(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 269 886 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
17.01.2018 Bulletin 2018/03

(21) Application number: **15884525.5**

(22) Date of filing: **09.03.2015**

(51) Int Cl.:
E03D 11/08 *(2006.01)*

(86) International application number:
PCT/JP2015/056813

(87) International publication number:
WO 2016/143029 (15.09.2016 Gazette 2016/37)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

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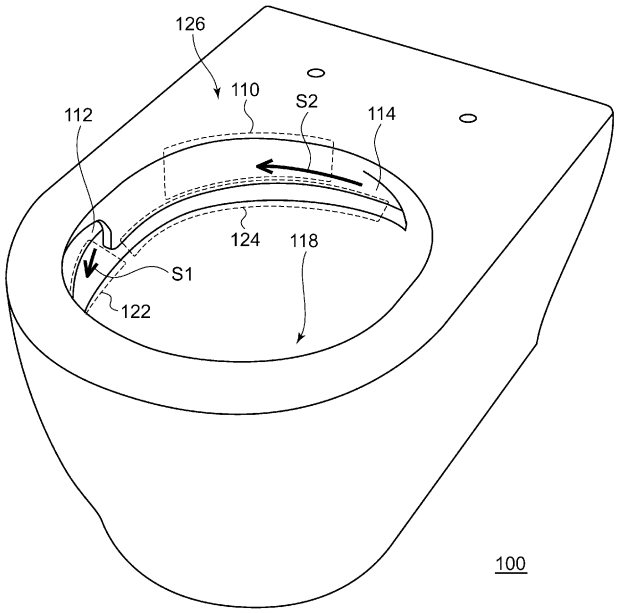
(54) FLUSH TOILET UNIT

(57) The disclosure relates to a flush toilet that includes a toilet bowl portion having first and second water discharge ports, a water supply unit that supplies cleaning water to the first and second water discharge ports, and a drain pipe for discharging retained water in the toilet bowl portion. The second water discharge port discharges water toward a rear region of the toilet bowl portion to form a second stream of water, and the first water discharge port is provided more forward than the second water discharge port in a direction of the second stream of water and discharges water toward an upper portion of the toilet bowl portion to form a first stream of water that swirls in a circumferential direction. An opening in the second water discharge port is located higher than an opening in the first water discharge port.

FIG. 3



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Description

[TECHNICAL FIELD]

[0001] The present invention relates to flush toilets and, in particular, relates to a flush toilet of a type that discharges cleaning water through a plurality of water discharge ports.

[BACKGROUND ART]

[0002] With regard to flush toilets, there is known a cleaning system in which cleaning water is discharged into a toilet bowl portion through one or more water discharge ports and waste is pushed out into a drain pipe by the force of that cleaning water. Hereinafter, the force that pushes out the waste in a toilet into a drain pipe is referred to as a "discharging force." In addition, a stream of water that cleans a broad range on the inner wall surface of a toilet bowl portion is required in order to prevent a piece of the waste from remaining on the inner wall surface of the toilet bowl portion. Hereinafter, the force that cleans the inner wall of a toilet bowl is referred to as a "cleaning force." In patent document 1, a first stream of water is discharged from a first water discharge port provided in an upper left portion of a toilet bowl to flow along the inner wall of the toilet bowl, and thus a swirling stream of water is formed to wash away the inner wall of the toilet bowl (refer to Fig. 4 of patent document 1). Furthermore, a second stream of water discharged from a second water discharge port provided in an upper right portion of the toilet bowl is made to join the first stream of water that has swirled to enhance the discharging force.

[patent document 1] International Publication No. 2014/027499

[PROBLEM TO BE SOLVED BY THE INVENTION]

[0003] In this manner, two functions, namely, the discharging force and the cleaning force are required for flush toilets. According to the flush toilet described in patent document 1, a broad range on two side surfaces and a front end surface of the inner wall of the toilet bowl can be washed away with the first stream of water.

[0004] The present inventors have recognized that a rear end surface, in particular, an upper portion of the rear end surface (hereinafter, simply referred to as a "rear region") of the inner wall of a toilet bowl is also likely to be soiled with a splash of waste. Although the first stream of water described in patent document 1 cleans the side surfaces, the front end surface, and a lower portion of the rear end surface of the inner wall of the toilet bowl, it is likely that the first stream of water does not sufficiently reach the rear region (an upper portion of the rear end surface). In addition, the second stream of water is for enhancing the force of the first stream of water that flows in a downward direction, that is, for enhancing the discharging force, and it is also likely that the second stream of water does not sufficiently reach the rear region.

[0005] The present invention has been completed on the basis of the recognition of the above issue by the present inventor and is primarily directed to providing a technique for effectively cleaning a rear region of a toilet bowl that is likely to be soiled with a splash of waste in a flush toilet.

[MEANS TO SOLVE THE PROBLEM]

[0006] A flush toilet according to the present disclosure includes a toilet main body and a water supply unit. The toilet main body includes a toilet bowl portion having first and second water discharge ports and a drain pipe for discharging retained water in the toilet bowl portion. The water supply unit supplies cleaning water to the first and second water discharge ports.

[0007] The second water discharge port discharges water in a horizontal direction toward a rear region between the first and second water discharge ports to form a second stream of water. The first water discharge port is provided more forward than the second water discharge port in a direction of the second stream of water and discharges water toward an upper portion of the toilet bowl portion to form a first stream of water that swirls in a circumferential direction.

[0008] An opening in the second water discharge port is located higher than an opening in the first water discharge port.

[0009] The flush toilet having the above configuration is provided with the water discharge port (the second water discharge port) for washing a rear end surface, in particular, a rear region, which is an upper region of the rear end surface, that is likely to be soiled with a splash of waste, and thus the cleaning effect of the flush toilet is further enhanced. The second water discharge port is provided at a position higher than that of the first water discharge port in order to prevent the vicinity of the upper end of the rear region from remaining unwashed as much as possible.

[0010] In the flush toilet configured as described above, it is preferable that, on an inner wall of the toilet bowl portion, a first water guiding unit be further formed in a circumferential direction from the first water discharge port and that a second water guiding unit be formed in a circumferential direction from the second water discharge port. In this case, it is preferable that the second water guiding unit is connected continuously with the first water guiding unit.

[0011] In the flush toilet configured as described above, it is preferable that the first water guiding unit be terminated before reaching the second water discharge port.

[0012] In the flush toilet configured as described above, it is preferable that more than 50%, in terms of the quantity of water, of the cleaning water supplied from the water supply unit be allocated to the first water dis-

charge port.

[0013] In the flush toilet configured as described above, it is preferable that a distance between the first water discharge port and the second water discharge port be more than or equal to one-fourth and less than or equal to two-fifths of an inner periphery of the toilet bowl portion.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0014]

Fig. 1 is a top view of a flush toilet;
Fig. 2 is a side sectional view of the flush toilet;
Fig. 3 is a first perspective view of the flush toilet;
Fig. 4 is a schematic diagram for describing a height-wise relationship between a first water discharge port and a second water discharge port;
Fig. 5 is an enlarged perspective view of the vicinity of the first water discharge port;
Fig. 6 is a second perspective view of the flush toilet;
Fig. 7 is a third perspective view of the flush toilet;
Fig. 8 is a perspective view of a flush toilet according to a first modification;
Fig. 9 is a perspective view of a flush toilet according to a second modification; and
Fig. 10 is a perspective view of a flush toilet according to a third modification.

[MODE FOR CARRYING OUT THE INVENTION]

[0015] Fig. 1 is a top view illustrating an example of a flush toilet. Fig. 2 is a side sectional view of the flush toilet illustrated in Fig. 1.

[0016] The following embodiments are described with an exemplary system in which cleaning water is discharged from two water discharge ports to form a swirling flow and thus the interior of a toilet is cleaned. However, the present invention is not limited to a configuration that includes two water discharge ports and can be applied to a flush toilet 100 that includes two or more water discharge ports.

[0017] The flush toilet 100 is roughly divided into a toilet main body 102 and a water supply unit 104. The toilet main body 102 includes a toilet bowl portion 106, a water retaining portion 118, and a drain pipe 120. The water retaining portion 118 is formed on a lower portion of the toilet bowl portion 106, and the drain pipe 120 is connected to the toilet bowl portion 106 through the water retaining portion 118. The water supply unit 104 supplies cleaning water to the toilet bowl portion 106.

[0018] The toilet bowl portion 106 is constituted as a receptacle having a bowl-shaped inner wall for receiving waste. The toilet bowl portion 106 according to the present embodiment includes two water discharge ports: a first water discharge port 112 (a main water discharge port) and a second water discharge port 114 (an auxiliary water discharge port).

[0019] Retained water remains all the time in the water retaining portion 118, and thus the smell of the drain pipe 120 is shut off. The waste that has fallen into the water retaining portion 118 is pushed out by the cleaning water along with the retained water into the drain pipe 120.

[0020] A "water passage (a passage through which the water is assumed to pass)" for the cleaning water is formed along an upper edge of the toilet bowl portion 106 on the upper end portion of the toilet bowl portion 106. The first water discharge port 112 is installed such as to communicate with the water passage along the upper edge of the toilet bowl portion 106. The cleaning water discharged from the first water discharge port 112 (hereinafter, a stream of water formed by the cleaning water discharged from the first water discharge port 112 is referred to as a "first stream of water S1") is discharged from the first water discharge port 112 into the toilet bowl portion. Specifically, the first stream of water S1 is discharged in a circumferential direction from the first water discharge port. The term "circumferential direction" as used herein refers to the direction that follows the water passage along the upper edge of the toilet bowl portion. The first stream of water S1 spirally flows downward inside the toilet bowl while circling or swirling on the inner wall surface (front end surface and two side surfaces) of the toilet bowl portion 102, falls into the water retaining portion 118, and is discharged from the drain pipe 120. The first stream of water S1 provides the cleaning force as broadly cleaning the inner wall of the toilet bowl portion 102 and also provides the discharging force by the water pressure thereof when falling downward.

[0021] Meanwhile, a first purpose of a second water discharge port 114 is to clean an upper portion of the rear end surface of the toilet bowl portion 102 (a rear region 110) . The second water discharge port 114 is also installed such as to communicate with the water passage provided along the upper edge of the toilet bowl portion 106. In the present embodiment, the first water discharge port and the second water discharge port serve as outlets through which the cleaning water that has passed through the water passage flows into the toilet.

[0022] The rear region 110 is likely to be soiled with stain adhered thereon as urine makes direct contact with that region when a male person urinates. In addition, depending on the position, the shape, and so on of the water retaining portion, there is a case in which adhered stain caused by a splash or a splatter of urine, feces, and other waste is more likely to soil the rear region 110 than other areas. Although a method can be contemplated in which the first stream of water S1 is made to make a large swirl and is then made to reach the rear region 110 in order to remove the stain adhered to the rear region 110, the cleaning water is less likely to reach a broad range on the rear region 110, in particular, the vicinity of the upper end of the rear region 110 with a sufficient force and in a sufficient amount through such a method. Therefore, in the present embodiment, the second water discharge port 114 is provided in order to clean the rear region 110

that is likely to be soiled. In addition, the second water discharge port 114 not only cleans the rear region 110 but also contributes to cleaning a broad range on the toilet bowl portion 106 by providing a portion of a swirling stream of water and contributes to enhancing the discharging force by providing a portion of the flow that pushes out the waste into the drain pipe 120 (details will be described later).

[0023] The "rear region 110" as used in the present embodiment refers to a region on an upper rear portion of the inner wall of the toilet bowl portion 102 and is a region that is expected to be soiled, in particular, with a splash of waste (stain expected region). The rear region 110 is at least a region between the first water discharge port 112 and the second water discharge port 114. To be more specific, when the center of gravity of the inner periphery of the toilet bowl portion 102 is represented by P, a perimeter of the rear region 110 is defined to a range in which an angle a formed by the rear region 110 with respect to the center of gravity P is from 30 degrees to 80 degrees or at least to a region in which the angle a is from 30 degrees to 60 degrees. In addition, at least, a height Z2 of the rear region 110 is less than or equal to a half of a distance Z1 (refer to Fig. 2) from the upper edge of the toilet bowl portion 106 to the water surface in the water retaining portion 118. In the present embodiment, the range from the upper end of the toilet bowl portion 106 to a second water guiding unit 124 (described later) is defined as the height of the rear region 110. The "water guiding unit" as used herein refers to a structure for defining a water passage by protruding like a shelf toward the inner side from the toilet bowl portion 106 or with a recess provided in the toilet bowl portion 106. The upper portion of the water guiding unit need not be a horizontal surface and may have a shape that includes an inclined surface.

[0024] The cleaning water discharged from the second water discharge port 114 (hereinafter, the stream of water formed by the cleaning water discharged from the second water discharge port 114 is referred to as a "second stream of water S2") is discharged in the horizontal direction toward the rear region 110 and then joins the first stream of water, the details of which will be described later. The "horizontal direction" as used herein does not mean the exact horizontal direction but means at least that the initial velocity of the second stream of water S2 has a greater velocity vector in the horizontal direction than in the vertical direction. In particular, it is ideal that the second water discharge port 114 can clean an area that thoroughly covers up to the vicinity of the upper end of the rear region 110.

[0025] The first water discharge port 112 is formed more forward (downstream side) than the second water discharge port 114 in the direction of the second stream of water S2 (counterclockwise in Fig. 1). In Fig. 1, the second water discharge port 114 is formed on a rear right side as the flush toilet 100 is viewed in the X-direction (front direction), and the first water discharge port 112 is formed on a left side. The rear region 110 is contained within a range from the leading end of the first water discharge port 112 to the leading end of the second water discharge port 114. Specifically, an angle b (> a) formed by the leading end of the first water discharge port 112 and the leading end of the second water discharge port 114 with respect to the center of gravity P is in a range from 90 degrees (one-fourth of the inner periphery of the toilet bowl) to 144 degrees (two-fifths of the inner periphery of the toilet bowl) and more preferably in a range from 100 degrees to 140 degrees. In addition, a large portion (more than 50% in terms of the quantity of water) of the cleaning water supplied from the water supply unit 104, preferably 70% to 85% thereof, is allocated to the first water discharge port 112, and the remaining cleaning water is allocated to the second water discharge port 114.

[0026] A second water guiding shelf 124 serving as a guide rail for the second stream of water S2 is formed from a starting point Q2 corresponding to the leading end of the second water discharge port 114 to an end point R2 corresponding to the terminal of the first water discharge port 112. The second water guiding shelf is an embodiment of a second water guiding unit. The second stream of water S2 discharged from the second water discharge port 114 is formed on the second water guiding shelf 124 (will be described in detail with reference to Figs. 3 and 4). A first water guiding shelf 122 serving as a guide rail for the first stream of water S1 is formed in an area from a starting point Q1 corresponding to the leading end of the first water discharge port 112 across the left side surface, the front end surface, and the right side surface of the toilet bowl portion 106. The first water guiding shelf is an embodiment of a first water guiding unit. The first water guiding shelf 122 is terminated at an end point R1 before reaching the leading end of the second water discharge port 114. Thus, an opening 130 is formed between the end point R1 and the starting point Q2 of the second water guiding shelf 124. The opening 130 will be described in detail with reference to Fig. 7.

[0027] Fig. 3 is a first perspective view of the flush toilet 100.

[0028] The flush toilet 100 illustrated in Fig. 3 is of a type that does not include a part (overhang) for preventing a splatter of water to an upper surface 126 of the toilet by the upper end portion of the toilet bowl portion 106 protruding toward the inner side. The design of the flush toilet 100 can be simplified as the flush toilet 100 does not include an overhang.

[0029] The second water discharge port 114 discharges the cleaning water toward the rear region 110 of the toilet bowl portion 102. The second water guiding unit 124 serving as a guide rail for the second stream of water S2 is formed from the second water discharge port 114 to the first water discharge port 112. The cleaning water discharged from the second water discharge port 114 forms the second stream of water S2 along the second water guiding unit 124 after cleaning the rear region 110 and reaches the first water discharge port 112.

[0030] The first water discharge port 112 discharges the cleaning water in the circumferential direction in the upper portion of the inner wall of the toilet bowl portion 102. From the first water discharge port 112, the first water guiding unit 122 is formed along the circumferential direction of the toilet bowl portion 102. The cleaning water discharged from the first water discharge port 112 forms the first stream of water S1 along the first water guiding unit 122 and swirls on the upper side of the front end surface and the side surfaces of the toilet bowl portion 102, which will be described later in detail.

[0031] The second water guiding shelf 124 is connected with the first water guiding shelf 122 smoothly, or in other words, continuously. Thus, the second stream of water S2 formed on the second water guiding shelf 124 smoothly joins the first stream of water S1 formed on the first water guiding shelf 122. In other words, the second stream of water S2 becomes a portion of the first stream of water S1 in the vicinity of the first water discharge port 112, which then together spirally flows downward while swirling on the upper portion of the inner wall of the toilet bowl portion 102. Hereinafter, the stream of water obtained after the first stream of water S1 and the second stream of water S2 join together is referred to as a "swirling stream of water S0." A large portion of the swirling stream of water S0 is the first stream of water S1, but the swirling stream of water S0 includes the second stream of water S2 as well.

[0032] Fig. 4 is a schematic diagram for describing the heightwise relationship between the first water discharge port 112 and the second water discharge port 114. Fig. 5 is an enlarged perspective view of the vicinity of the first water discharge port 112.

[0033] As described above, the role of the first stream of water S1 is to clean a broad range on the toilet bowl portion 102 while swirling on the water passage (the upper portion of the inner wall of the toilet bowl portion 102) along the first water guiding unit 122 and to push out the waste in the water retaining portion 118 into the drain pipe 120. Meanwhile, a primary role of the second stream of water S2 is to locally clean the rear region 110. The rear region 110 may be soiled up to the vicinity of the upper end thereof, and thus it is preferable that the water discharged from the second water discharge port 114 reach a region of the rear region 110 that is as high as possible. Therefore, it is desirable that the second water discharge port 114 be installed at a position that is as high as possible to an extend that the second stream of water S2 does not splatter above the rear region 110 to splash to the upper surface 126 of the flush toilet 100.

[0034] Meanwhile, in the case of the first stream of water S1, the necessity of reaching the upper end of the inner wall of the toilet bowl portion 102 is lower than that for the second stream of water S2. In view of the design purpose described above, in the present embodiment, the second water discharge port 114 is formed at a position higher than that of the first water discharge port 112. In Fig. 4, the height of the lower end of the opening in the first water discharge port 112 is H4, the width of the opening in the first water discharge port 112 is Z4, the height of the upper end of the opening in the first water discharge port 112 is H6, and the height of the center of the opening in the first water discharge port 112 is H5. The "height" as used herein is defined as the height from the bottom surface of the flush toilet 100, the height from the water surface of the retained water in the water retaining portion 118, or the height from the floor surface on which the flush toilet 100 is installed. In this case, H5 = H4 + Z4/2 and H6 = H4 + Z4 hold.

[0035] In a similar manner, in Fig. 4, the height of the lower end of the opening in the second water discharge port 114 is H1, the width of the opening in the second water discharge port 114 is Z3, the height of the upper end of the opening in the second water discharge port 114 is H2, and the height of the center of the opening in the second water discharge port 114 is H3. In this case, H3 = H1 + Z3/2 and H2 = H1 + Z3 hold.

[0036] Herein, that "the second water discharge port 114 is higher than the first water discharge port 112" means any one of the following:

(1) $H1 \geq H4$ (comparison of the lower ends) and $H3 > H5$ (comparison of the centers) hold;
(2) although $H1 < H4$ (comparison of the lower ends) holds, $H3 > H5$ (comparison of the centers) and $H2 > H6$ (comparison of the upper ends) hold; and
(3) although $H3 \leq H5$ (comparison of the centers) holds, $H1 > H4$ (comparison of the lower ends) holds.

[0037] The present embodiment (Fig. 4) corresponds to (1).

[0038] The case (1) means that the second water discharge port 114 is located at a position higher than that of the first water discharge port 112 when the centers of the openings (S3, S5) are compared and that the lower end of the opening in the second water discharge port 114 is located at a position that is the same as or higher than that of the lower end of opening in the first water discharge port 112 when the lower ends of the openings are compared. In this case, the second water guiding unit 124 extends horizontally or is inclined in a downward direction from the second water discharge port 114.

[0039] The case (2) means that the second water discharge port 114 is lower than the first water discharge port 112 when the lower ends of the openings (S1, S4) are compared, and thus the second water guiding unit 124 is inclined in an upward direction. However, both the center of the opening and the upper end of the opening in the second water discharge port 114 are higher than those of the first water discharge port 112.

[0040] The case (3) means that, although the second water discharge port 114 is located at a position lower than that of the first water discharge port 112 when the centers of the openings (S3, S5) are compared, the second water discharge port 114 is located at a position higher than that of the first water discharge port 112 when

the lower ends of the openings (S1, S4) are compared, and thus the second water guiding unit 124 is inclined in a downward direction.

[0041] In any of the above cases, the point is that the entirety or a portion of the cleaning water discharged from the second water discharge port 114 is provided with the potential energy higher than that of the cleaning water discharged from the first water discharge port 112 (the reason will be described later).

[0042] A larger amount of the cleaning water is allocated to the first water discharge port 112 than to the second water discharge port 114 such that the first stream of water S1 can clean a broad range on the inner wall surface of the toilet bowl portion 102. Thus, it is highly likely that, when the first water discharge port 112 that discharges water in a greater amount is installed at a high position, the water therefrom splashes more than does the water from the second water discharge port 114 that discharges water in a relatively smaller amount. Meanwhile, since the amount of water discharged from the second water discharge port 114 is relatively small, it is easier to install the second water discharge port 114 at a position higher than that of the first water discharge port 112. From such a viewpoint as well, it is rational to provide the second water discharge port 114 at a position higher than that of the first water discharge port 112, instead of allocating a large portion (more than or qeual to 50%, preferable 70% to 85%) of the cleaning water to the first water discharge port 112.

[0043] The second stream of water S2 flows toward the first water discharge port 112 along the second water guiding unit 124, which is inclined downward, after cleaning the rear region 110. The second water guiding unit 124, serving as a guide rail, forms the water passage for the second stream of water S2. The second water guiding unit 124 is smoothly connected with the first water guiding unit 122 (refer to Fig. 5) . The term "smoothly" as used herein means a state that is linear and continuous and has substantially no step.

[0044] The directions of the first stream of water S1 and the second stream of water S2 are both counterclockwise as viewed from the above, and the first water discharge port 112 is formed more forward than the second water discharge port 114 in the direction of the streams of water. Thus, if the height of the first water discharge port 112 is the same as the height of the second water discharge port 114, the second stream of water S2 loses a portion of its kinetic energy (the force of water) prior to joining the first stream of water S1, and a difference in the force of water is likely to be produced between the two streams of water when joining. However, in the present embodiment, the second water discharge port 114 is located at a position higher than that of the first water discharge port 112, and thus the second stream of water S2 can have an added force by the advantage amount corresponding to the potential energy. In this manner, although the second water discharge port 114 discharges water from a position behind the first water discharge port 112, since the second water discharge port 114 discharges water from a position higher than that of the first water discharge port 112, the force of the first stream of water and the force of the second stream of water can be brought close to each other, and the two streams of water can join smoothly.

[0045] When it is assumed that 70% to 85% of the cleaning water is allocated to the first water discharge port 112, the arc from the leading end of the first water discharge port 112 to the leading end of the second water discharge port 114 is preferably approximately one-fourth to two-fifths of the entire periphery of the toilet bowl portion 102. With such a design, a sufficiently large region can be secured for the rear region 110 (stain expected region) that is to be cleaned, the rear region 110 can be cleaned properly up to the vicinity of the upper end thereof with a relatively small amount of cleaning water from the second water discharge port 114, and the first stream of water S1 and the second stream of water S2 can join together with approximately the same force of water with ease.

[0046] When the first water discharge port 112 and the second water discharge port 114 are too close to each other, either one of the water discharge ports enters into a portion of the stain expected region (rear region 110) to be cleaned. For example, when the first water discharge port 112 is installed on a rear side instead of on a lateral side, the first water discharge port 112 may be soiled with waste. The first water discharge port 112 and the second water discharge port 114 need to be spaced apart from each other to a certain extent in order to secure a sufficiently large region for the stain expected region (rear region 110) . In contrast, when the two water discharge ports are spaced apart from each other excessively, the second stream of water loses too much of its force before joining the first stream of water. Such a trade-off needs to be taken into consideration when designing.

[0047] Fig. 6 is a second perspective view of the flush toilet 100.

[0048] The first stream of water S1 and the second stream of water S2 join together to form the swirling stream of water S0. The swirling stream of water S0 is formed in the circumferential direction on the upper portion of the inner wall of the toilet bowl portion 102 along the first water guiding unit 122. A portion of the swirling stream of water S0 washes the inner wall of the toilet bowl portion 102 upon falling from the first water guiding unit 122, but a large portion of the swirling stream of water S0 circles to the end point R1 (refer to Fig. 1) along the first water guiding unit 122. In this manner, the first water guiding unit 122, serving as a guide rail for the swirling stream of water S0, forms the water passage for the swirling stream of water S0.

[0049] Fig. 7 is a third perspective view of the flush toilet 100.

[0050] The first water guiding shelf 122 makes one circle on the inner wall of the toilet bowl portion 102, and a shelf terminal portion 128, which is a terminal portion of

the first water guiding shelf 122, is formed right before the second water discharge port 114. The shelf terminal portion 128 gradually becomes narrower and is terminated at the end point R1 before the second water discharge port 114, and thus a shelf discontinuous portion 130 is formed between the end point R1 and the second water discharge port 114 (refer also to Fig. 1). The swirling stream of water S0 that has circled on the inside of the toilet bowl portion 102 gradually loses its force until reaching the shelf terminal portion 128 of the first water guiding shelf 122, and a large portion of the swirling stream of water S0 falls toward the water retaining portion 118 from the opening 130 in the end. The toilet bowl portion 102 has a smooth inner wall surface on the shelf discontinuous portion 130, and thus the swirling stream of water S0 falls smoothly and at once into the water retaining portion 118, and the force of that falling water powerfully pushes out the waste in the water retaining portion 118. In other words, the fall of the swirling stream of water S0 provides the discharging force.

[0051] In summarizing the above, the flush toilet 100 can provide the local cleaning force targeting the rear region 110, in addition to the discharging force and the broad range cleaning force (targeting the front end surface and the side surfaces) . The water discharged from the first water discharge port 112 washes away the inner wall surface of the toilet bowl portion 102 while swirling in a broad range along the first water discharge port 112 (the cleaning force for the front surface and the side surfaces) and falls at once in a large amount after passing through the shelf terminal portion 128 to powerfully push out the waste (discharging force) .

[0052] Meanwhile, the water discharged from the second water discharge port 114 aims to clean the rear region 110, forms the second stream of water S2 along the second water guiding unit 124, and smoothly joins the first stream of water S1. The second stream of water S2 becomes a portion of the swirling stream of water S0 even after washing the rear region 110, and thus the second stream of water S2 can be used without being wasted. In addition, the second water discharge port 114 is provided at a relatively high position in order to wash the rear region 110, in particular, the upper portion thereof on which conventionally stain is likely to remain. Such a structure enhances the cleaning effect of the toilet bowl portion 102 as a whole.

[0053] Lastly, first to third modifications will be described additionally.

[0054] Fig. 8 is a perspective view of a flush toilet 100A according to a first modification.

[0055] In the first modification, the second water guiding unit 124 and the first water guiding unit 122 are not connected smoothly, but a step is provided therebetween. When a step is provided, the second water guiding unit 124 may be horizontal or may be inclined to a certain extent, as illustrated in Fig. 4. According to the first modification, the second stream of water S2 joins the first stream of water S1 such as to cover the first stream of water S1. In other words, the second stream of water S2 can be made to join the first stream of water S1 from above the first stream of water S1.

[0056] Fig. 9 is a perspective view of a flush toilet 100B according to a second modification.

[0057] In the second modification, an overhang 132 is formed along the upper periphery of the toilet bowl portion 102. The overhang 132 has an effect of preventing a splash of water or waste. Therefore, a configuration in which the overhang 132 is provided makes it easier to install the second water discharge port 114 at a higher position.

[0058] Fig. 10 is a perspective view of a flush toilet 100C according to a third modification.

[0059] The third modification is a combination of the first and second modifications. Specifically, a step is provided between the first water guiding unit 122 and the second water guiding unit 124, and the overhang 132 is formed.

[0060] As described thus far, continuously connecting the first water guiding unit 122, serving as a guide rail for the water discharged from the first water discharge port 112, with the second water guiding unit 124 makes it easier for the first stream of water S1 and the second stream of water S2 to join smoothly. A large portion of the water that has circled on the first water guiding unit 122 falls before the second water discharge port 114 . Making the first stream of water S1 fall sharply with keeping its force after the first stream of water S1 circling within the toilet bowl makes it easier to effectively push down the waste into the drain pipe. A sufficiently large region can be secured for the rear region 110 (stain expected region) that is to be cleaned, the rear region 110 can be cleaned broadly with a relatively small amount of cleaning water from the second water discharge port 114, and the first stream of water S1 and the second stream of water S2 can join together with approximately the same force of water with ease.

[0061] According to the present invention represented by the embodiments described thus far, with a configuration in which the second water discharge port is provided at a position higher than that of the first water discharge port in the vertical direction, while the function as an auxiliary stream of water that supports the swirling is retained, the stream of water can be sent out efficiently to an area on the upper rear portion inside the toilet bowl to which stain is likely to adhere. As a result, the upper rear area to which stain is likely to adhere can be cleaned efficiently and effectively without increasing the amount of water to be used.

[0062] In addition, with regard to the direction in which the water swirls, as the starting point of the first water guiding unit and the end point of the second water guiding unit are configured continuously, the first stream of water and the second stream of water can join smoothly, and the streams of water can be used efficiently for the toilet cleaning performance.

[0063] In addition, with regard to the direction in which

the water swirls, as the end point of the first water guiding unit and the starting point of the second water guiding unit are configured discontinuously, a large portion of the stream of water that has circled inside the toilet while being guided by the first water guiding unit can be easily made to fall before the second water discharge port. Making the first stream of water fall sharply with keeping its force after the first stream of water circling within the toilet bowl makes it easier to effectively push down the waste into the drain pipe.

[0064] In addition, with a configuration in which the distance between the first water discharge port and the second water discharge port in the circumferential direction is more than or equal to one-fourth and less than or equal to two-fifths of the inner periphery of the toilet bowl portion, the swirling stream can be formed efficiently without increasing the amount of water to be used, and a region in the upper rear of the inner surface of the toilet bowl to which stain is likely to adhere can be cleaned efficiently by using the stream of water discharged from the second water discharge port. In particular, this configuration is most effective when the ratio of the amount of water discharged from the first water discharge port to the amount of water discharged from the second water discharge port is (7 to 8.5):(3 to 1.5).

[0065] The present invention is not limited to the above embodiments. Modification, corrections, or improvements can be made within the scope that does not depart from the appended claims, and such modification, corrections, or improvements also belong to the claims of the present invention. In addition, those construed to be equivalent to the shapes, the functions, or the configurations in the present disclosure are also encompassed by the scope of the present invention.

[INDUSTRIAL APPLICABILITY]

[0066] The present invention can be applied to flush toilets and, in particular, to a flush toilet of a type that discharges cleaning water through a plurality of water discharge ports.

Claims

1. A flush toilet, comprising:

a toilet main body that includes a toilet bowl portion having first and second water discharge ports and a drain pipe for discharging retained water in the toilet bowl portion; and
a water supply unit that supplies cleaning water to the first and second water discharge ports, wherein:

the second water discharge port discharging water toward a rear region between the first and second water discharge ports to form a second stream of water;
the first water discharge port being provided more forward than the second water discharge port in a direction of the second stream of water and discharging water toward an upper portion of the toilet bowl portion to form a first stream of water that swirls in a circumferential direction; and
an opening in the second water discharge port being located higher than an opening in the first water discharge port.

2. The flush toilet according to claim 1, wherein
on an inner wall of the toilet bowl portion, a first water guiding unit is further formed in a circumferential direction from the first water discharge port, a second water guiding unit is formed in a circumferential direction from the second water discharge port, and the second water guiding unit is connected continuously with the first water guiding unit.

3. The flush toilet according to claim 2, wherein
the first water guiding unit is terminated before reaching the second water discharge port.

4. The flush toilet according to claim 1, wherein
on an inner wall of the toilet bowl portion, a first water guiding unit is further formed in a circumferential direction from the first water discharge port, and the first water guiding unit is terminated before reaching the second water discharge port.

5. The flush toilet according to any one of claims 1 to 4, wherein
more than 50%, in terms of the quantity of water, of the cleaning water supplied from the water supply unit is allocated to the first water discharge port.

6. The flush toilet according to any one of claims 1 to 5, wherein
a distance between the first water discharge port and the second water discharge port is more than or equal to one-fourth and less than or equal to two-fifths of an inner periphery of the toilet bowl portion.

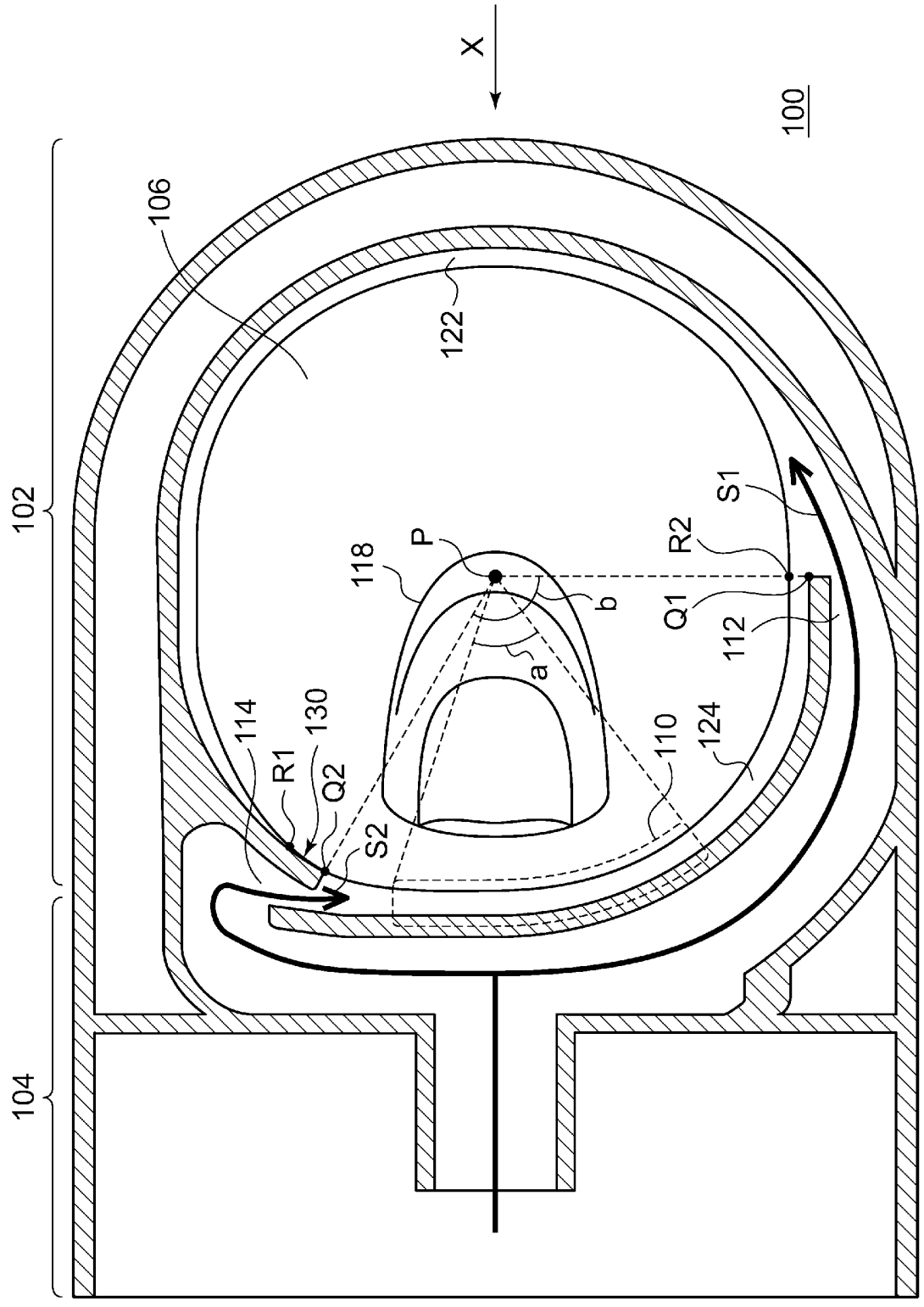


FIG. 1

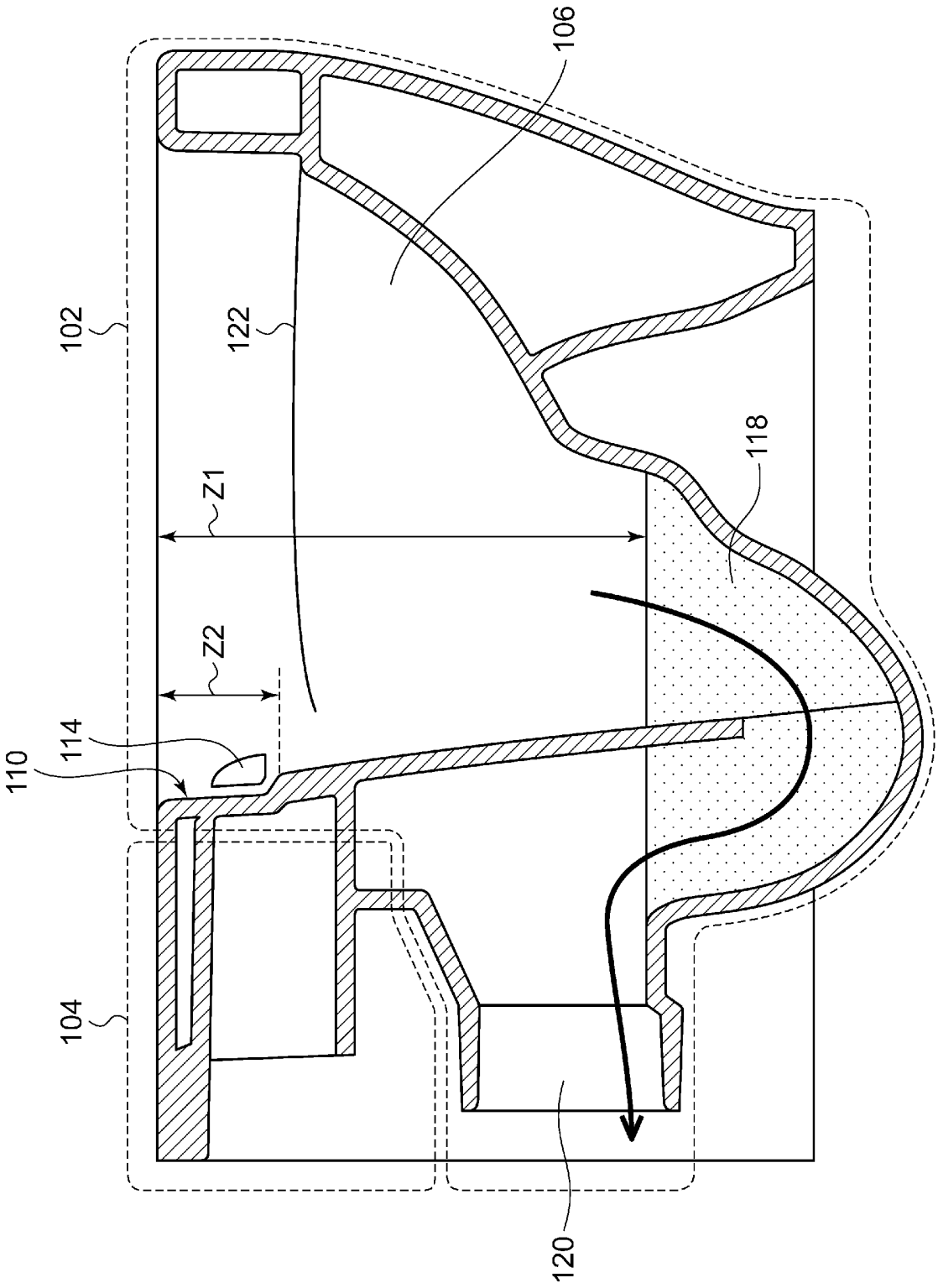


FIG. 2

FIG. 3

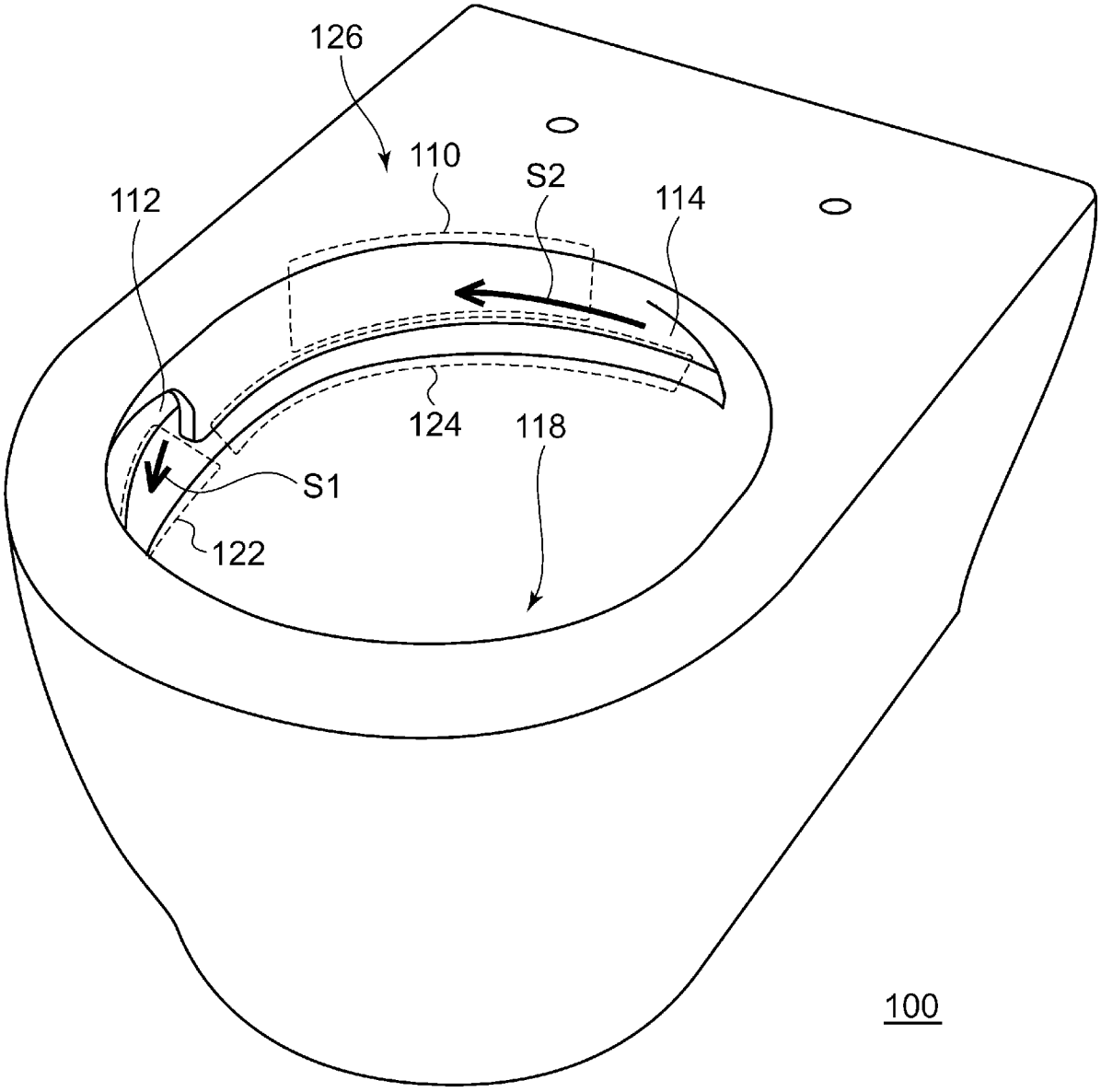
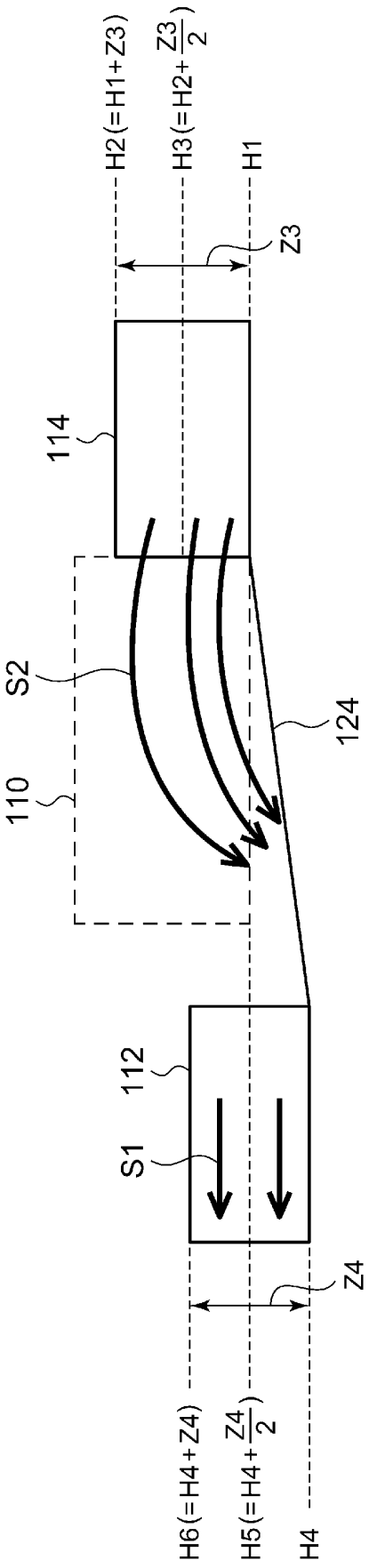


FIG. 4


H2(=H1+Z3)
H3(=H2+Z3/2)
H1
Z3
114
S2
110
124
112
S1
Z4
H6(=H4+Z4)
H5(=H4+Z4/2)
H4

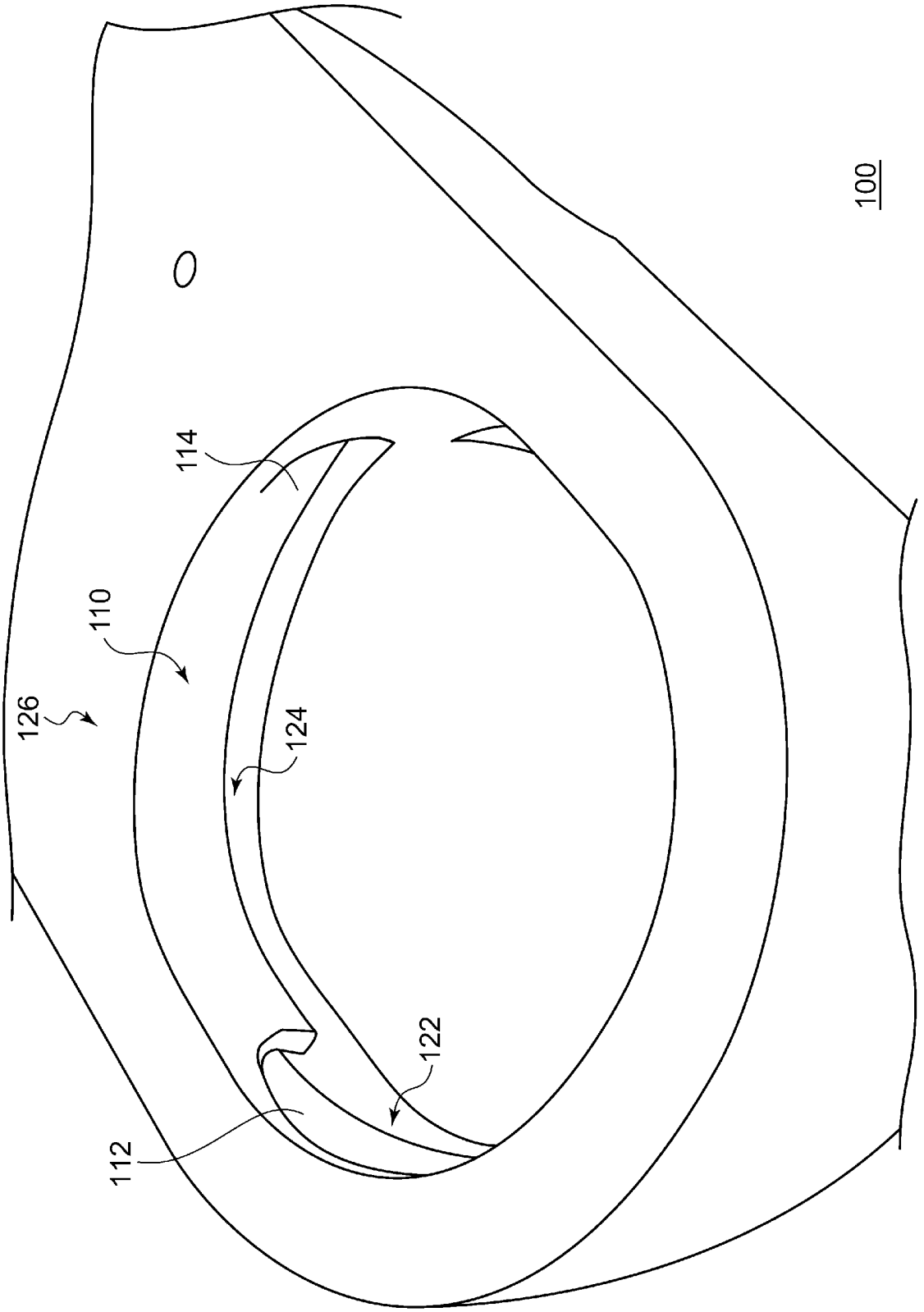


FIG. 5

FIG. 6

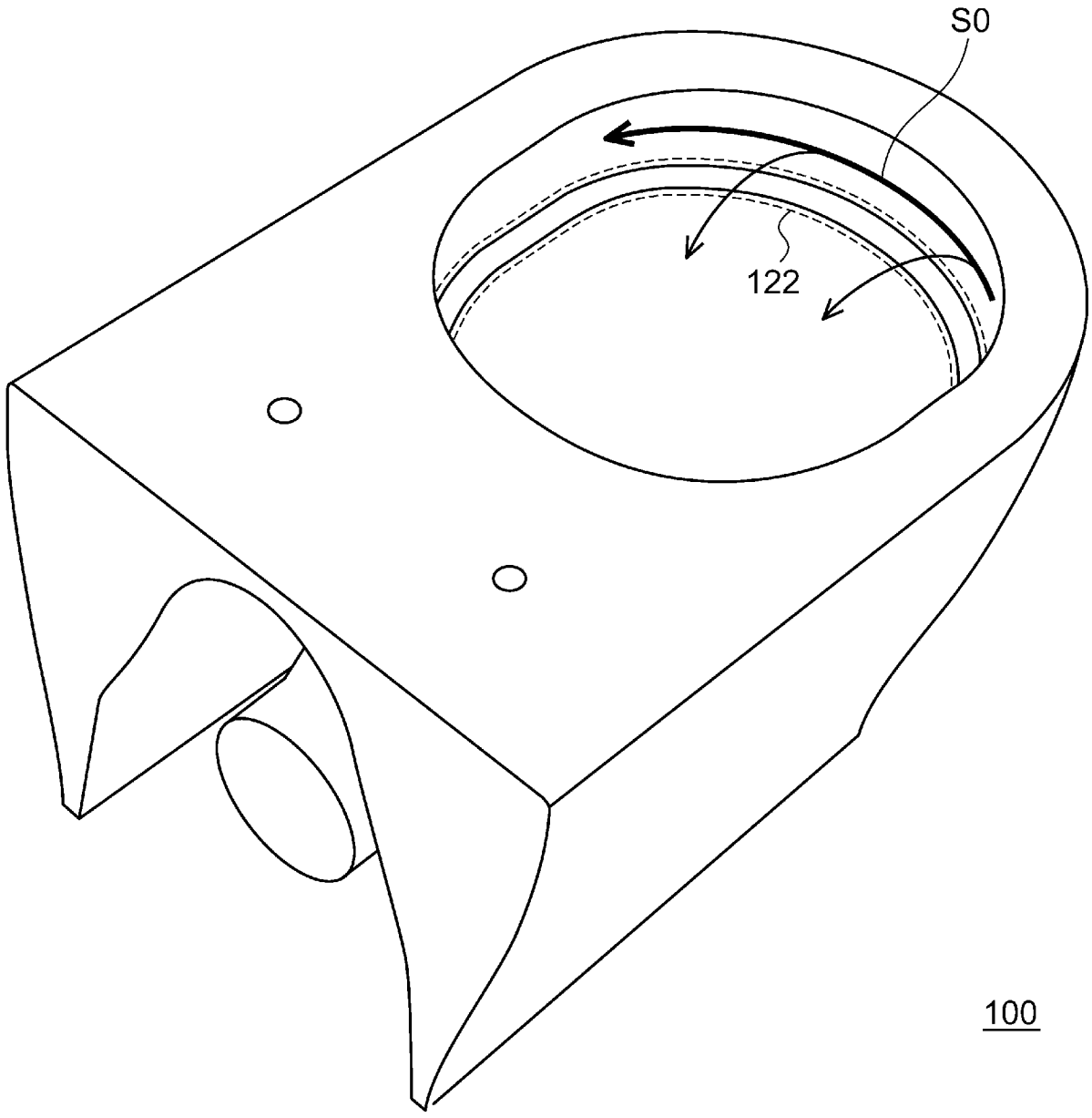
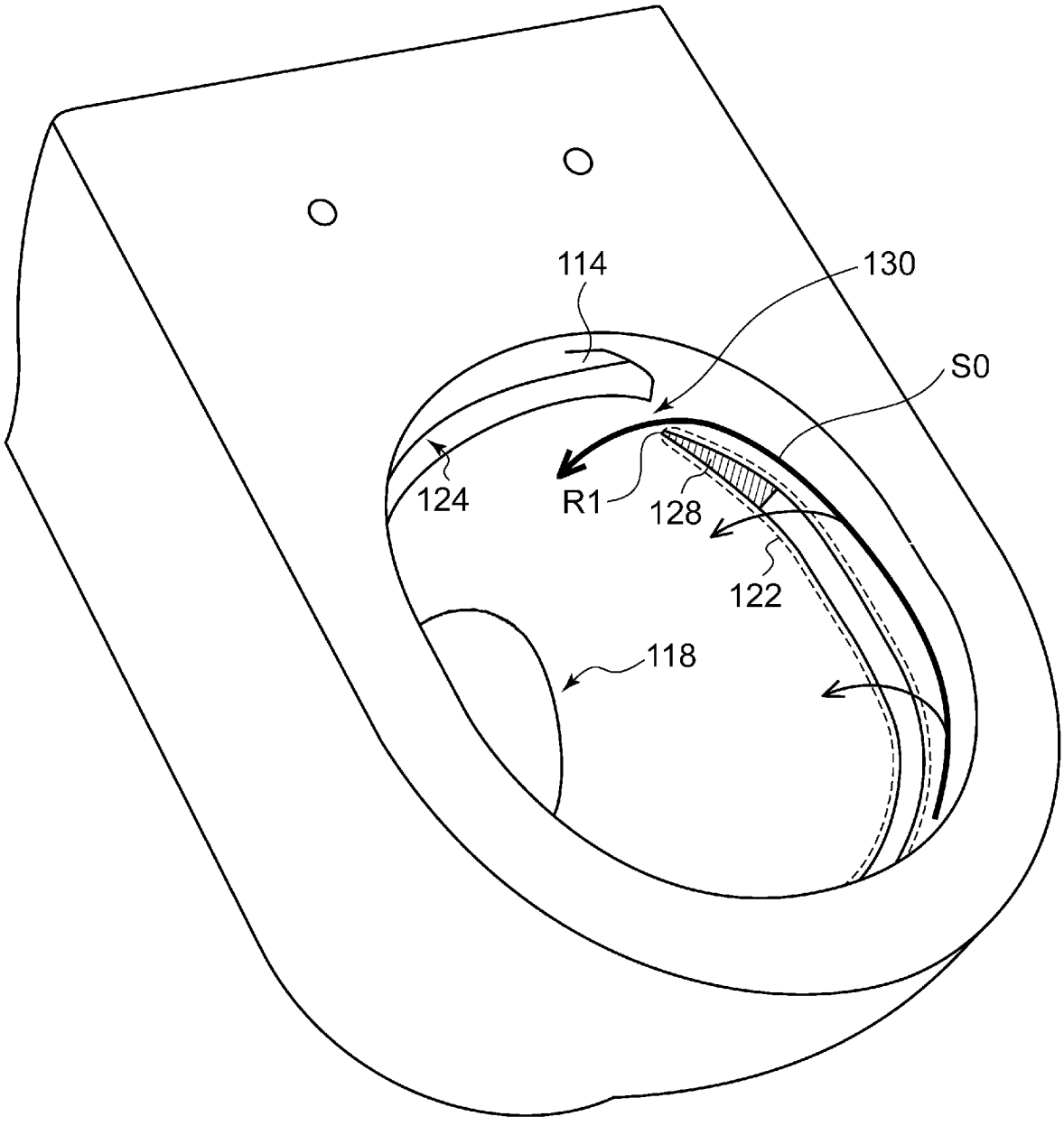


FIG. 7



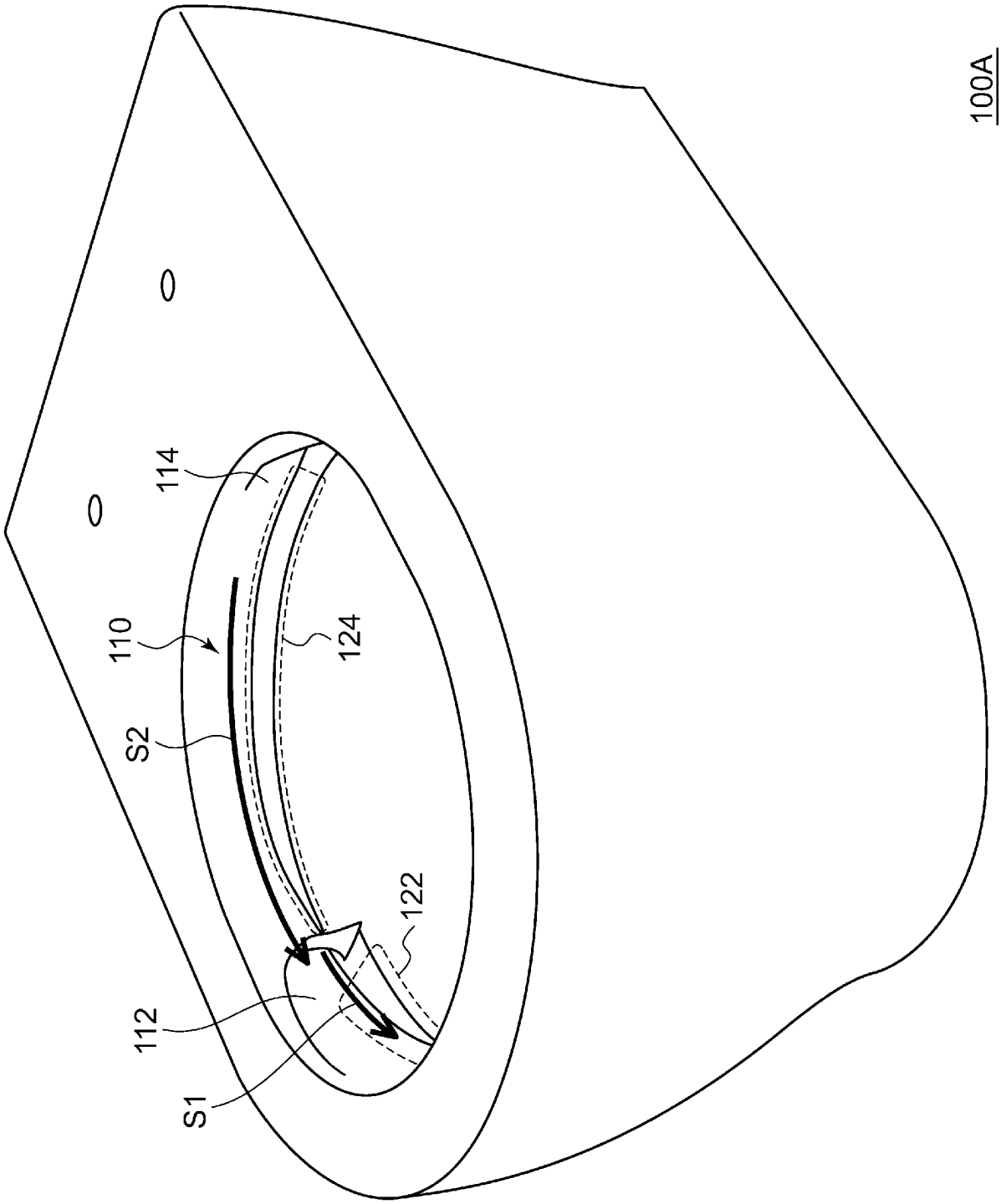
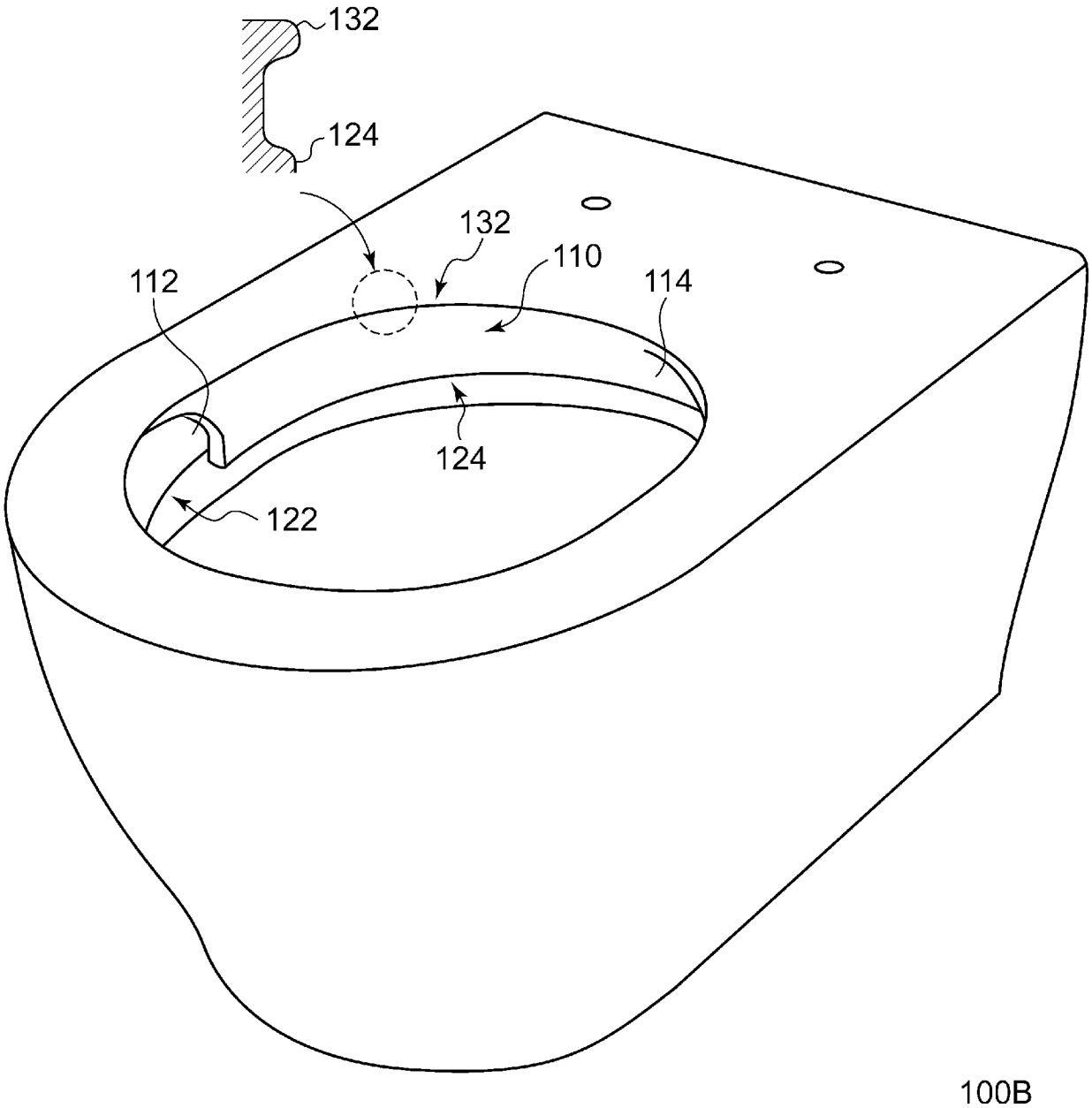


FIG. 8

FIG. 9



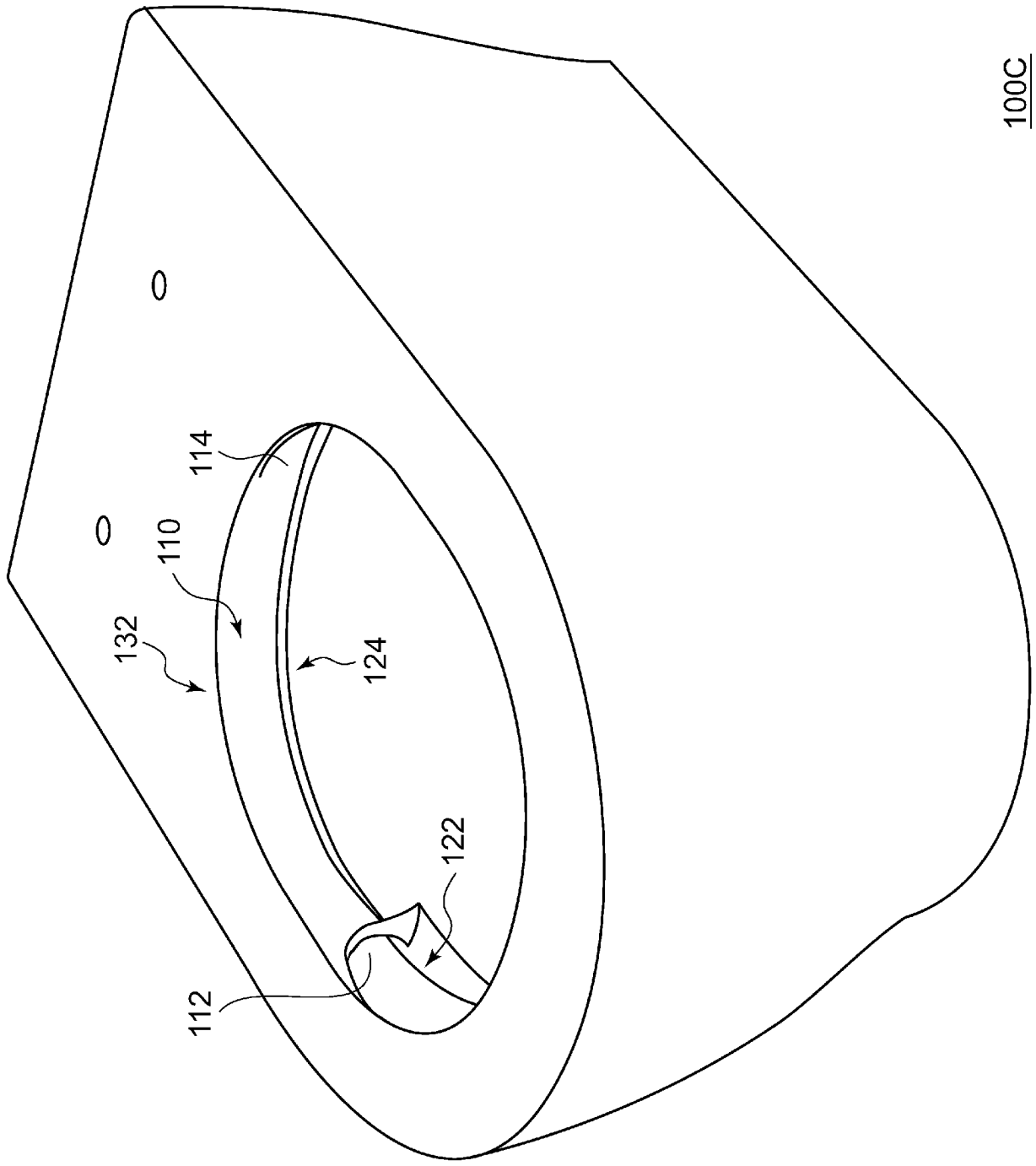


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/056813

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 1996-2015
Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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.
A	JP 2010-229738 A (Panasonic Electric Works Co., Ltd.), 14 October 2010 (14.10.2010), paragraphs [0029] to [0031]; fig. 3A (Family: none)	1-6
A	JP 2011-174363 A (LIXIL Corp.), 08 September 2011 (08.09.2011), paragraphs [0018], [0019], [0022]; fig. 3 to 6 (Family: none)	1-6
A	JP 2014-5594 A (TOTO Ltd.), 16 January 2014 (16.01.2014), paragraphs [0019], [0020], [0028] to [0031]; fig. 1 to 4 (Family: none)	1-6

☒ 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
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"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
21 May 2015 (21.05.15)	02 June 2015 (02.06.15)
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) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/056813

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2013-194410 A (TOTO Ltd.), 30 September 2013 (30.09.2013), paragraph [0024]; fig. 1 to 5 (Family: none)	1-6

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2014027499 A **[0002]**