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(54) **URINAL**

(57) Provided in embodiments of the present disclosure is a urinal, comprising a urinal body. The urinal body comprises: a nozzle and a water inlet; and a flushing surface that comprises a front surface which is opposite to a person when in use. The urinal body is characterized in that the front surface of the flushing surface comprises a curved surface of steepest descent, the curved surface of steepest descent using the shape of a curve of steepest descent presented by a contour obtained by cross-cutting via a horizontal plane. The urinal in embodiments of the present disclosure has a large flushing area and a good anti-overflow effect, can be used under a working condition with relatively low water pressure, and consumes a small amount of flushing water a time, thereby saving water resources.

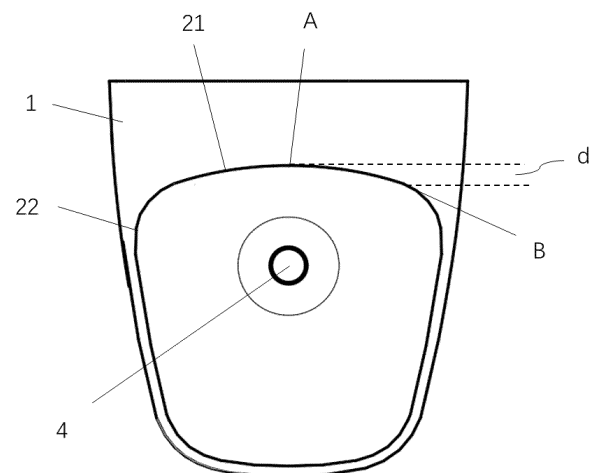


FIG. 3

## Description

**[0001]** This application claims the benefit of priority to Chinese Patent Application No. 202220705526.X, filed with China National Intellectual Property Administration on 29 March 2022 and entitled "URINAL", the entire disclosure of which is incorporated herein by reference.

## TECHNICAL FIELD

**[0002]** Embodiments of the present disclosure relate to the technical field of washroom appliances, and in particular, to urinals.

## BACKGROUND

**[0003]** Urinals are mostly used in washrooms in public buildings such as hotels, shopping malls, parks, etc., and could also be used in household bathrooms.

**[0004]** A designed water consumption of a traditional urinal is mostly 0.9L to 3L, which is a large amount of water. In order to ensure a flushing effect of the bottom surface, a traditional urinal is always designed with a gutter structure to guide the flushing water to the front end and complete the flushing of the bottom surface. However, the gutter structure has a visual sense of fragmentation.

## SUMMARY

**[0005]** In order to solve problems of traditional urinals that consume a large amount of water, waste water resources, and have poor visual effects, embodiments of the present disclosure provide a urinal.

**[0006]** A urinal according to embodiments of the present disclosure includes a urinal body, and the urinal body includes: a nozzle and a water inlet; a flushing surface including an opposite surface facing a person when in use; the opposite surface of the flushing surface includes a Brachistochrone Curve surface having a Brachistochrone Curve shape outline obtained by transecting the Brachistochrone Curve surface with a horizontal plane.

**[0007]** In some embodiments, a line connecting the water inlet and the nozzle on the flushing surface constitutes a centerline, and a point on the centerline is a point with the smallest curvature on the Brachistochrone Curve surface.

**[0008]** In some embodiments, the Brachistochrone Curve surface is symmetric about the centerline.

**[0009]** In some embodiments, the Brachistochrone Curve starts from a point on the centerline and extends toward two sides thereof in a horizontal direction.

**[0010]** In some embodiments, the flushing surface further includes oblique side surfaces located on two sides of the opposite surface, being inclined planes, and having a circular arc transition with the Brachistochrone Curve surface.

**[0011]** In some embodiments, the flushing surface further includes a water sealing surface located between the two oblique side surfaces, and having an outline including a Brachistochrone Curve shape and a circular arc shape and obtained by transecting the water sealing surface with a horizontal plane.

**[0012]** In some embodiments, the Brachistochrone Curve surface, the oblique side surfaces and the water sealing surface form a cone with an inclined opening, and the lowest point of the inclined opening is located on the water sealing surface.

**[0013]** In some embodiments, an intersection of the Brachistochrone Curve surface, the oblique side surfaces and the water sealing surface is a circular arc transition.

**[0014]** In some embodiments, a water pressure of a flushing water sprayed by the nozzle is less than 0.7MPa.

**[0015]** In some embodiments, the water sealing surface is funnel-shaped, suitable for preventing the flushing water from overflowing from the urinal body, an outline obtained by transecting the water sealing surface on a side of the urinal body is a first curve, and the first curve includes a first point and a second point. The first point is an intersection point of the water sealing surface and the water inlet. The second point is a sudden increase point of a curvature when extending along the first curve towards the highest point of the water sealing surface. The curvature of the first curve is minimum between the first point and the second point. A vertical distance between the first point and the second point is less than or equal to 10mm.

**[0016]** Compared with the prior art, technical solutions of embodiments of the present disclosure have following beneficial effects:

**[0017]** A Brachistochrone Curve surface is included in an opposite surface of a flushing surface of a urinal according to embodiments of the present disclosure. When a distance between a nozzle and a water inlet is fixed, a falling time of water droplets is fixed. On the Brachistochrone Curve surface, the water droplets could flush to a longer distance in a horizontal direction, resulting in a larger flushing area and an improved flushing capacity and flushing effect.

**[0018]** A urinal according to embodiments of the present disclosure has a nozzle spraying a flushing water with a water pressure of less than 0.7MPa and a one time spray water amount of less than or equal to 0.5L, could achieve a purpose of flushing under a low water pressure condition, and consumes a smaller one time amount of flushing water and saves more water resources than traditional urinals.

**[0019]** A water sealing surface of a urinal according to embodiments of the present disclosure is funnel-shaped, a first curve is obtained by transecting the water sealing surface on a side of a urinal body, and the first curve includes a first point and a second point. The first point is an intersection point of the water sealing surface and the water inlet. The second point is a sudden increase point

of a curvature when extending along the first curve towards the highest point of the water sealing surface. A vertical distance between the first point and the second point is less than or equal to 10mm. Such a structural design prevents the flushing water from easily overflowing from the urinal body during a flushing process, and the water sealing surface has a good water storage capacity and anti-overflow effect.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0020]** Other features and advantages of the present disclosure will be better understood from the following detailed description of optional embodiments in conjunction with the accompanying drawings, in which like reference numerals refer to same or similar parts, in which:

FIG. 1 shows a schematic structural diagram of a conventional urinal with a gutter;

FIG. 2 shows a schematic front structural view of a urinal according to an embodiment of the present disclosure;

FIG. 3 shows a schematic top structural view of a urinal according to an embodiment of the present disclosure, in a cross-section at a nozzle;

FIG. 4 shows a schematic top structural view of a urinal according to an embodiment of the present disclosure, in a horizontal cross-section at a water sealing surface;

FIG. 5 shows a schematic side structural view of a urinal according to an embodiment of the present disclosure.

#### DETAILED DESCRIPTION

**[0021]** Embodiments of the present disclosure are described in detail below, examples of which are illustrated in the accompanying drawings. In the drawings, same or similar reference numerals represent same or similar elements or elements with same or similar functions. Embodiments described below with reference to the drawings are exemplary, are only used to explain the present disclosure, and are not to be construed as limitations of the present disclosure.

**[0022]** Unless otherwise defined, technical or scientific terms used herein shall have their ordinary meanings understood by a person of ordinary skill in the art to which this disclosure belongs. In the description of the present disclosure, it should be understood that orientations or positional relationships indicated by terms "center", "longitudinal", "lateral", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer", etc. are based on the orientations or positional relationships shown in the drawings, and are only

for the convenience and the simplification of describing the present disclosure. The description does not indicate or imply that a device or an element referred to must have a particular orientation, be constructed and operated in a particular orientation, and hence is not to be construed as a limitation on the disclosure.

**[0023]** In order to solve the problems of traditional urinals with large water consumption and poor visual effects, embodiments of the present disclosure provide a urinal with advantages of small water consumption and large flushing area. The urinal provided by embodiments of the present disclosure will be described in detail below with reference to the accompanying drawings.

**[0024]** FIG. 1 shows a schematic structural diagram of a conventional urinal with a gutter. Referring to FIG. 1, a conventional urinal includes a urinal body 1', which includes a flushing surface 2', and two gutters 21' provided on the flushing surface 2'. The function of the gutters 21' is to guide a flow direction of a flushing water to ensure a flushing effect. It is obvious that the gutters 21' have a visual sense of fragmentation.

**[0025]** FIG. 2 shows a schematic front structural view of a urinal according to an embodiment of the present disclosure. Referring to FIG. 2, a urinal provided by embodiments of the present disclosure includes a urinal body 1. The urinal body 1 includes: a nozzle 3, a water inlet 4 and a flushing surface 2. The flushing surface 2 includes an inner wall from the nozzle 3 to the water inlet 4. The inner wall includes an opposite surface facing a person when in use. The opposite surface of the flushing surface 2 includes a Brachistochrone Curve surface 21, and an inner outline of a horizontal cross-section of the Brachistochrone Curve surface 21 has a Brachistochrone Curve shape.

**[0026]** FIG. 3 shows a schematic top structural view of a urinal according to an embodiment of the present disclosure, in a cross-section at a nozzle. Referring to FIG. 3, the flushing surface 2 also includes oblique side surfaces 22 located on two sides of the Brachistochrone Curve surface 21 of the flushing surface. The oblique side surfaces 22 are inclined planes. There is a circular arc transition between the Brachistochrone Curve surface 21 and the oblique side surfaces 22. A surface curvature at the circular arc transition is greater than a surface curvature of the Brachistochrone Curve surface 21.

**[0027]** FIG. 4 shows a schematic top structural view of a urinal according to an embodiment of the present disclosure, in a horizontal cross-section at a water sealing surface. Referring to FIG. 4, the flushing surface 2 (not shown) also includes a water sealing surface 23 located between the two oblique side surfaces 22. Using a horizontal plane to transect the water sealing surface 23, an obtained outline includes a Brachistochrone Curve shape 231 and a circular arc shape 232. The Brachistochrone Curve shape 231 is located on a side directly opposite a urinal user, and the circular arc shape 232 is located on a side close to the urinal user.

**[0028]** In some embodiments, the Brachistochrone

Curve surface 21, the oblique side surfaces 22 and the water sealing surface 23 form a cone with an inclined opening, and the lowest point of the inclined opening is located on the water sealing surface 23.

**[0029]** In some embodiments, an intersection of the Brachistochrone Curve surface 21, the oblique side surfaces 22 and the water sealing surface 23 is a circular arc transition.

**[0030]** FIG. 5 shows a schematic side structural view of a urinal according to an embodiment of the present disclosure. Referring to FIG. 5, the water sealing surface 23 is in a shape of a funnel, and is suitable for preventing a flushing water from overflowing from the urinal body 1. The water sealing surface 23 is in a shape of an asymmetrical funnel. A side of the water sealing surface 23 close to a urinal user has a larger area than the other side.

**[0031]** Referring to FIG. 5, an outline obtained by transecting the water sealing surface 23 on a side of the urinal body 1 is a first curve, and the first curve includes a first point and a second point. The first point is the lowest point of the water sealing surface 23 and the lowest point of the inclined opening of the cone composed of the Brachistochrone Curved surface 21, the oblique side surfaces 22 and the water sealing surface 23. The second point is a sudden increase point of a curvature when extending along the first curve towards the highest point of the water sealing surface 23. A curvature of the first curve is minimum between the first point and the second point.

**[0032]** In some embodiments, a vertical distance  $h_3$  between the first point and the second point is less than or equal to 10mm.

**[0033]** Continuing to refer to FIG. 5, a vertical distance  $h_2$  between the lowest point and the highest point of the water sealing surface 23 is not less than 50mm.

**[0034]** The Brachistochrone Curve surface 21 will be described in detail below with reference to FIGS. 2 and 3. Referring to FIGS. 2 and 3, a line connecting the water inlet 4 and the nozzle 3 on the flushing surface 2 constitutes a centerline 5. A point on the centerline 5 is a point with the smallest curvature, 0, on the Brachistochrone Curve surface. The Brachistochrone Curve surface 21 is symmetrical about the centerline 5.

**[0035]** Referring to FIGS. 2 and 3, taking a point on the centerline 5 as a starting point and extending horizontally to left and right sides along the Brachistochrone Curve surface 21, a Brachistochrone Curve is obtained. A starting point of the Brachistochrone Curve is a point on the centerline 5, and an ending point is a point where the Brachistochrone Curve at the same horizontal level intersects the oblique side surfaces 22. Plural Brachistochrone Curves form the Brachistochrone Curve surface 21. A horizontal range of the Brachistochrone Curve surface 21 includes the flushing surface between the two oblique side surfaces 22, and a vertical range includes the flushing surface from the nozzle 3 to the water inlet 4.

**[0036]** Referring to FIGS. 2 and 3, a position A of the

nozzle 3 on the flushing surface 2 has the smallest curvature. Extending horizontally from the nozzle 3 toward two sides according to the Brachistochrone Curve to a curvature mutation position B, a horizontal distance between the position A and the position B is d.

**[0037]** A working principle of embodiments of the present disclosure is: the flushing problem of a urinal mainly depends on a design of a flushing surface, and an arc shape of the flushing surface is inspired by a Brachistochrone Curve surface. According to principles of mechanics, two tracks are placed on an inclined plane, one track is straight, the other track is curved, and both tracks have the same starting and ending heights. Two small balls of same masses and sizes fall downward from the starting point at the same time, the small ball on the curved track reaches the ending point first. Because the small ball on the curved track reaches the highest speed first, it arrives first. However, there is only one straight line between two points, there are countless curves. So, which curve is the fastest? In 1696, Swiss mathematician John Bernoulli solved this problem. A Brachistochrone Curve is a cycloid, also called a spinning wheel line. A ratio of the sine of an angle between a tangent and a plumb at any point to a square root of a falling height of that point is a constant.

**[0038]** Since the Brachistochrone Curve surface has this unique property, that is, from a high point to a low point, a small ball takes the shortest time to move along the Brachistochrone Curve surface, and, since a height between a spray hole and a water inlet of a urinal is a constant value, if a water droplet replaces a small ball, it will be affected by gravity in a vertical direction, and a falling time is a constant value. At the same time, the water droplet will travel the longest distance on a cross section. Therefore, a purpose of maximizing a flushing area could be achieved. The sewage is discharged completely.

**[0039]** Referring to FIG. 2, a bottom width w of the flushing surface 2 is the bottom width of the Brachistochrone Curve surface 21, and the bottom width w of the flushing surface 2 is not less than 140mm. A vertical distance from the nozzle 3 to the water inlet 4 is  $h_1$ . A relationship between  $h_1$  and w is:  $h_1 > w$ .

**[0040]** In some embodiments, the nozzle 3 is adapted to spray a flushing water in a set direction to flush the flushing surface 2 of the urinal. Directions in which the nozzle 3 sprays the flushing water include at least two horizontal sides of the nozzle 3. A water pressure of the flushing water sprayed by the nozzle 3 is less than 0.7MPa, and the urinal could be used in low-pressure working conditions and solve the problem of flushing in low-pressure working conditions. A water consumption of a single spray of the nozzle 3 is less than 0.5L, smaller than a usual water consumption of 0.9L to 3L of convention urinals.

**[0041]** As a specific embodiment, the bottom width w of the flushing surface 2 of the urinal 1 is greater than 140mm, and is selected to be 198mm. The vertical dis-

tance from the nozzle 3 to the water inlet 4 is 446mm, greater than 198mm. A first curve is obtained by transecting the water sealing surface 23 on the side of the urinal body 1. A vertical distance  $h_3$  between the first point and the second point on the first curve is 7mm. A vertical distance  $h_2$  between the lowest point and the highest point of the water sealing surface 23 is 50mm, and the water sealing surface 23 could accommodate 2L of the flushing water and has an excellent anti-overflow effect. Taking a horizontal cross-section of the urinal at the nozzle 3, two Brachistochrone Curves extending horizontally to the left and the right from the nozzle 3 are obtained. The nozzle 3 is located at a position A with the smallest curvature, and a position B has a sudden change in curvature on the Brachistochrone Curve. A horizontal distance d between the position A and the position B is 18mm.

**[0042]** Compared with traditional urinals, a urinal provided by embodiments of the present disclosure uses less water when flushing a same area; and could flush a larger inner wall area of a urinal body with a same water consumption. Therefore, a urinal provided by embodiments of the present disclosure achieves flushing of a larger area with less water consumption by improving the flushing surface of the inner wall of the urinal body.

**[0043]** The above-described exemplary embodiments are only used to illustrate principles of the present disclosure and are not intended to limit the protection scope of the present disclosure. For those of ordinary skill in the art, various modifications and improvements could be made without departing from the spirit and essence of the present disclosure, and these modifications and improvements are also within the protection scope of the present disclosure.

## Claims

1. A urinal, **characterized by** comprising a urinal body, the urinal body comprising:

a nozzle and a water inlet;  
a flushing surface comprising an opposite surface facing a person when in use;  
wherein  
the opposite surface of the flushing surface comprises a Brachistochrone Curve surface, and the Brachistochrone Curve surface has a Brachistochrone Curve shape outline obtained by transecting the Brachistochrone Curve surface with a horizontal plane.

2. The urinal according to claim 1, **characterized in that** a line connecting the water inlet and the nozzle on the flushing surface constitutes a centerline, and a point on the centerline is a point with the smallest curvature on the Brachistochrone Curve surface.

3. The urinal according to claim 2, **characterized in that** the Brachistochrone Curve surface is symmetric about the centerline.

4. The urinal according to claim 2, **characterized in that** the Brachistochrone Curve starts from a point on the centerline and extends toward two sides thereof in a horizontal direction.

5. The urinal according to claim 4, **characterized in that** the flushing surface further includes oblique side surfaces located on two sides of the opposite surface, being inclined planes, and having a circular arc transition with the Brachistochrone Curve surface.

6. The urinal according to claim 5, **characterized in that** the flushing surface further includes a water sealing surface located between the two oblique side surfaces, and having an outline including a Brachistochrone Curve shape and a circular arc shape and obtained by transecting the water sealing surface with a horizontal plane.

7. The urinal according to claim 6, **characterized in that** the Brachistochrone Curve surface, the oblique side surfaces and the water sealing surface form a cone with an inclined opening, and the lowest point of the inclined opening is located on the water sealing surface.

8. The urinal according to claim 6, **characterized in that** an intersection of the Brachistochrone Curve surface, the oblique side surfaces and the water sealing surface is a circular arc transition.

9. The urinal according to any one of claims 1 to 8, **characterized in that** a water pressure of a flushing water sprayed by the nozzle is less than 0.7MPa.

10. The urinal according to any one of claims 6-8, **characterized in that**

the water sealing surface is funnel-shaped and suitable for preventing the flushing water from overflowing from the urinal body, an outline obtained by transecting the water sealing surface on a side of the urinal body is a first curve, the first curve includes a first point and a second point, the first point is an intersection point of the water sealing surface and the water inlet, and the second point is a sudden increase point of a curvature when extending along the first curve towards the highest point of the water sealing surface;  
a curvature of the first curve is minimum between the first point and the second point;  
a vertical distance between the first point and the

second point is less than or equal to 10mm.

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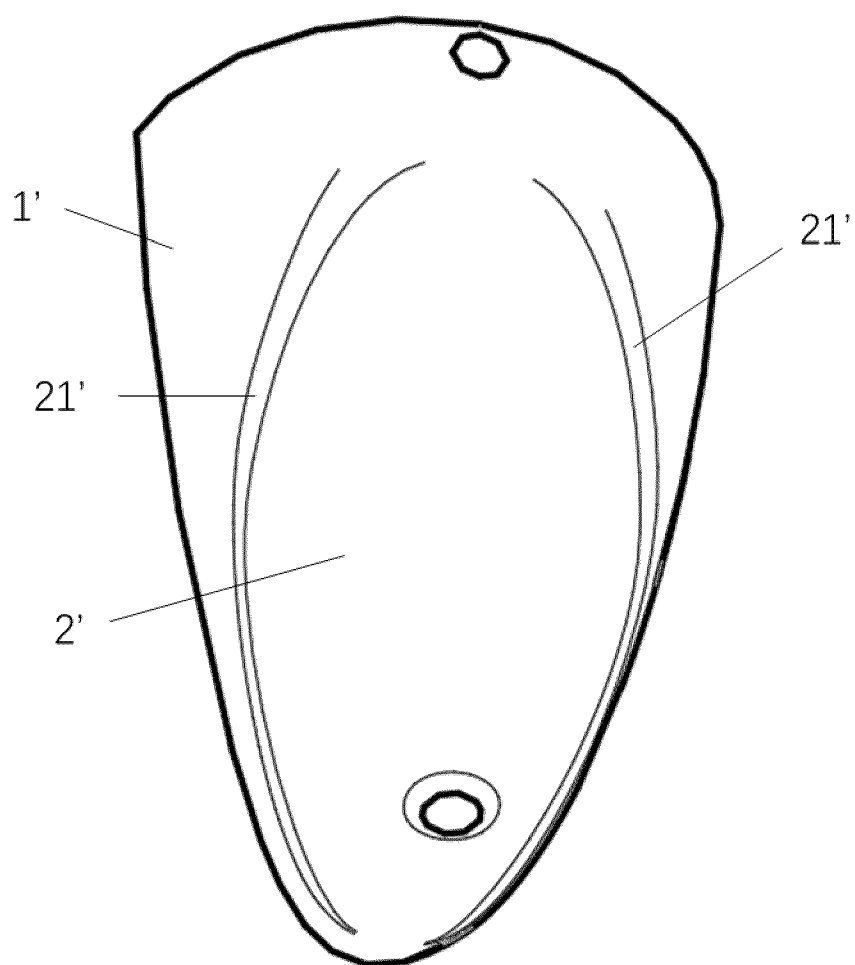


FIG. 1

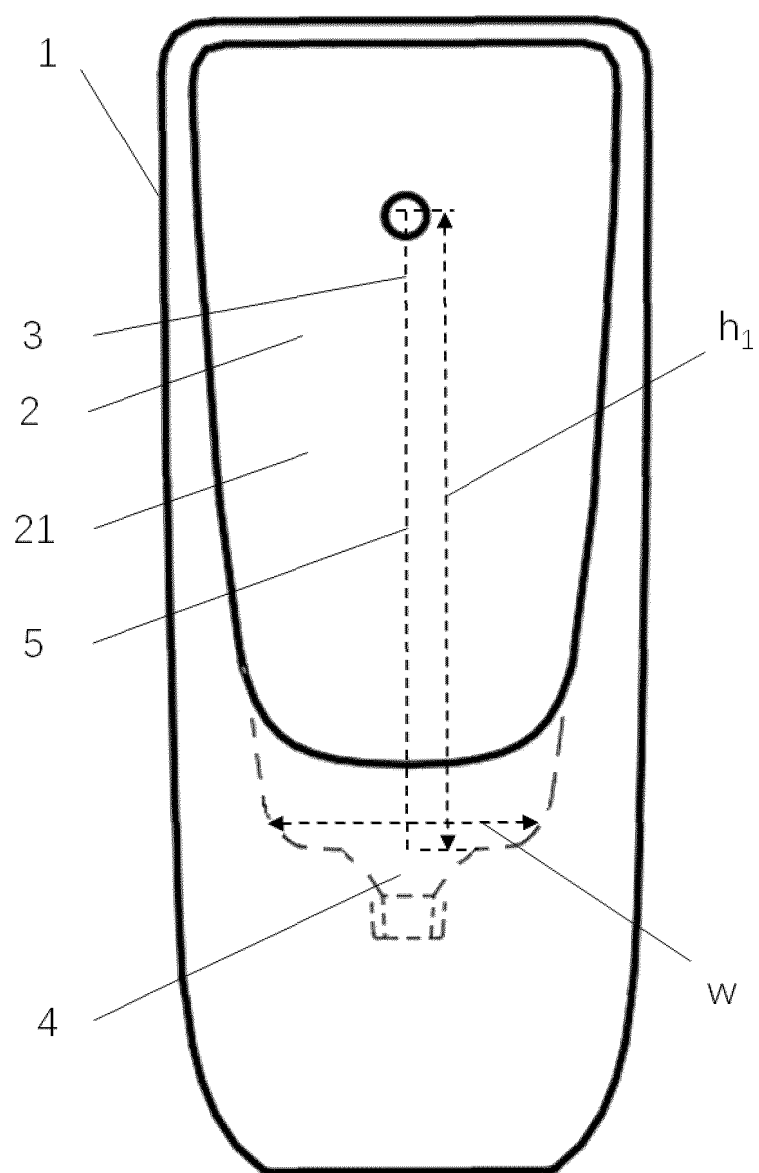


FIG 2



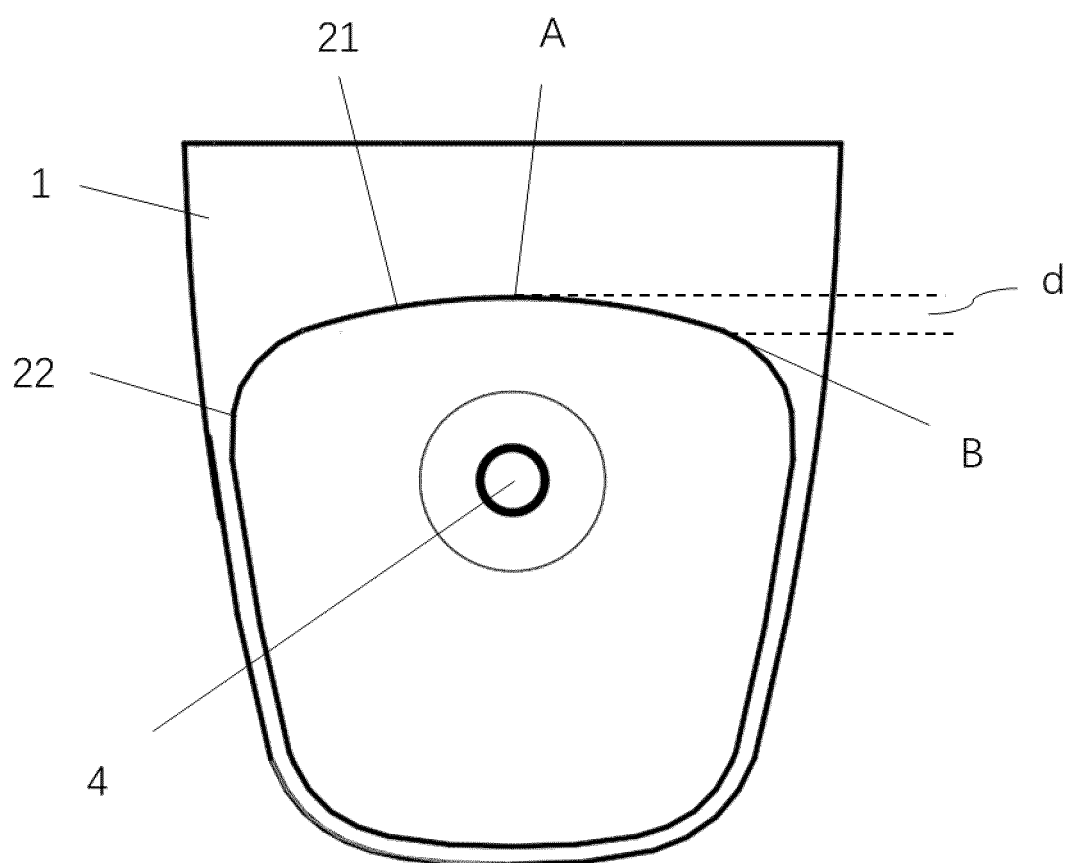


FIG. 3

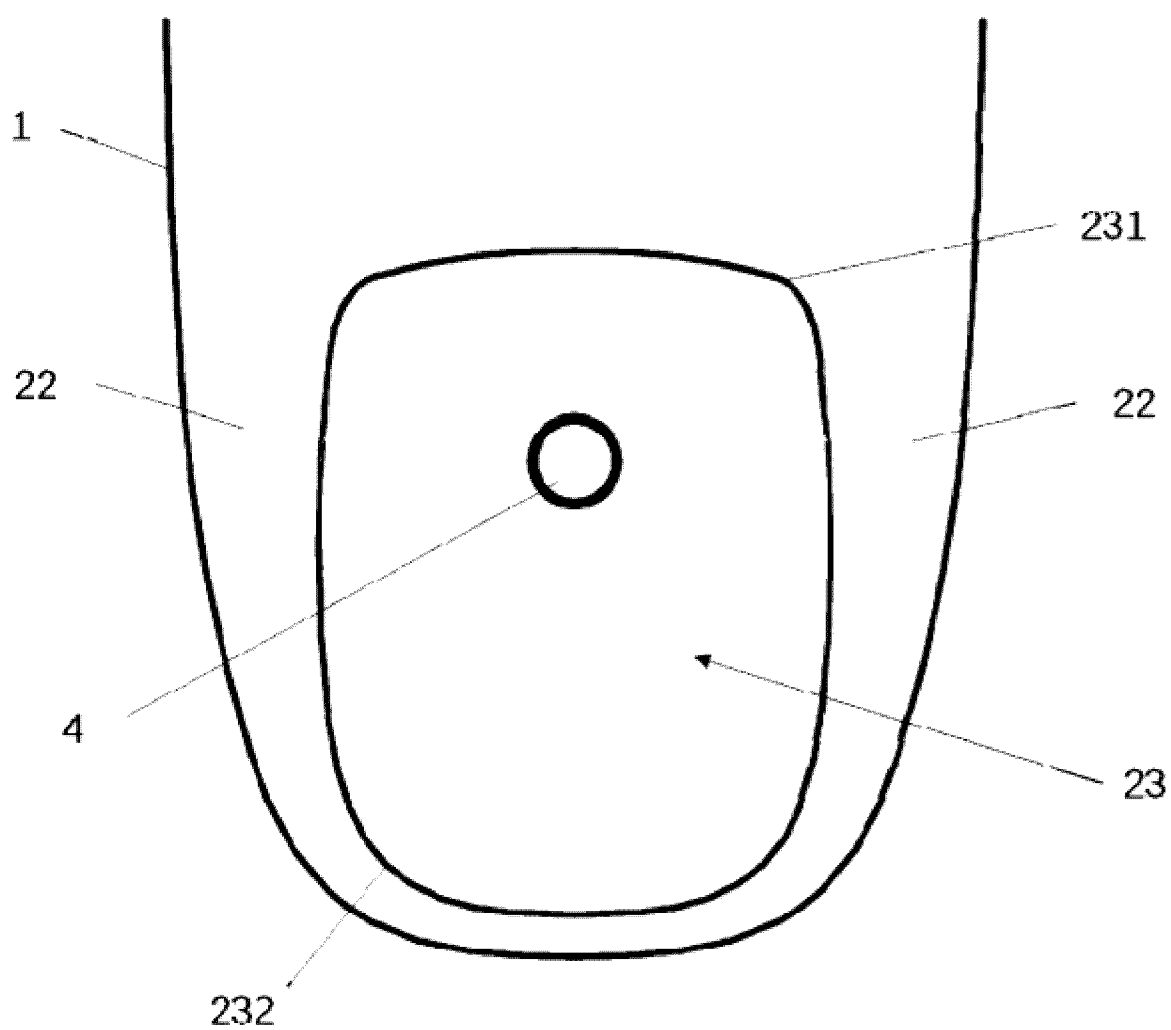


FIG. 4

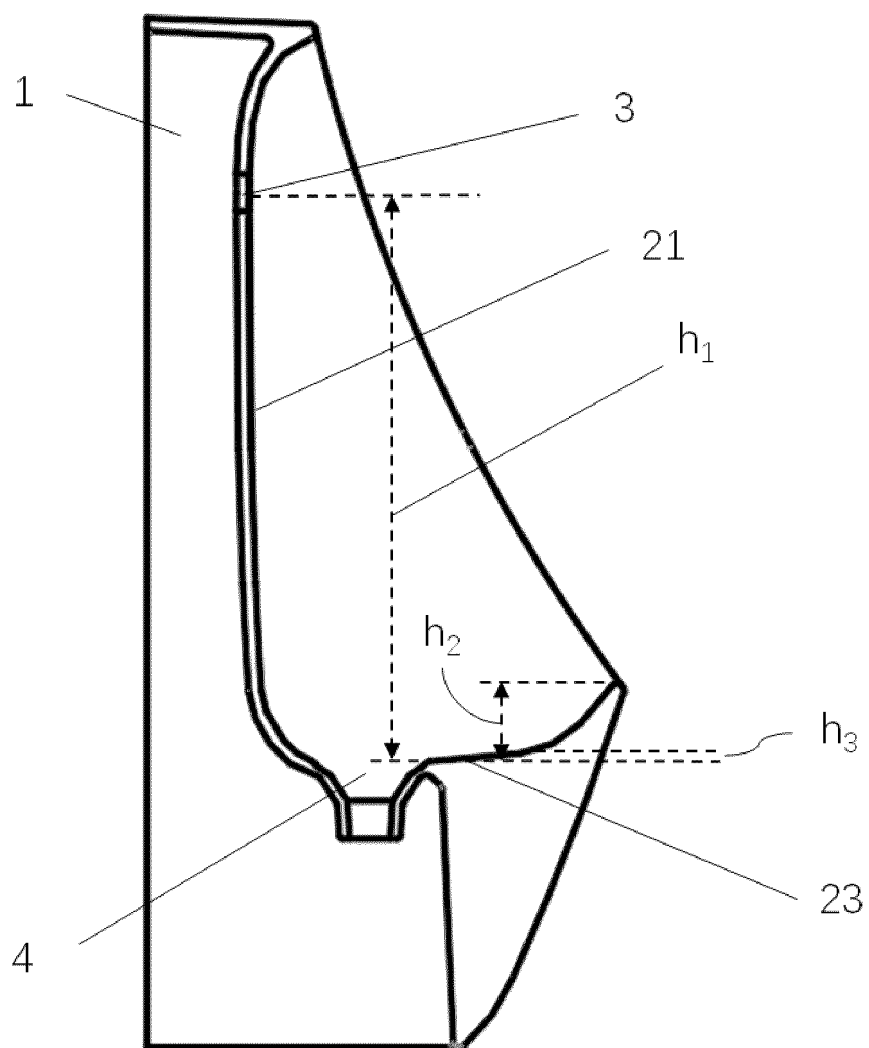


FIG. 5

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/082028

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> E03D13/00(2006.01)i  According to International Patent Classification (IPC) or to both national classification and IPC																		
<b>B. FIELDS SEARCHED</b>  Minimum documentation searched (classification system followed by classification symbols) IPC:E03D  Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNABS, CNTXT, VEN, WPABS, DWPI, ENTXT, USTXT, OETXT, 读秀, DUXIU, CNKI: 骊住, 便器, 马桶, 坐厕, 蹲厕, 座厕, 最速降, 最快降, 曲线, 曲面, 曲率, 摆线, 旋轮线, 水平, 横截, 横向, 冲洗, 冲刷, 范围, 面积, 距离, 大, closetool, bowl, closet, toilet, brachistochrone, cycloid, roulette, trochoid, horizontal, curve, flushing, washing, rinsing, area, distance																		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>																		
<table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>PX</td> <td>CN 217105397 U (LIXIL (CHINA) INVESTMENT CO., LTD.) 02 August 2022 (2022-08-02) claims 1-10</td> <td>1-10</td> </tr> <tr> <td>X</td> <td>CN 203113493 U (TANGSHAN MONOPY CERAMIC CO., LTD.) 07 August 2013 (2013-08-07) description, paragraphs [0023]-[0025], and figures 1-5</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 103306354 A (XIONG ZHENGYONG) 18 September 2013 (2013-09-18) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 209817024 U (FUJIAN LIANGCI TECHNOLOGY CO., LTD.) 20 December 2019 (2019-12-20) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>JP 2009007922 A (SUGANAMI MASAJI) 15 January 2009 (2009-01-15) entire document</td> <td>1-10</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	PX	CN 217105397 U (LIXIL (CHINA) INVESTMENT CO., LTD.) 02 August 2022 (2022-08-02) claims 1-10	1-10	X	CN 203113493 U (TANGSHAN MONOPY CERAMIC CO., LTD.) 07 August 2013 (2013-08-07) description, paragraphs [0023]-[0025], and figures 1-5	1-10	A	CN 103306354 A (XIONG ZHENGYONG) 18 September 2013 (2013-09-18) entire document	1-10	A	CN 209817024 U (FUJIAN LIANGCI TECHNOLOGY CO., LTD.) 20 December 2019 (2019-12-20) entire document	1-10	A	JP 2009007922 A (SUGANAMI MASAJI) 15 January 2009 (2009-01-15) entire document	1-10
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<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.																		
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**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.  
**PCT/CN2023/082028**

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