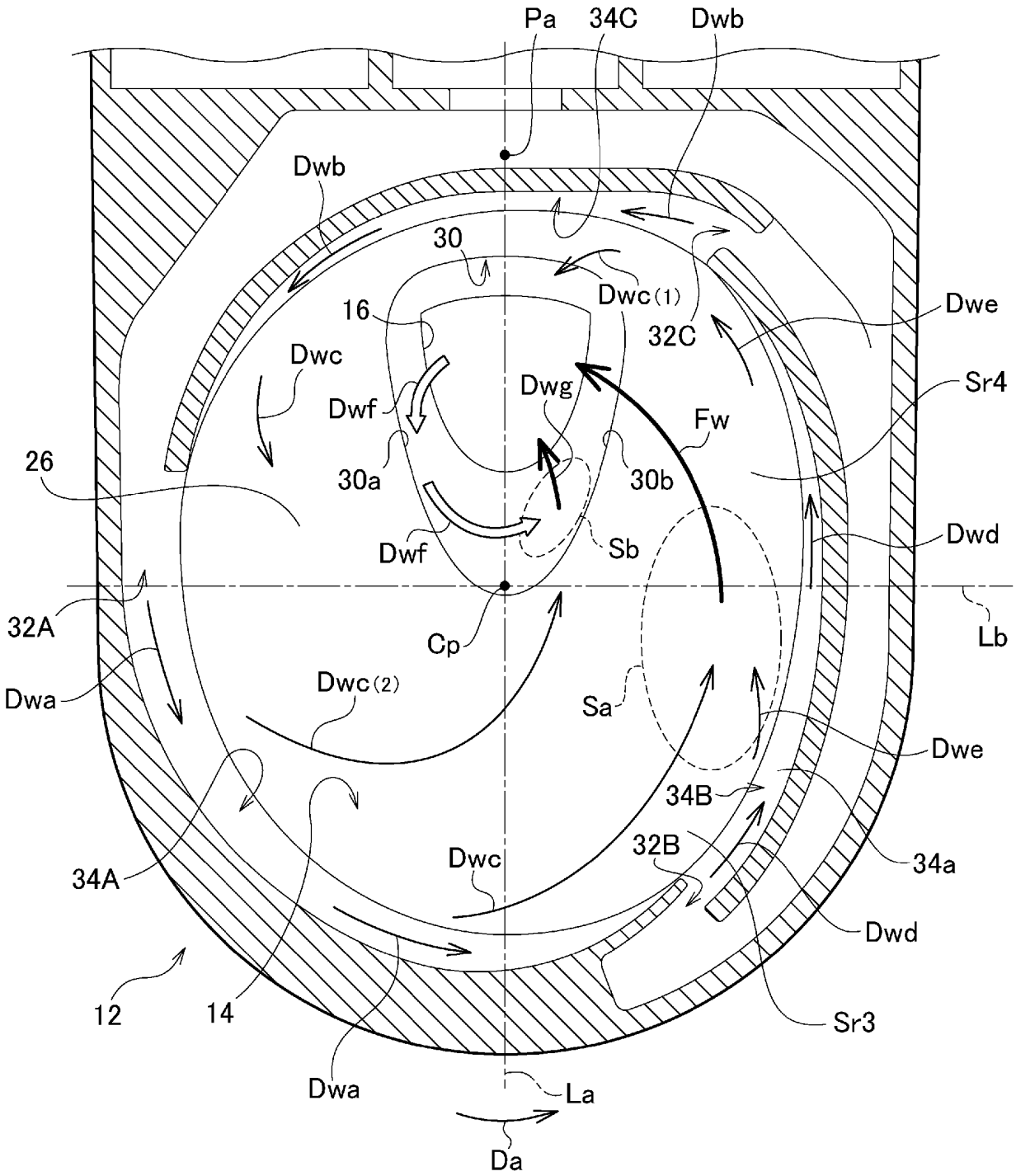
32A
Dwa
Dwc
34a
32B
Dwc
34A
14
Dwa

FIG. 6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Dwb
30
Dwc(1)
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32C
Dwe
Dwc
Dwg
Sr4
Dwf
Fw
26
30a
30b
Dwf
Sb
Dwd
32A
Cp
Lb
Dwa
Dwc(2)
Sa
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34B
32B
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34A
Dwc
Dwd
12
14
Sr3
Dwa
La
Da

FIG. 7

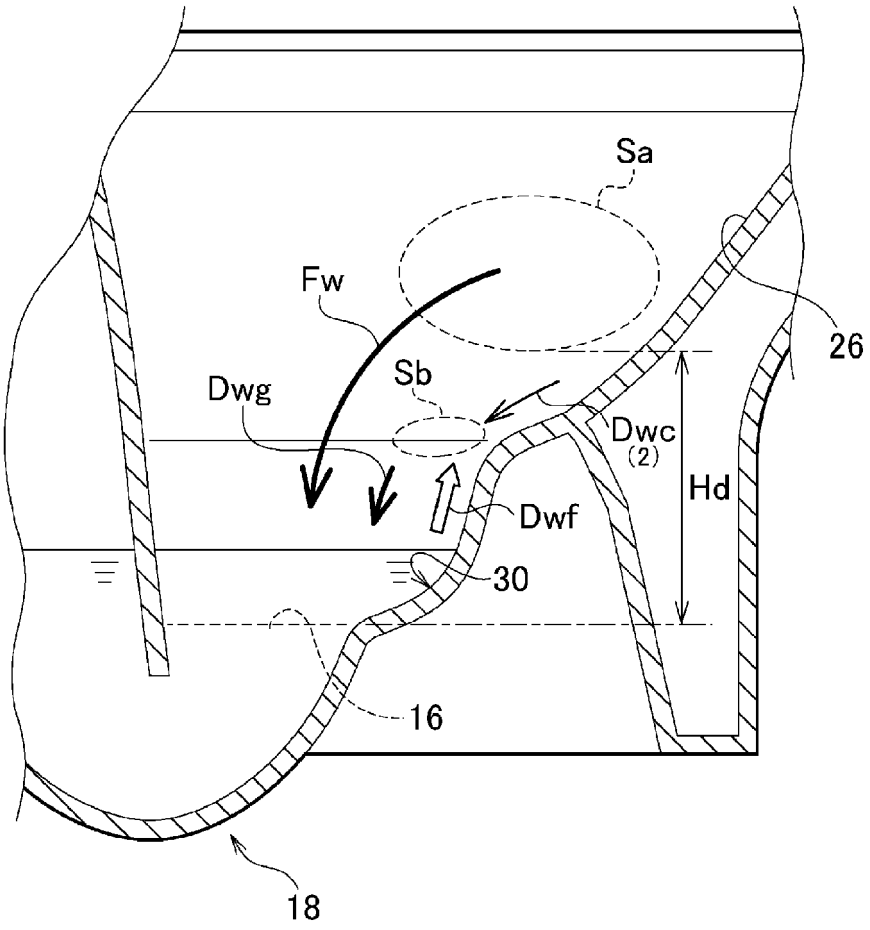


FIG. 8

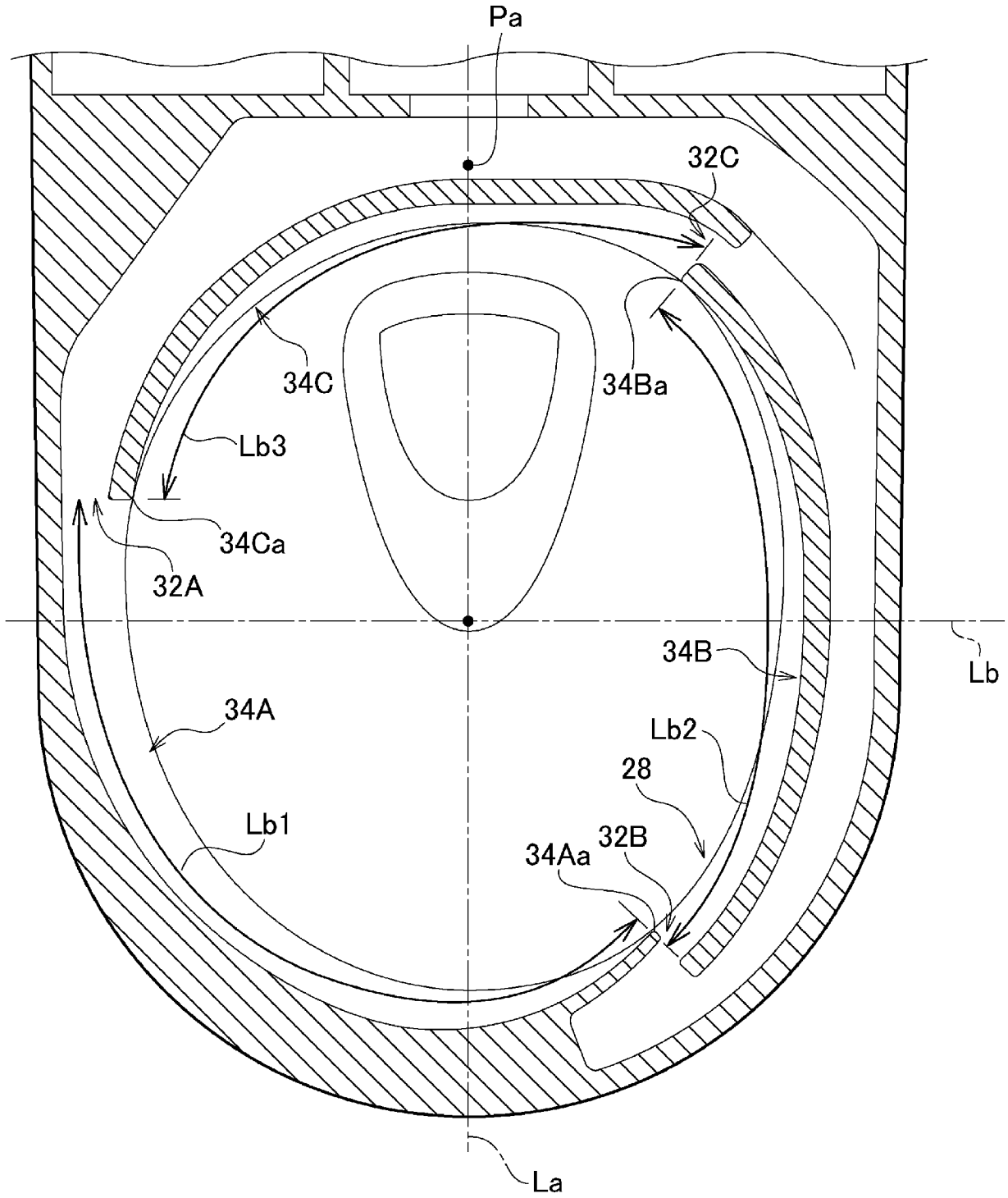


FIG. 9A

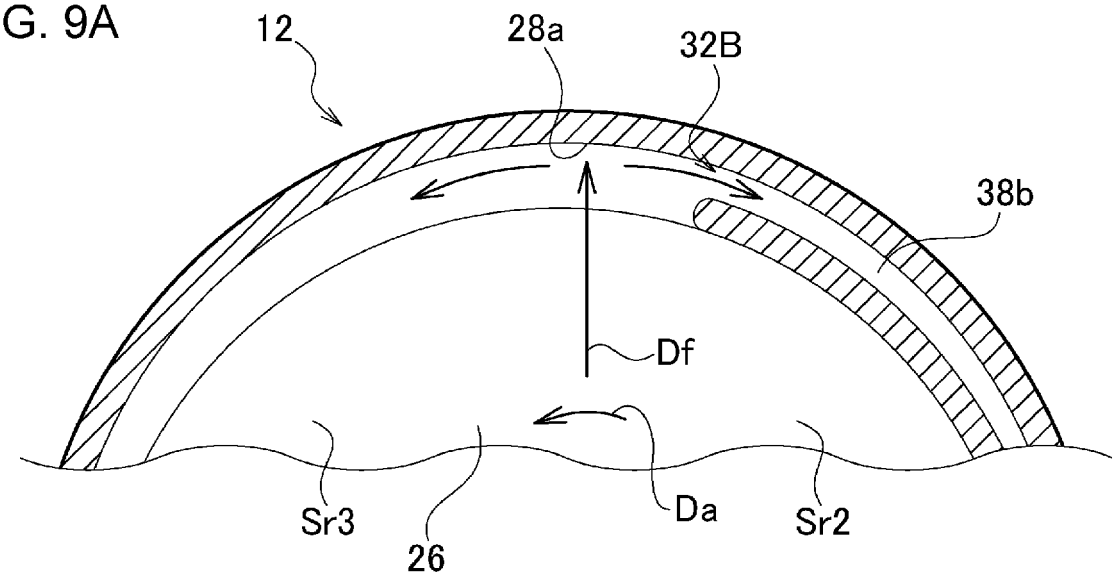


FIG. 9B

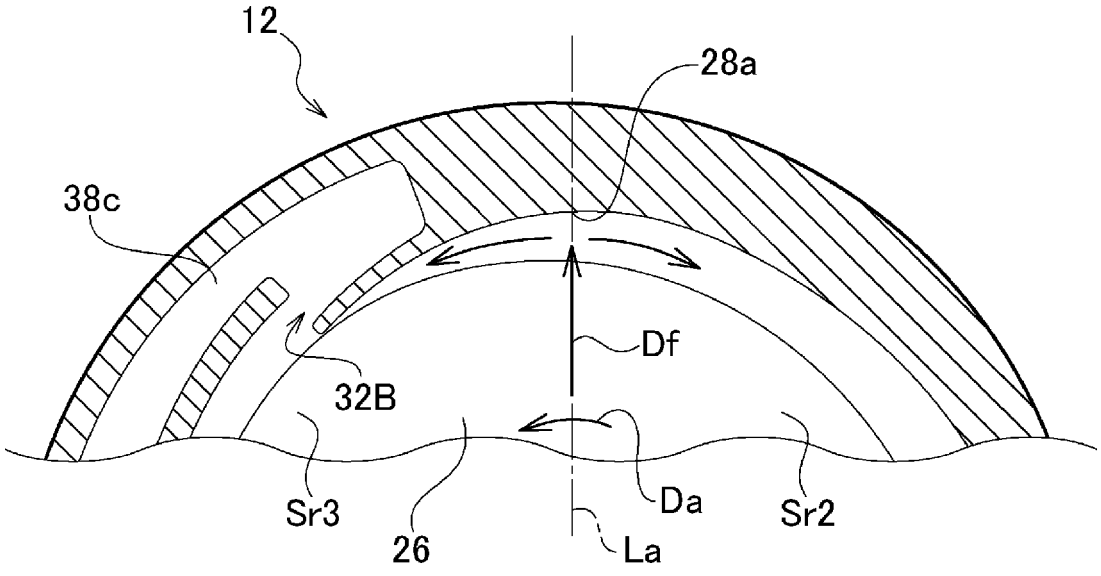


FIG. 10

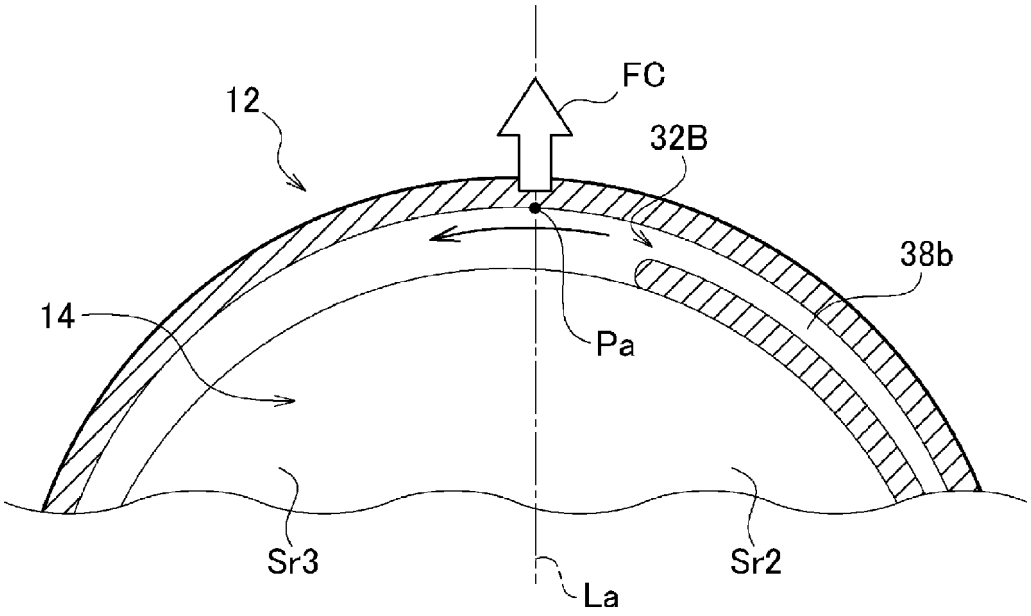


FIG. 11A

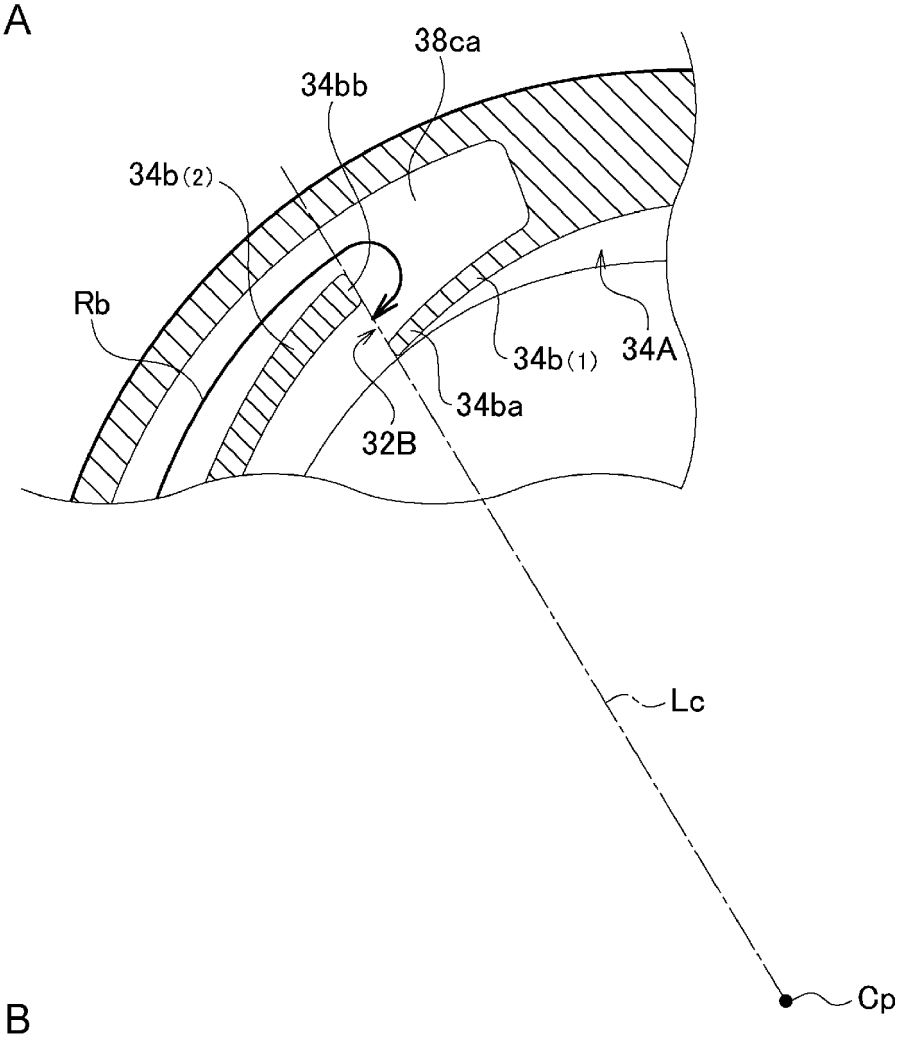


FIG. 11B

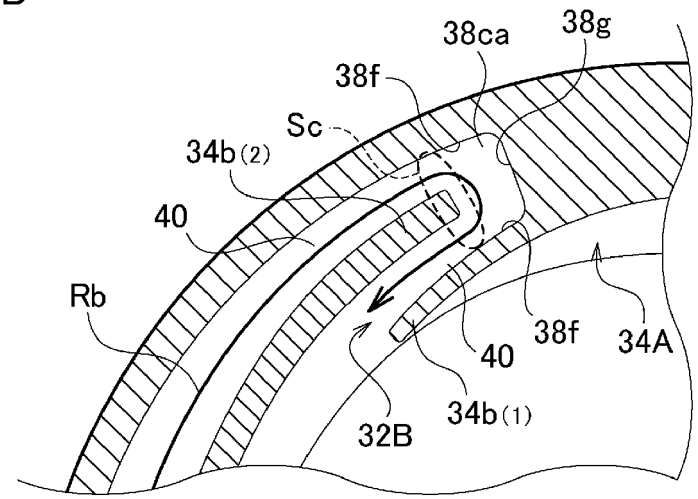


FIG. 12

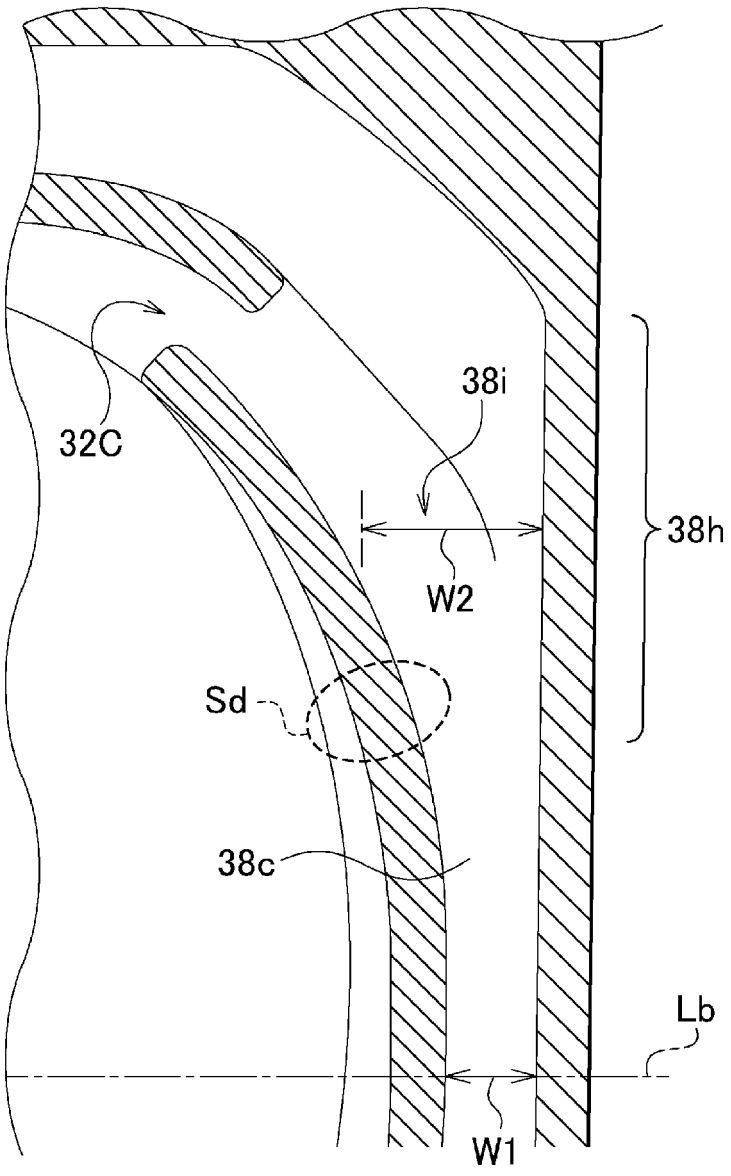


FIG. 13A

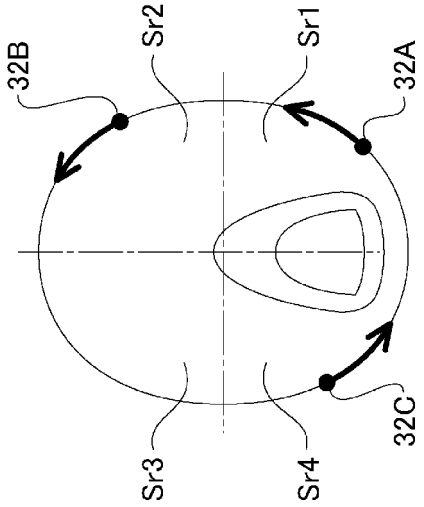


FIG. 13B

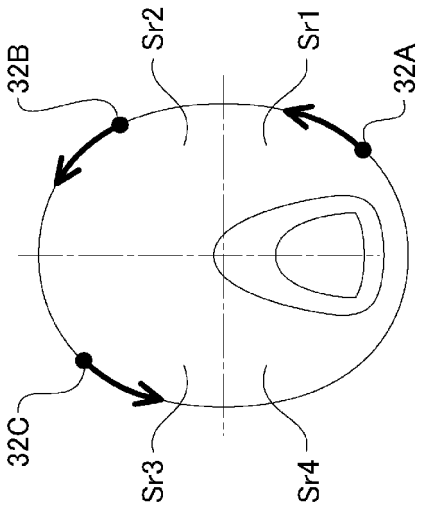


FIG. 13C

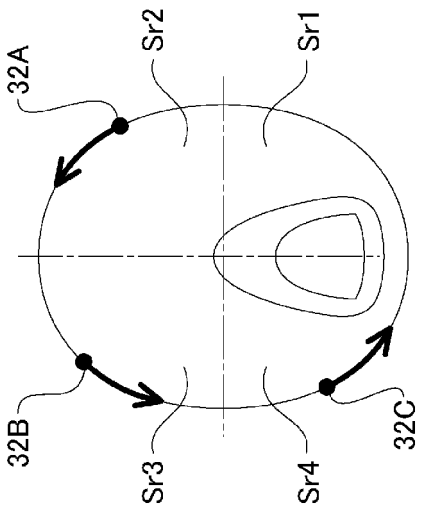


FIG. 14A

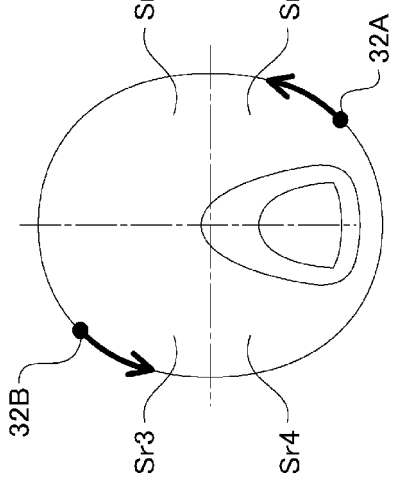


FIG. 14B

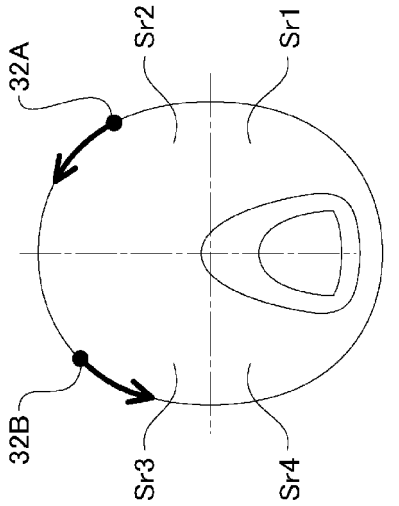
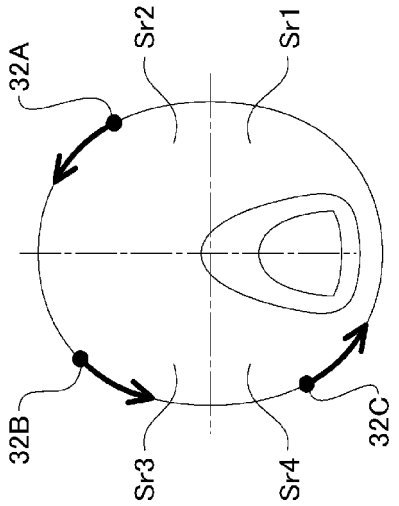


FIG. 14C



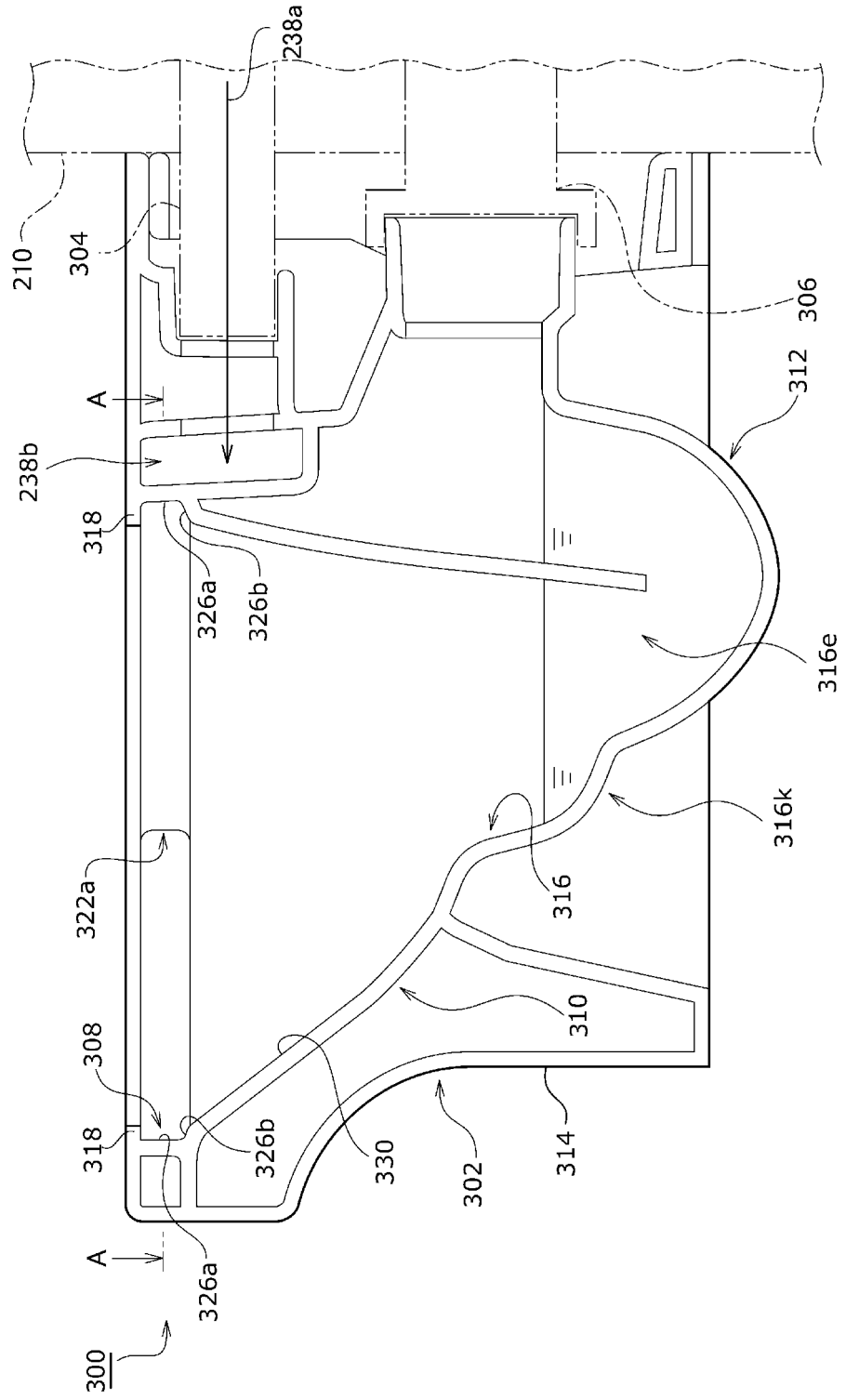

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FIG. 15

FIG. 16

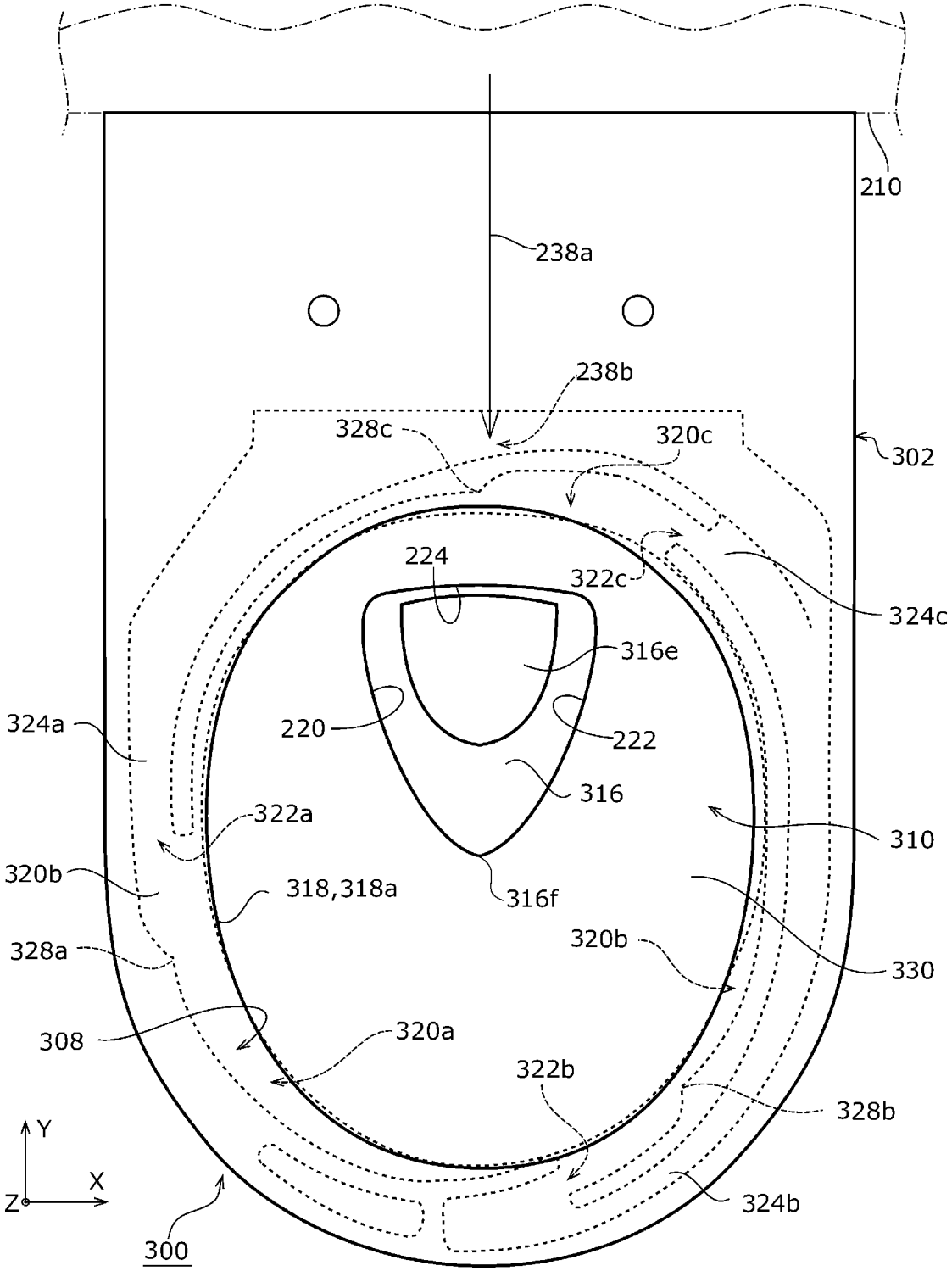
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FIG. 17

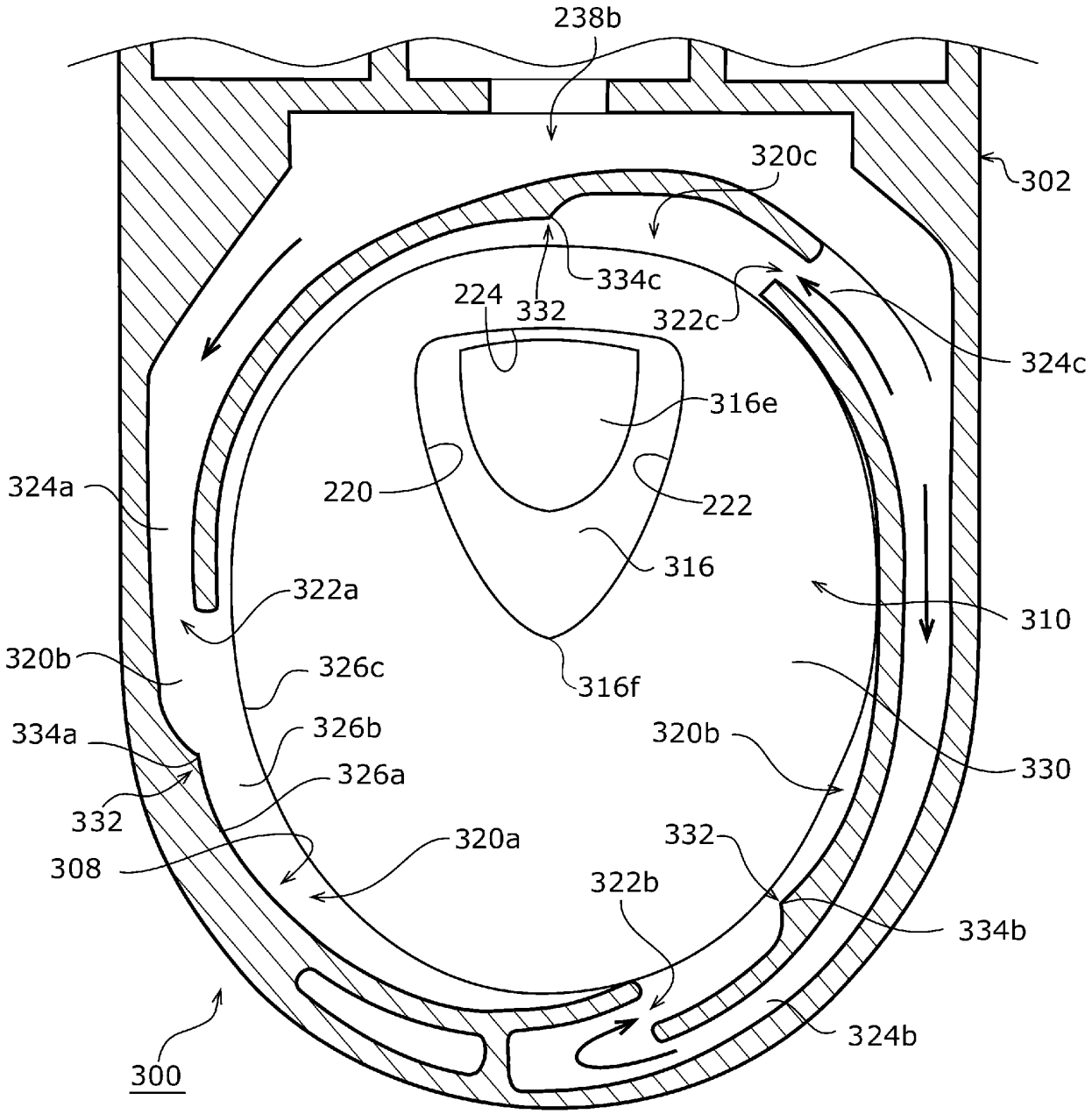
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FIG. 18

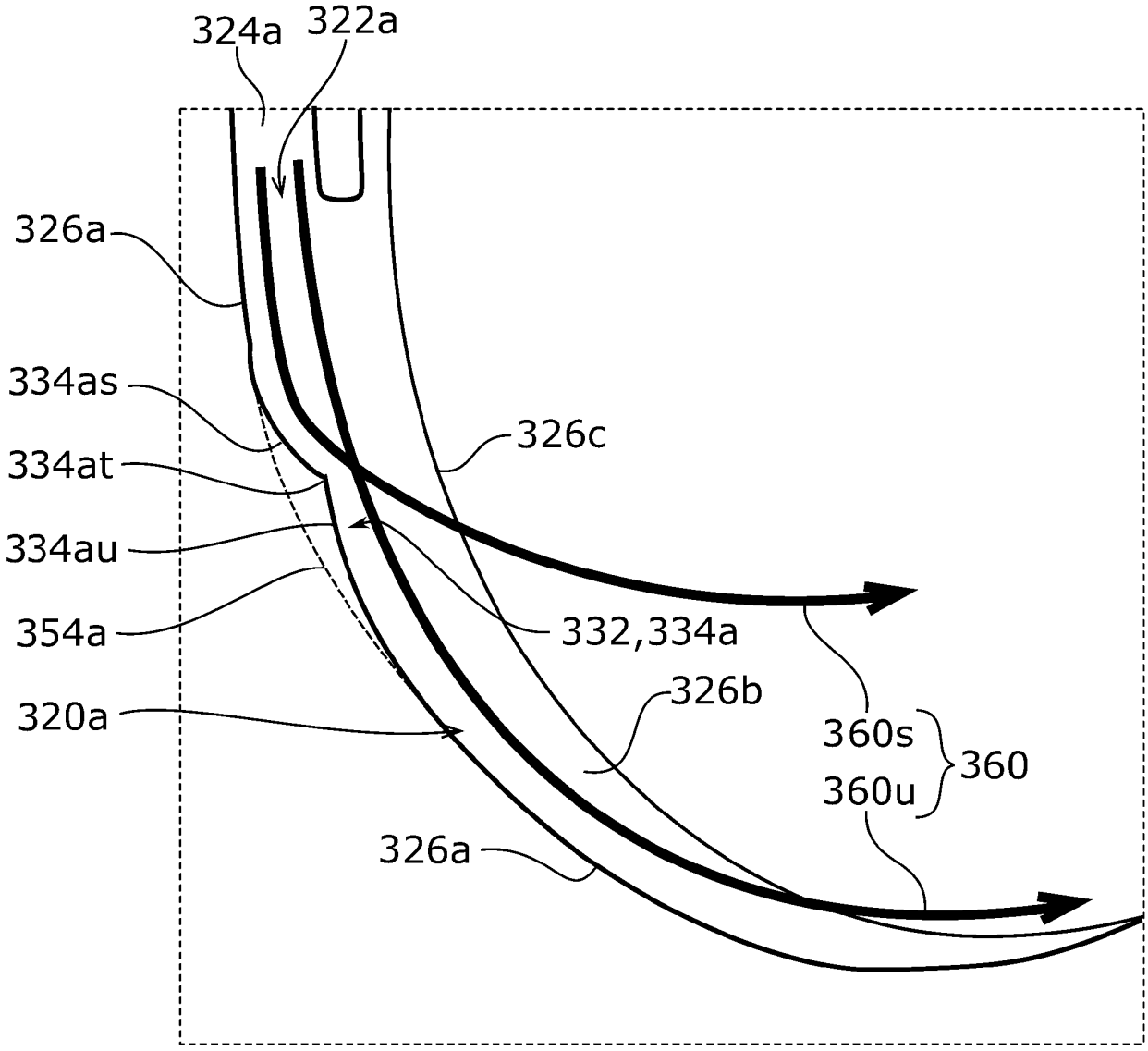
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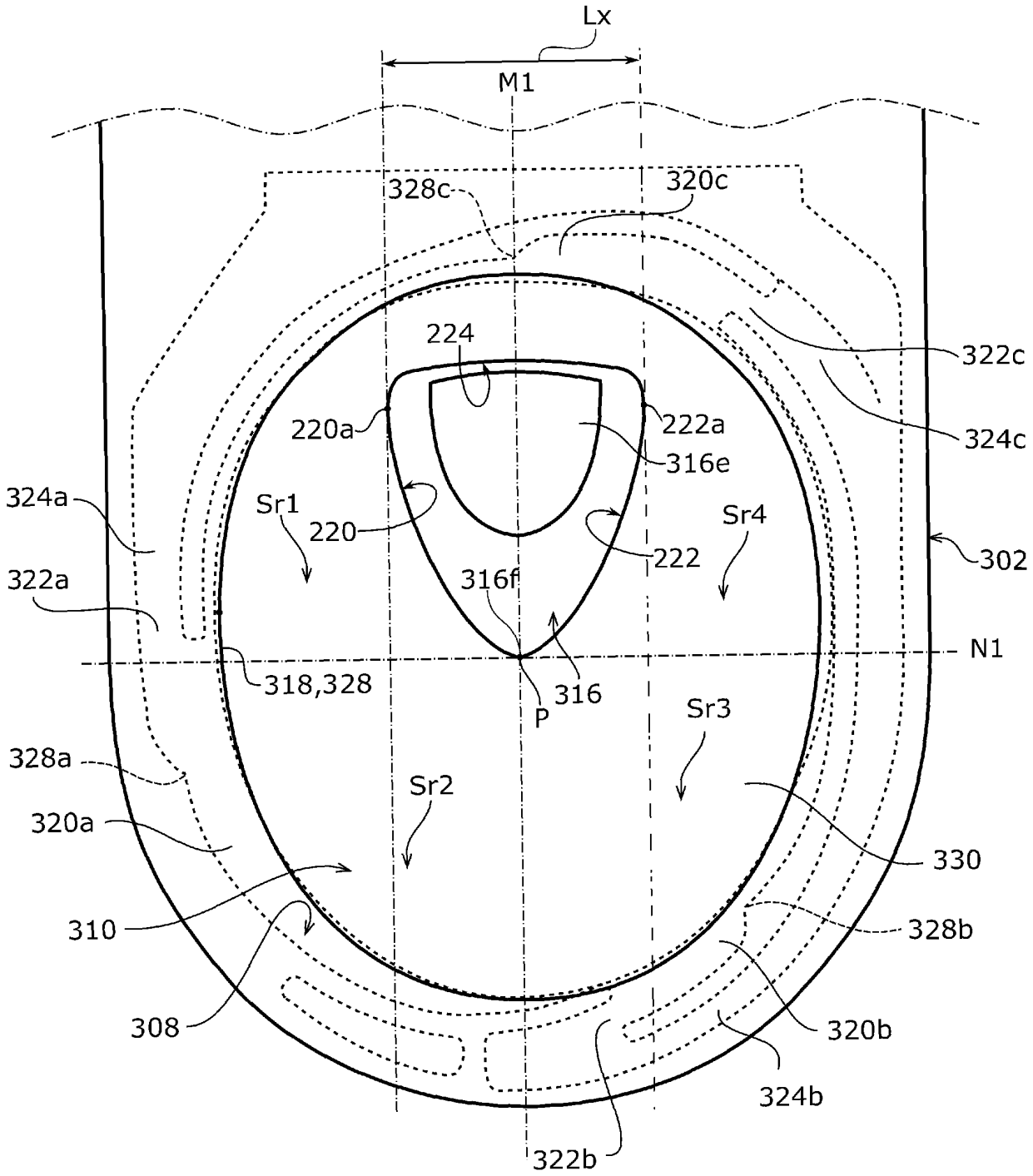
FIG. 19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316f
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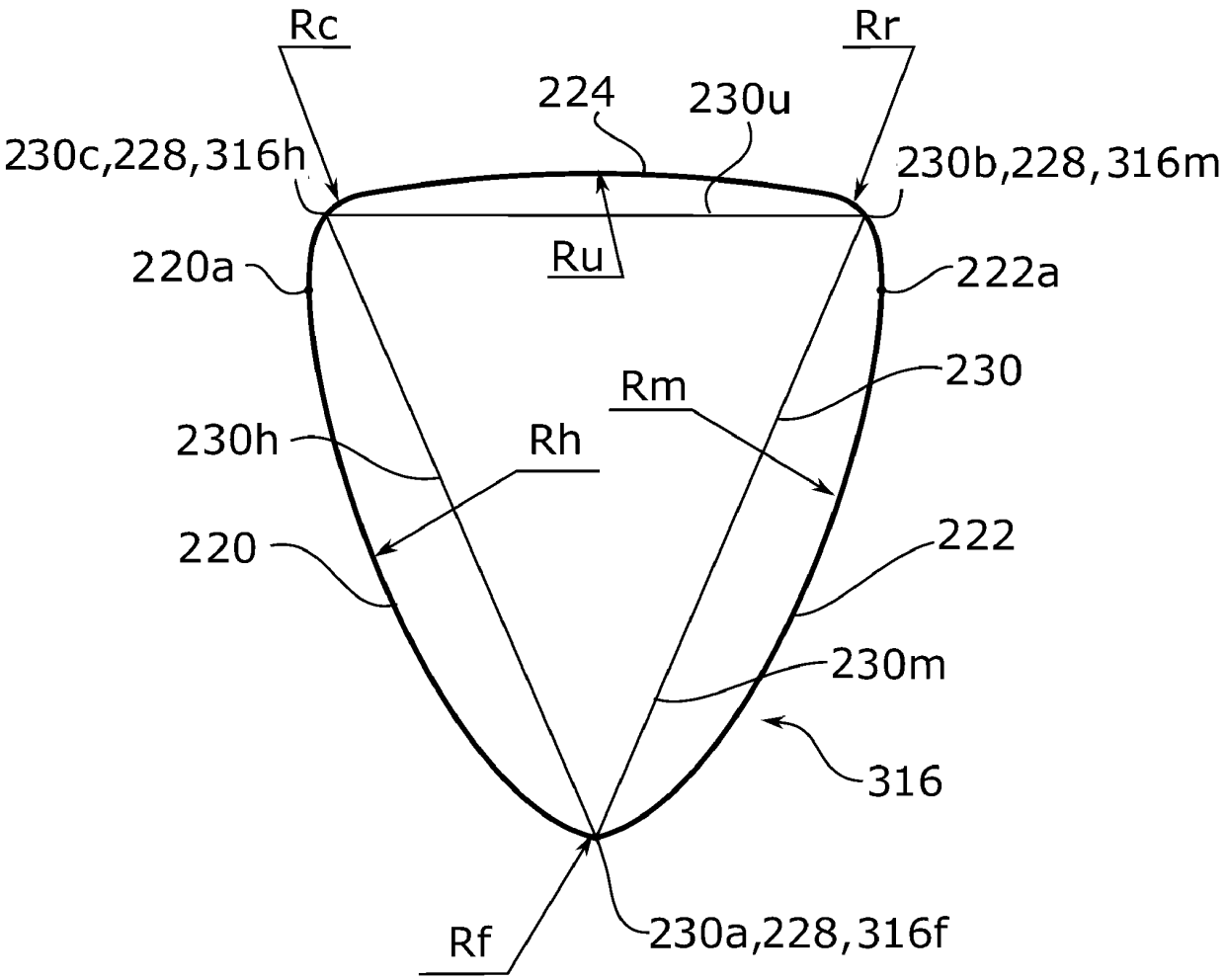
FIG. 20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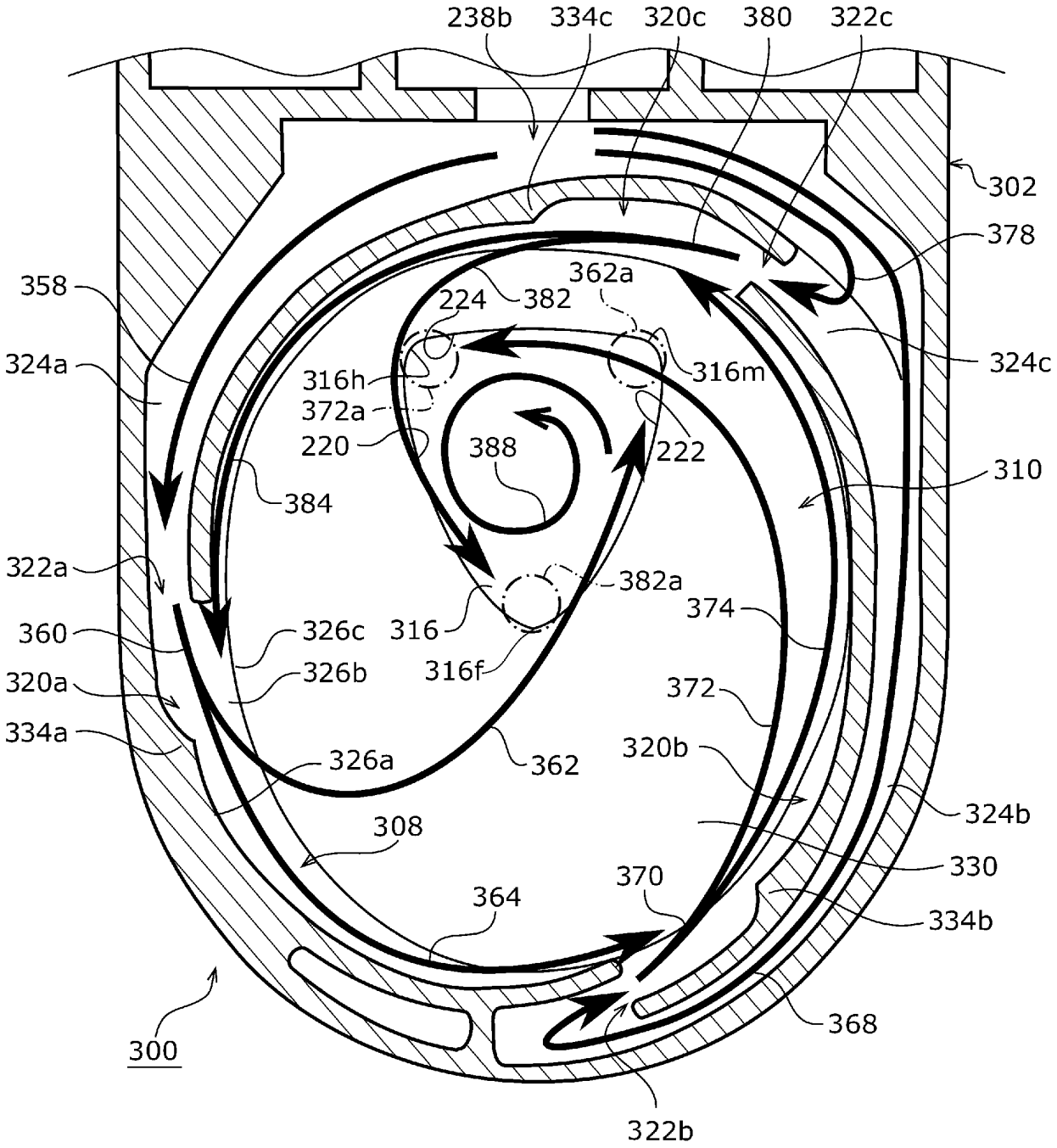
Rf
230a,228,316f

FIG. 21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326b
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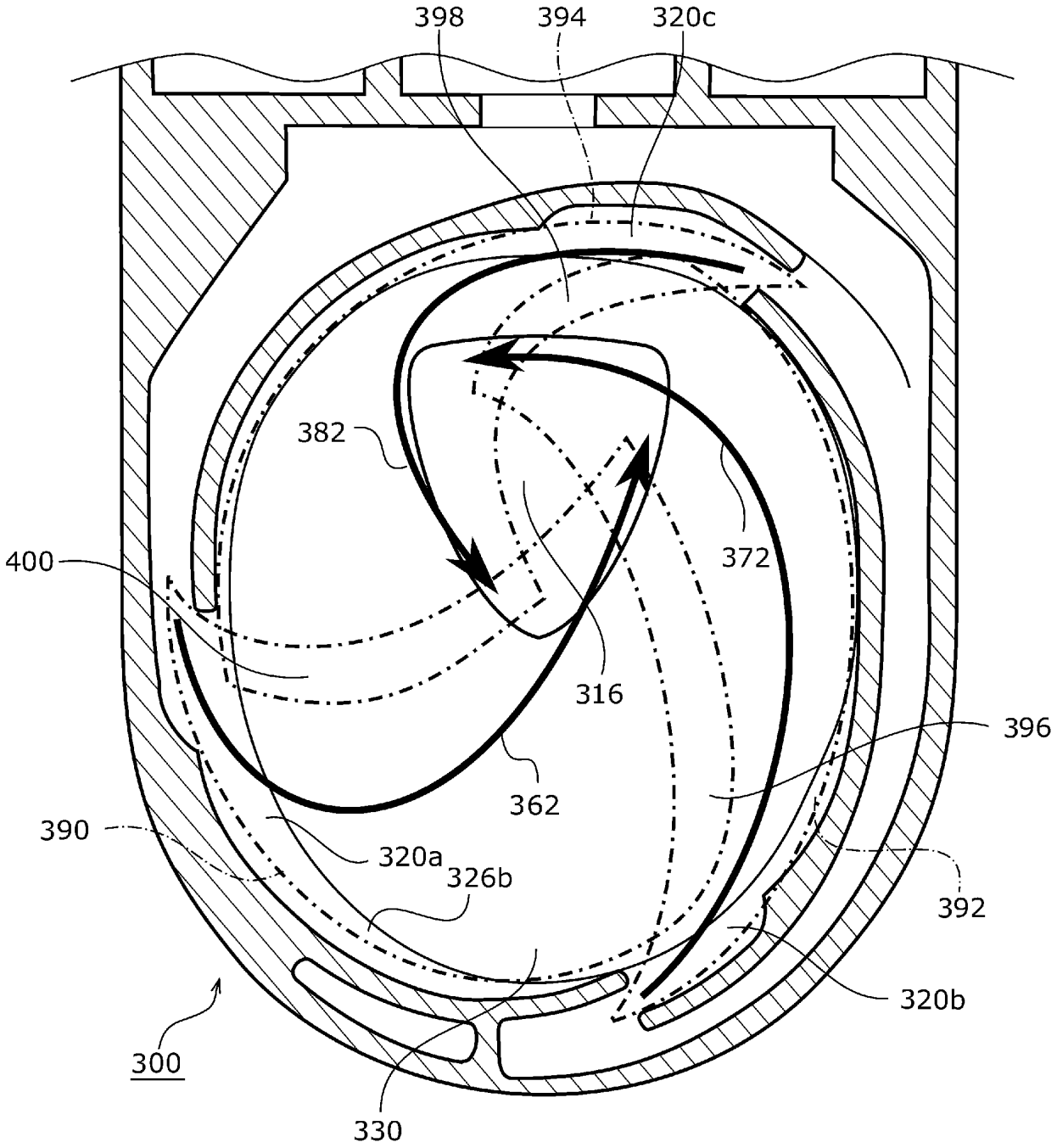
FIG. 22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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/069766

A. CLASSIFICATION OF SUBJECT MATTER
E03D11/08(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E03D11/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2000-355967 A (Toto Ltd.), 26 December 2000 (26.12.2000), paragraphs [0032] to [0034]; fig. 2 (Family: none)	1,7,10,11, 12,14,15 2,3,6,8,9, 16,20,21 4,5,13,17-19
X Y A	JP 6-299587 A (Inax Corp.), 25 October 1994 (25.10.1994), paragraphs [0013], [0014]; fig. 2 (Family: none)	1,7,10,11, 12,14,15 2,3,6,8,9, 16,20,21 4,5,13,17-19
Y	JP 9-4028 A (Inax Corp.), 07 January 1997 (07.01.1997), paragraphs [0028] to [0034]; fig. 1 to 4 (Family: none)	2,3,6,8,9

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 September 2016 (12.09.16)	20 September 2016 (20.09.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/069766

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-213881 A (Toto Ltd.), 11 August 2005 (11.08.2005), paragraphs [0015] to [0017]; fig. 3 (Family: none)	9
Y	JP 2015-74876 A (LIXIL Corp.), 20 April 2015 (20.04.2015), paragraphs [0016] to [0022]; fig. 2, 3 (Family: none)	16,20,21
Y	JP 2013-170396 A (TOTO Ltd.), 02 September 2013 (02.09.2013), paragraphs [0021] to [0023]; fig. 3 (Family: none)	20,21

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/069766

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Continued to extra sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/069766

Continuation of Box No.III of continuation of first sheet(2)

Document: JP 2000-355967 A (Toto Ltd.), 26 December 2000 (26.12.2000), paragraphs [0032] to [0034]; fig. 2 (Family: none)

Claims are classified into the following two inventions.

(Invention 1) claims 1-15

Claims 1 to 15 are classified into Invention 1 because the claims have a special technical feature, i.e., "a flush toilet comprising a toilet body which has a toilet bowl section and a water discharge section for discharging flush water into the toilet bowl section, the flush toilet being characterized in that the toilet bowl section has a receiving surface portion for receiving filth and a rim part connected to the upper edge of the receiving surface portion; the water discharge section has three water discharge ports formed in the rim part and allows the flush water to be discharged through the three water discharge ports in one circumferential direction along the inner circumferential surface of the rim part; the toilet bowl section has four split regions having been divided in plan view by a right-and-left center line and a back-and-forth center line, the right-and-left center line bisecting the right-and-left size of the outer surface portion of the toilet body, the back-and-forth center line bisecting the back-and-forth size of the inner surface portion of the toilet bowl section; and the three water discharge ports are formed individually in three respective ones of the four split regions."

(Invention 2) claims 16-21

Claims 16 to 21 have a technical feature common to claim 1 classified into Invention 1, i.e., "a flush toilet comprising a toilet body having a toilet bowl section, wherein the toilet bowl section has a receiving surface portion for receiving filth and a rim part connected to the upper edge of the receiving surface portion; the rim part has three water discharge ports formed therein; and the three water discharge ports discharge flush water therefrom in one circumferential direction along the rim part."

However, the above-said technical feature cannot be considered to be a special technical feature, since the technical feature does not make a contribution over the prior art in the light of the contents disclosed in the above-said document (particularly, see [0032]-[0034]).

Further, there is no other same or corresponding special technical feature between these inventions.

In addition, claims 16-21 are not dependent on claim 1.

Further, claims 16-21 have no relationship such that these claims are substantially same as or equivalent to any claim classified into Invention 1.

Consequently, claims 16-21 cannot be classified into Invention 1.

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Then, claims 16 to 21 are classified into Invention 2 because the claims have a special technical feature, i.e., "a flush toilet comprising a toilet body having a toilet bowl section, the flush toilet being characterized in that the toilet bowl section has a receiving surface portion for receiving filth, a rim part connected to the upper edge of the receiving surface portion, and a recessed portion formed to be recessed downwardly from the lower edge of the receiving surface portion; the recessed portion is partitioned by three vertical walls which are made up of, in plan view, a right vertical wall and a left vertical wall corresponding to the right and left sides of a triangle, respectively, with the base located in a rearward position of the right and left sides, and a rear vertical wall corresponding to the base; the rim part is provided with three water discharge ports which are made up of, in plan view, a first water discharge port provided in a sideward direction of the recessed portion, a second water discharge port provided in a frontward direction of the recessed portion, and a third water discharge port provided in a rearward direction of the recessed portion; and the three water discharge ports discharge flush water in one circumferential direction along the rim part."

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006009382 A **[0003]**
- JP 5553188 B **[0003]**
- JP 2015067954 A **[0003]**