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

(11) **EP 4 290 024 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
13.12.2023 Bulletin 2023/50

(21) Application number: **22182392.5**

(22) Date of filing: **30.06.2022**

(51) International Patent Classification (IPC):
E03D 11/08 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E03D 11/08

(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:
KH MA MD TN

(30) Priority: **10.06.2022 DE 102022114693**

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(54) WATER-FLUSHED TOILET PAN

(57) The object of the invention is a water-flushed toilet pan with a rimless toilet bowl (1), with the supply of flush water in the rear top part of the toilet bowl (1), which includes an inlet pipe (8) terminated with an inlet hole (7) and a channel (9) located behind it, terminated with an outlet (10), wherein the toilet pan has the first central plane (A-A), which, when the toilet pan is assembled, is parallel to the installation wall and abstractly divides the toilet pan through the centre of the outlet hole (2) into the front and rear section, which rear section adjoins the installation wall, and wherein the toilet bowl (1) on its inner side, correspondingly to the outlet (10) and just below the top edge (6) has a horizontally positioned upper threshold (12) created in the form of a bulge, wherein the beginning of this upper threshold (12) is located at the level of the outlet (10), it further runs inside the toilet bowl (1) in a direction matching the one faced by the outlet (10), and the end of this upper threshold (12) is placed opposite the outlet (10), on the opposite side of the toilet bowl (1) relative to the first central plane (A-A); wherein the toilet bowl (1) on the side opposite to the side comprising the upper threshold (12) is shaped in the form of a gentle arch; wherein the top edge (6) is formed as a sector of a flat elliptical ring, this sector being placed directly above the upper threshold (12), in an area whose length measured horizontally corresponds to the length of the area occupied by the upper threshold (12); and wherein below the upper threshold (12) and above the level of the water surface present in the operating state of the pan, the toilet bowl (1) has a lower threshold (13) in the form of a bulge, the beginning of this upper threshold (13) being placed in the rear section of the toilet bowl (1), further running in a direction matching the one faced by the outlet (10), and the end of this lower threshold (13) being placed on the opposite side of the toilet bowl (1) relative to the beginning of this upper threshold (13), so that it is essentially located halfway around the perimeter of the toilet bowl (1).

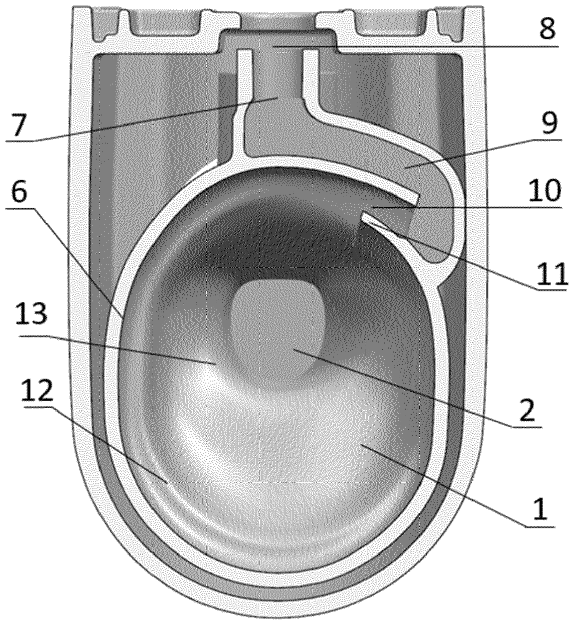

Fig. 2a

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Description

Technical Field

[0001] This invention concerns a water-flushed toilet pan with a toilet bowl.

Prior Art

[0002] Water-flushed toilet pans with a toilet bowl supplied with flush water and connected to a sewage drain are commonly known and used. Water-flushed toilet pans normally have a body with a pan-shaped bowl with an opening in the top part, wherein the bowl is connected to a drain of used sewage, usually using a water trap. Toilet pans are normally made of ceramic material.

[0003] The flushing of a toilet pan with water is used to carry out two operations: to clean the toilet bowl's inner surface and to carry the used water along with impurities through the trap to the drain. In conventional toilet bowls, normally the inner top edge of the bowl has a so-called flush rim, which has the form of a circumferential channel provided with holes or a slot, which acts as a ring-shaped shower. Flushing is performed by directing a part of water into the hollow rim, from which it is drained into the bowl through a narrow slot or a series of holes arranged at a certain space, which enables the washing of the inner surface of the bowl. Higher water volumes may be directed at specific points in the bowl, for example downwards onto the front and rear surfaces of the pan (e.g. through larger holes made therein). The part of the rim with the channel may be made either as a separate hollow section and added to the bowl during production or as an integral part of the bowl, during the production process. In either case, it usually has the form of a collar; it protrudes inside so that it hangs down from the top part of the pan around the whole rim or a part thereof. From prior art we also know toilet pans with other flushing mechanisms, for example such that use a rotary (approximately swirling) motion of the water stream induced by the introduction of the water stream tangentially to the bowl, as well as toilet pans which, in place of the hanging collar, have a hollow groove/channel that surrounds the inner surface of the bowl.

[0004] The bowl arrangement that uses a conventional, annular flush rim (usually with a collar) as well as any type of hollow channels or grooves, implies hard-to-reach areas within the bowl, which have the form of overhangs or concavities, which significantly hinders or sometimes even prevents effective cleaning of the toilet bowl. The channel in the flush rim is completely inaccessible and impossible to be cleaned. Such a design therefore makes conventional toilet pans particularly susceptible to contamination and deposits in the form of scale. Furthermore, since the water stream pressure on the walls of the bowl is too weak, the flushing of bowls with such a structure is relatively ineffective and, as a consequence, high volumes of water must be used. In addition, water flowing down on the bowl's walls reaches the trap with an insufficient momentum, which makes it possible that a single flushing cycle will not move all impurities into the drain.

[0005] A water-flushed toilet pan with a symmetric internal shape of the bowl and a conventional flush rim is disclosed, for example, in the description in British application GB 685960 A.

[0006] Patent GB 2045311 B proposes a toilet bowl with an essentially smooth internal contour, which has no collar around its rim. The rim of that bowl is, however, surrounded by a hollow water channel provided with one or more flush holes. The hollows made in that rim bowl, as in a conventional collar, also make it difficult to maintain the toilet pan clean, as they can collect impurities and scale.

[0007] From the description in French application FR 2744744 A, we know a water-flushed toilet pan whose bowl has an asymmetric internal shape and is provided with a conventional flush rim. The outlet opening of the toilet bowl into the trap is shifted relative to the symmetry axis of its rim. The internal wall of the bowl consists of spherical or conical segments interlinked with edges, with their joints slightly lifted so that the bowl can be flushed and emptied at the same time.

[0008] The description in British application GB 2431937 A discloses a toilet pan with a bowl having a symmetric internal shape, which does not have a conventional annular flush rim. In that solution, flush water is directed to the pan through an inlet pointing downwards and through inlets pointing at the top part of the bowl's inner surface (approximately in parallel to the plane of the bowl's opening). Flush water escapes from the prechamber located directly downstream of the inlet that supplies water from pipelines to the toilet pan that is covered (closed) by a fragment of its rim, and is directed simultaneously to the left and right side of the bowl, tangentially with its internal wall, and then the two streams move on the internal wall of the bowl and hit each other in its front section.

[0009] Patent EP 2604761 B1 constitutes the closest prior art to the developed solution. That document concerns a water-flushed toilet pan which does not have a conventional flush rim, in which the flush stream inlet is asymmetric, and which is provided with a bowl having an asymmetric shape. The essence of the solution disclosed herein is that the shape of the toilet bowl is asymmetric to the vertical central plane, and consequently the internal shape of the bowl determines the route of the flush water stream, i.e. it forces it to move in a specified way: circumferentially at the internal wall of the bowl. The route of the flush water stream on one side of the central plane is located lower than on the other side, and as a result the water's rotary motion is overlaid with a downward motion dependent on the internal shape of the bowl, and thus the speed of flush water is increased by the vertical component directed downwards, caused by the internal shape of the bowl.

The Essence of the Invention

[0010] Thus, the described prior art contains various solutions of a technical issue regarding how to provide a water-flushed toilet pan that ensures the fastest possible flushing of water downwards in the bowl with the possibly most precise cleaning of its surface. Unexpectedly, it turned out that the issue can be solved even more effectively with a new structure of a toilet pan unknown in prior art, which is an alternative to the structures described above, especially to those described in GB 2431937 A and EP 2604761 B1. Document GB 2431937 A discloses a toilet pan without a conventional flush rim, whose bowl has a symmetric internal shape, and in which water is introduced into the bowl symmetrically (through a symmetric inlet), to the left and right side at the same time. Patent EP 2604761 B1 discloses a toilet pan without a conventional flush rim, which has a bowl whose shape is asymmetric to the vertical central plane, and where water is introduced into the bowl asymmetrically. A solution alternative to the mentioned technical issue is provided by a toilet pan according to claim 1, whose structure does not include a flush rim (i.e. includes a rimless bowl), which supplies water into the bowl asymmetrically, and with an asymmetric bowl. That structure will be presented more specifically further in this description.

[0011] As it unexpectedly turned out during the experimental tests carried out by the authors of this invention, the pan being most effective in terms of the speed of bringing down water in the toilet bowl is a pan which introduces water into the bowl asymmetrically; the water is introduced tangentially to the inner surface of the bowl, in its top part, at the rear of the bowl, and it is directed rightwards or leftwards. Such a bowl allows for much faster and more dynamic descent of water than in a pan which is known, for example, from the aforementioned patent EP 2604761 B1. The developed shape of the pan, meaning such where the path for introducing water is asymmetric relative to the central plane, while the lower part of the pan is symmetrical, enables the generation of rotary motion of flush water in the toilet bowl, as well as the achievement of a considerable vertical component of the water stream motion speed downwards towards an outlet into the trap. Flush water in a bowl with such a shape moves with a high momentum, which additionally improves its cleaning properties, as it can separate impurities from the bowl's internal walls with a higher strength.

[0012] The authors of the present invention have also found out that for efficient flushing action, particularly with low amounts of flush water, apart from a noticeable vertical speed component, it is also important to ensure adequately long retention of water in the bowl and to direct the water path so as to clean the internal walls of the bowl as precisely as possible, which according to the invention can be achieved due to the presence of thresholds in the bowl. Due to their shape, the thresholds prolong the rotary motion of the water stream, and thus enable efficient use of the energy of the flush water stream. Said thresholds form areas on the bowl's inner surface where vertical inclination of this inner surface is lower than in the areas located directly above and below them. Colloquially speaking, these areas are "more horizontal". Using the precise language of mathematics - the gradient of vertical inclination of the bowl's inner surface in these areas has a locally lower value than in the areas located directly above and below them. Technically (structurally), the threshold has the form of a bulge running horizontally on the inner surface of the toilet bowl. Each threshold runs horizontally, essentially around slightly over half the bowl, starting from the flush water inlet and ending on the opposite side of the bowl with respect to this inlet - opposite it with respect to the central plane dividing the bowl into a front and a rear section. The entire inner surface of the bowl below the flush water inlet is asymmetric (left side to right side) relative to the vertical central plane.

[0013] The toilet pan according to the present invention has a bowl without a flush rim, which will be further referred to as a rimless bowl. The internal shape of such a bowl does not have a flush rim, that is a circumferential flush water channel whose inlet holes used for the inflow of water into the bowl are pointed downwards.

[0014] The construction according to the present invention combines the lack of a rim, asymmetric introduction of flush water into the bowl and an asymmetric bowl.

[0015] A water-flushed toilet pan with a rimless toilet bowl, with the supply of flush water in the rear top part of the toilet bowl, which includes an inlet pipe terminated with an inlet hole and a channel located behind it, terminated with an outlet, wherein the outlet hole to the trap is located in the bottom part of the toilet bowl, the toilet pan having the first central plane (A-A), which, when the toilet pan is assembled, is parallel to the installation wall and abstractly divides the toilet pan through the centre of the outlet hole into the front and rear section, which rear section adjoins the installation wall, as well as a perpendicular second central plane (C-C), which abstractly divides the toilet pan through the centre of the outlet hole into the right and left section, and wherein the toilet bowl has a top edge that is a fragment of the top inner surface of the toilet bowl with walls constituted essentially vertically, located directly below the external cover, above which top edge an external cover is installed, and the outlet hole is shifted towards the rear of the toilet pan, and wherein the outlet of the channel is positioned asymmetrically to the second central plane (C-C), on the right or left side of the toilet bowl, in its upper area, so that flush water flows into the toilet bowl falling first on the rear section of the top edge, in a direction essentially horizontal and tangential with the inner surface of the toilet bowl, and then performs rotary motion inside the toilet bowl, and wherein the toilet bowl on its inner side, correspondingly to the outlet and just below the top edge has a horizontally positioned upper threshold created in the form of a bulge, is characterised in that

the beginning of the upper threshold is located at the level of the outlet; it further runs inside the toilet bowl in a direction matching the one faced by the outlet, and the end of this upper threshold is placed opposite the outlet, on the opposite side of the toilet bowl relative to the first central plane (A-A),

wherein the toilet bowl on the side opposite the side comprising the upper threshold (relative to the second central plane C-C) is shaped in the form of a gentle arch,

wherein the top edge is formed as a sector of a flat elliptical ring, this sector being placed directly above the upper threshold, in an area whose length measured horizontally corresponds to the length of the area occupied by the upper threshold,

and wherein below the upper threshold and above the level of the water surface present in the operating state of the pan, the toilet bowl has a lower threshold in the form of a bulge, the beginning of this upper threshold being placed in the rear section of the toilet bowl, further running in a direction matching the one faced by the outlet, and the end of this lower threshold being placed on the opposite side of the toilet bowl relative to the beginning of this upper threshold, so that it is essentially located halfway around the perimeter of the toilet bowl.

[0016] Preferably, the upper threshold at its ending portion is gently flattened and passes into the curvature of the toilet bowl.

[0017] Preferably, the height of the upper threshold measured vertically is 4 mm, and the width of the upper threshold measured horizontally is 9 mm, whereas the radius of curvature of the upper threshold in normal plane relative to the inner surface of the toilet bowl is 13 mm, and the radius of curvature of the arc between the top edge and the beginning of the upper threshold at the said plane is 17 mm.

[0018] Preferably, the lower threshold has a radius of curvature in normal plane relative to the inner surface of the toilet bowl, ranging from 32 to 66 mm.

[0019] Preferably, the lower threshold is located less than halfway between the upper threshold and the level of water surface, preferably at 2/3 of the distance between the upper threshold and the level of the water surface.

[0020] Preferably, the channel is inclined towards the inside of the toilet pan, so that its starting point (A) is placed higher than the ending point (B), the difference in the position between this starting point (A) and the ending point (B) being from 23 mm to 27 mm, preferably 25 mm.

[0021] Preferably, the first section of the channel downstream of the inlet hole is directed to the right or left side of the bowl and is slightly bent according to the shape of the top edge, and further has a curve of approximately 180°, so the outlet is located on the right or left side of the toilet bowl but is directed to the opposite side than the said first section of the channel, so to the left or right side, correspondingly.

[0022] Preferably, the cross-sectional area of the flush water inlet hole is 15.5 to 16.5 cm^2, preferably 16.04 cm^2.

[0023] Preferably, the cross-sectional area of the channel in the part between the inlet hole and the curve is 16 to 17.5 cm^2, preferably 16.81 cm^2.

[0024] Preferably, the cross section of the channel is flattened, which means it is longer in the vertical direction and narrows down more at the outlet.

[0025] Preferably, the cross section of the channel is rectangular.

[0026] Preferably, the ratio of the height of the vertically extending outlet to the width of this outlet is between 4.0 and 4.12, preferably 4.06.

[0027] Preferably, the height of the outlet is 68 to 74 mm, preferably 71 mm, and the width of the outlet is 17 to 18 mm, preferably 17.5 mm.

[0028] Preferably, the channel has a curve with a curvature radius of 27 to 40 mm.

[0029] Preferably, the lower threshold is located at a distance of at least 15.5 cm, preferably 17.3 cm, from the top edge of the bowl, the distance being measured in straight line (vertically) from the verge of the top edge of the bowl to the level where the lower threshold is located.

Advantages of the invention

[0030] The present invention, with the use of rotary/circular motion of water in the bowl, allows for effective cleaning of the bowl surface and, owing to the high momentum of flush water, effective movement of water with impurities into the trap and drain. The structure of the toilet bowl according to the invention additionally allows for significant reduction in the volume of flush water, which is beneficial in terms of economy and the environment. The toilet pan according to the invention is also easy to clean, as it has smooth internal walls that are easily accessible for cleaning, and given its simple design, its production is easy and cheap.

Description of figures

[0031] The object of the invention will now be presented more closely in preferred embodiments, with reference to the attached drawing, in which:

Fig. 1 is a top view of the toilet pan according to the invention, with marked section planes;

Fig. 2a is a top view of the toilet pan according to the invention without the external cover;

Fig. 2b is a top view of the toilet pan according to the invention with the starting point and the ending point of the channel indicated;

Fig. 3 is an oblique view of the toilet pan according to the invention without the external cover;

Fig. 4a schematically shows a section of the toilet pan in A-A plane;

Fig. 4b shows the arrangement of the upper threshold in a section in A-A plane;

Fig. 5 shows a section of the toilet pan in the A-A plane shown in Fig. 4a, with a view on the structural components located outside that plane.

Fig. 6 schematically shows a section of the toilet pan in B-B plane;

Fig. 7 shows a section of the toilet pan in the B-B plane shown in Fig. 6, with a view on the structural components located outside that plane;

Fig. 8 schematically shows a section of the toilet pan in C-C plane;

Fig. 9 shows a section of the toilet pan in the C-C plane shown in Fig. 8, with a view on the structural components located outside that plane;

[0032] The drawing uses the following numerical symbols: 1 - toilet bowl, 2 - outlet hole, 3 - trap, 4 - drain, 5 - external cover, 6 - top edge, 7 - inlet hole, 8 - inlet pipe, 9 - channel, 10 - outlet, 11 - protrusion, 12 - upper threshold, 13 - lower threshold compartment.

Detailed description of the preferred embodiment

[0033] Below the invention will be presented more specifically based on a preferred embodiment, in reference to the drawing figures.

[0034] The drawing figures generally present a toilet pan with a rimless toilet bowl (without a circumferential flush water channel whose inlet holes used for the inflow of water into the bowl are pointed downwards), made for example of ceramic material. Fig. 1 to Fig. 9 present the toilet pan according to the invention.

[0035] Fig. 1 shows a top view on the toilet bowl according to the invention, with marked planes crossing the bowl in specified locations: the first central plane A-A, which crosses the toilet pan horizontally, in parallel to the installation wall (not shown) in the pan's assembled condition, and runs through the centre of the outlet hole 2; plane B-B, which crosses the pan horizontally below plane A-A, outside the outlet hole 2; second central plane C-C, which is perpendicular to the said planes A-A and B-B and crosses the pan vertically, dividing it into two equal sections: right and left. The outlet hole 2 is located in the bottom part of the toilet bowl 1 and leads to the trap 3, which is connected to the rear outlet 4 in a known manner (the trap 3 and the rear outlet 4 are not shown in Fig. 1). In other words, we can say that the outlet hole 2 is the beginning of the trap 3. The toilet bowl 1 has an external cover 5 with a hole having an approximately elliptical shape, and the outlet hole 2 within that ellipse is shifted backwards (towards the rear outlet 4) and located centrally relative to central plane C-C, which is a known solution in toilet bowls. In a non-limiting embodiment, the distance between plane A-A and the point of the toilet bowl 1 most protruding outside (the one most distant from the installation wall, that is: with the external end of the cover 5 located at the front of the pan) is 240 mm. Section plane B-B was chosen arbitrarily to better depict the symmetry of the pan. In Fig. 1, this plane is located halfway between plane A-A and the internal end of the cover 5 located at the front of the pan, in the most protruding part thereof, and in this case the distance between plane A-A and plane B-B is 100 mm. However, this plane could be located in any other place between plane A-A and the internal end of the cover 5 at the front of the pan; it is marked only to illustrate that the pan is symmetric relative to plane C-C at any point between plane A-A and the inner end of the cover 5 at the front of the pan. Fig. 2a shows a toilet pan without the external cover 5. The toilet bowl 1 has a top edge 6, which constitutes a fragment of the top part of the toilet bowl 1, and more precisely a fragment of the top internal surface of the toilet bowl 1 located directly below the external cover 5, which top edge 6 is normally covered by the external cover 5. The top edge 6 is formed as a sector of a flat elliptical ring located in the top part of the pan, with walls essentially vertical, and it is preferably 90 mm high. The sector constituting the top edge 6 is placed in an area occupying slightly more than half of the inner perimeter of the top part of the bowl 1, and it corresponds to an area occupied by the upper threshold 12, described in more detail in the following part of the description. The remaining area of the toilet bowl 1 (without the top edge 6) essentially has the shape of a basin, like in numerous known toilet bowls. The flush water inlet hole 7 is preferably located in the rear area of the toilet bowl 1, in its top part, preferably at the highest possible point of the route of flush water. The inlet hole 7 is reached through an inlet pipe 8, which is preferably positioned in parallel to plane C-C and in perpendicular to the toilet pan's installation wall (not shown). Downstream of the inlet hole 7, there is a channel 9 that drains flush water to the toilet bowl 1 and is terminated with an outlet 10. The inlet hole 7 in the embodiment has a circular cross section and a diameter ranging from 15.5 to 16.5 cm^2, preferably 16.04 cm^2. The inlet hole 7 may also have a cross section of a different shape, but regardless of that shape, the cross sectional area of the inlet hole 7 may be 16 to 17.5 cm^2, preferably 16.81 cm^2. Such a relatively large cross section ensures the inflow of an adequate volume of water to the channel 9, so the kinetic energy of flush water can be well used.

[0036] Fig. 2b presents a pan like in Fig. 2a, two places in the channel 9 being indicated here: the starting point A and the ending point B. In order to shorten the duration

of outflow of the remaining water after flushing from the channel 9, the channel 9 is inclined between the indicated points A and B, so that the starting point A is placed higher than the ending point B. The difference in position between the height at which point A is placed, and the height at which point B is placed, is preferably 25 mm, with a small permitted range of deviation (+/- 2 mm). The placement of the starting point A is determined by standards describing the size requirements of the toilet. The inclination of the channel 9 makes the water leave it completely after the end of flushing. In other words, the inclination of the channel 9 causes it to be directed slightly downwards towards the inside of the pan. Such a shape of the channel 9 allows for reducing the duration of outflow of the remaining waterfrom the channel 9, since the entire water present in the channel 9 flows out of this channel 9 after flushing the toilet bowl 1. In known toilet pans in which the gradient of the channel 9 is too low, once the pan is flushed, the portion of water which has reached the channel 9 from the inlet hole 7 remains in this channel 9, which results from the surface tension of water and the shape of the channel, and in particular its low or zero inclination. The remaining water thus keeps flowing down from the channel for a long time, forming a thin stream. In the toilet pans according to the invention, a high gradient of the channel 9 ensures that the flush water will stop flowing out very soon after flushing, which eliminates the issue of water leakage in the form of a thin stream. Additionally, such leakage of water in known pans causes scale deposition in this area, and therefore the use of a properly inclined channel 9 causes the pan to become more hygienic and even easier to clean.

[0037] In the embodiment, the channel 9 is approximately J-shaped, with its end more bent upwards, while its cross section, especially near the channel outlet 10, is flattened, i.e. its height is notably larger than its width. The channel 9 is formed in such a way that the first slightly arched (bent according to the line of the top edge 6) section of that channel 9 is directed to the right side of the toilet pan (essentially in parallel to planes A-A and B-B), further has a curve, i.e. a bend formed in such a way that the channel 9 turns by approximately 180°, and as a result the channel outlet 10 is located on the right side of the bowl 1 but is directed to the opposite side, in this case to the left. The outlet 10 of the channel 9 is preferably longitudinal in shape, extending in vertical direction. Preferably, the relation of between the height and the width of that outlet 10 is 4.0 to 4.12, and most preferably 4.06. More specifically, the height of the outlet 10 may be 68 to 74 mm, more preferably 71 mm, and its width may be 17 to 18 mm, more preferably 17.5 mm. The outlet 10 is designed in such a way that water flowing out of it is directed to the inner surface of the toilet bowl 1, specifically to the inner surface of its top edge 6, in the rear section of the toilet bowl 1, which is easier to see in Fig. 3. Fig. 3 shows a toilet pan according to the invention at a different angle than in Fig. 2a. Therefore, the supply of water to the toilet bowl 1 is asymmetric, and in this case water is supplied from the right side of the toilet bowl 1 (relative to plane C-C). Appropriate routing of water stream is supported by a protrusion 11 at the outlet 10 of the channel 9. The cross section of the channel 9 is flattened, i.e. its height is larger than its width. In the embodiment, the channel is rectangular, but its cross section may have any other shape as long as the channel appropriately serves its function. To properly use the kinetic energy of the water stream, the channel 9 should not be bent too sharply, in particular it should not have any rectilinear geometric shapes. The radius of curvature of the arch of channel 9 is preferably 27 to 40 mm.

[0038] The toilet pan according to the invention in an embodiment has an upper threshold 12, running horizontally inside the toilet bowl 1, starting at the level of the outlet 10 of the channel 9, and ending in the front section of the toilet bowl 1 (and in this way occupying half or slightly more of the perimeter of the toilet bowl 1), allowing for keeping the water stream in the toilet bowl 1.

[0039] Fig. 4a and Fig. 5 show the toilet pan in a cross section through plane A-A. In Fig. 4a, we can clearly see the shape of the inner surface of top edge 6 as well as the arrangement and shape of the outlet 10 of the channel 9. The top edge 6 formed as a sector of a flat, elliptical ring is placed directly above the upper threshold 12, in an area whose length measured horizontally corresponds to the length of the area occupied by the upper threshold 12; the top edge is placed only above the upper threshold 12. This is directly due to the fact that the presence of the top edge 6 is forced by the presence of the upper threshold 12. Moreover, as seen clearly in Fig. 4a, the toilet pan in its upper part has no cavity or undercut between the external cover 5 and the inside of the bowl (this does not apply to the place where water flows into the inside of the pan, located on the rear wall of the toilet table).

[0040] Also, Fig. 4a and Fig. 5 clearly show the position and shape of the upper threshold 12 and the lower threshold 13. These thresholds have the form of bulges, the upper threshold 12 being located at the level of the outlet 10 of the channel 9, and the lower threshold 13 being located less than halfway between the upper threshold 12 and the level of the water surface, starting from the upper threshold 12, preferably at 2/3 of this distance. The upper threshold 12 begins at the level of the outlet 10 of the channel 9, and it runs further horizontally inside the toilet bowl 1, in a direction matching the one of the motion of the flush water. Upon circling slightly more than half of the toilet bowl 1, the upper threshold 12 ends in a gentle way - it flattens and passes into the curvature of the toilet bowl 1. The end of the upper threshold 12 is placed opposite the outlet 10 of the channel 9. In other words, it is located on the opposite side of the toilet bowl 1 relative to the plane A-A, approximately where a mirror reflection of the outlet 10 of the channel 9 would be relative to plane A-A. With regard to the top edge 6 of the bowl 1, and using absolute values, the lower threshold 13 is located at least 15.5 cm, preferably 17.3 cm, from

the top edge 6 of the bowl 1, the distance being measured in straight line (vertically) from the verge of the top edge 6 of the bowl to the level where the lower threshold 13 is located. The lower threshold 13 runs analogically to the upper threshold 12, meaning it begins correspondingly to the outlet 10, but properly below it (so that the beginning of the lower threshold 13 is placed more or less below the outlet 10, at a distance specified above). Analogically to the upper threshold 12, the lower threshold 13 runs horizontally inside the toilet bowl 1, in a direction matching the one of the motion of the flush water, and after circling slightly more than half of the toilet bowl 1, the lower threshold 13 ends in a gentle way - it flattens and passes into the curvature of the toilet bowl 1.

[0041] Therefore, in accordance with Figs. 4a and 5, the toilet pan in a cross-section through the centre of the trap 3 exhibits the following features:

- it is asymmetric - the side of the bowl 1 comprising the upper threshold 12 and the lower threshold 13 essentially has a shape which is different from the side without these thresholds 12, 13:
    - one side of the bowl 1 has two clearly pronounced thresholds 12, 13 over which water can flow, the thresholds 12, 13 being characterised by the existence of precisely two nearly horizontal tangents touching the flat portions of the inside of the pan;
    - the other side has no thresholds and no "water flow paths" can be distinguished thereon - it is shaped as a gentle arch and it has no distinguishable nearly horizontal tangents which would touch the flat surface of the pan;
- the thresholds 12, 13 are shaped such that the descent of water towards the trap 3 is caused by the mutual ratio of forces related to the potential energy of water being converted into kinetic energy and the centrifugal force related to the circling motion relative to the tapering centre of the trap 3 in the gravity field.

[0042] In order to maintain the functional requirement related to washing a required area of the pan during flushing, the upper threshold 12 must have dimensions compliant with those presented in Fig. 4b, which will be specified in the following part of the description. Maintaining these dimensions allows for complete washing of the pan below the upper surface of the collar - in particular, water is able to reach a place below the outlet (first circle) and travel a total of 1.5 circles around the trap 3. Water flowing out of the outlet 10 has a kinetic energy that results from the amount of water that must be supplied to flush the toilet bowl 1 and from the height at which the tank supplying the toilet pan with water is situated. The kinetic energy of water is related to the speed at which water flows out from the outlet 10, according to relation $E_k=(mv^2)/2$. The water flowing out is affected by two forces: gravity and the force related to a rotary motion in a circle. We may approximately calculate in theory that water will flow down quite fast to the trap 3 of the pan (approximately 40 cm) and will not manage to go around the entire toilet bowl 1 and thus to wash its entire inner surface. In order for the water to wash the entire bowl 1, there is a need for the upper threshold 12 with properly adjusted dimensions, which will enable at least one circle of water around the toilet bowl 1.

[0043] The above theoretic considerations are, however, insufficient to accurately determine the optimum position and shape of the upper threshold 12 in the toilet bowl 1. In order for the toilet pan to properly serve its function, it is required to keep appropriate dimensions of that upper threshold 12 (and possibly the lower threshold 13): they must fall within appropriate ranges. The dimensions of that upper threshold 12 are determined by the following factors: if the threshold is too small, water will flow down to the trap 3 too fast (the pan surface will not be washed); if the threshold is too big, the toilet bowl 1 will become unhygienic, as impurities will remain inside it. Accurate, appropriate dimensions of that upper threshold 12 have been determined by the author of this invention by way of experiments.

[0044] An example of appropriate dimensions of the upper threshold 12 is shown in Fig. 4b. In this embodiment, the distance between the beginning of the upper threshold 12 and the top end of the top edge 6, which is equal to the hight of the top edge 6, is 90 mm. The dimensions of the upper threshold 12 are as follows: the height of the upper threshold 12 measured vertically is 4 mm, and the width of the upper threshold 12 measured horizontally is 9 mm, whereas the radius of curvature of the upper threshold 12 in normal plane relative to the inner surface of the toilet bowl 1 is 13 mm, and the radius of curvature of the arc between the top edge 6 and the beginning of the upper threshold 12 at the said plane is 17 mm. Such dimensions of the upper threshold 12 ensure 1.5 circles travelled by water inside the toilet bowl 1 before it flows down into the trap 3. The upper threshold 12 is shaped such that (has a sharp enough edge) it splits the descending water into two streams. The function of the first stream is to wash the top part of the pan - this first stream travels 1.5 circles around the trap 3. The stream below the upper threshold 12 washes the central portion of the pan and travels 0.75-1.0 circles.

[0045] The lower threshold 13 has a radius of curvature in normal plane relative to the inner surface of the toilet bowl 1, ranging from 32 to 66 mm. The lower threshold 13 slows down the vertical descend speed of water (keeping the horizontal unchanged), so as to wash the pan by performing between 0.25 and 0.75 circles of water around the trap 3.

[0046] In addition, as mentioned above, i.e. to make it possible to maintain balance between adequately dynamic flushing (momentum) and adequately long water retention in the pan, translating into the accuracy of surface cleaning, the upper threshold 12 must be positioned

in an appropriate location, i.e. at an appropriate height relative to the outlet 10 of the channel 9, preferably slightly above the bottom of the outlet 10. Preferably the upper threshold 12 is situated 2 to 5 mm above the outlet 10, most preferably 3.5 mm above the outlet 10.

[0047] Fig. 6 and Fig. 7 show the toilet pan in cross section through plane B-B. In this cross section, we can clearly see the shape of the bottom of the toilet bowl 1.

[0048] Fig 8 and Fig. 9 show the toilet pan in cross section according to plane C-C. It can be seen here that the trap 3 is located in the bottom part of the toilet bowl 1 and connected to the rear outlet 4. In these Fig. 8 and Fig. 9, we can clearly see that the inner surface of the top edge 6 of the toilet bowl 1 is formed as a section of a flat (non-curved) ring and crosses the upper threshold 12 to reach further part of the toilet bowl 1. The lower threshold 13 runs on slightly more than a half of the toilet bowl 1, but in the rear section of the toilet bowl 1 it is slightly gentler, i.e. less protruding. Such a structure allows for appropriate guidance of the water stream along a spiral inside the toilet bowl 1. In addition, the protrusion 11 also directs the water stream in an appropriate way. The top edge 6 runs above the upper threshold 12 in an area corresponding to the length of this upper threshold 12. The further part of the toilet bowl 1, below the upper threshold 12, is curved, which means it has a shape resembling a basin. In areas in which there is no upper threshold 12 (on the opposite side of the toilet bowl 1 relative to the plane C-C from the position of this upper threshold 12), the toilet bowl 1 is ordinarily curved - it has a shape resembling a basin.

[0049] Of course, the above embodiments are not limiting. For instance, we can imagine that the channel 9 along with the channel outlet 10 will be pointed in opposite directions than in the drawing; in other words, that the design of the toilet pan will be a mirror reflection of the design shown in the drawing.

[0050] Rotating the water stream in the toilet bowl 1 may continuously cover a relatively large area around the water surface. In the embodiment, the water stream is routed from the outlet 10 of the channel 9 to the inside, so it falls first on the rear central area inside the toilet bowl 1 (as shown in the drawing), where particularly strong dirt patches may exist.

[0051] The toilet pan according to the invention operates preferably only in gravimetric manner, i.e. only with the use of gravity and the kinetic energy of water. This means that the use of an internal pump feeding the toilet pan is not necessary, and thus the toilet pan is relatively cheap to manufacture and more cost-effective in terms of operation.

[0052] The rotary motion of the water stream, meaning the route of the stream, is determined by a tangential direction of inflow of flush water from the inlet hole 7 and by the internal shape of the toilet bowl 1, and the downward motion is induced by gravity. Due to the lateral (asymmetric) inlet of the water stream into the bowl as well as the internal shape of the bowl, the water stream has a relatively high kinetic energy and flows into the trap 3 with a high momentum. Therefore, the flushing operation is effective both on the inner surface of the toilet bowl 1 and in the bottom area located deeper, directly above the trap 3.

[0053] The toilet pan according to the invention may use a static trap or dynamic trap, the static trap being more preferable. Dynamic trap should be understood as, for example, a solution wherein due to artificial narrowing or shut-off of outflow, for example with a flap valve, water in the bowl is artificially swelled so to enable a subsequent sudden outflow with the use of the trap effect. Therefore, a dynamic trap includes movable parts used to impact the route of outflow.

[0054] The toilet pan in question may be made using various methods for supplying flush water under a specified pressure, for example without a flush (in a pressurised water duct) or, more preferably, it may have a system combined with a flush, as in this case the potential energy of flush water can be better used. This refers in particular to a concealed cistern installed in an installation wall behind the toilet pan.

[0055] As already mentioned, water in the toilet bowl 1 falls first on the rear section of the top edge 6, and then, with a swirling motion, it flows down the toilet bowl 1 into the outlet hole 2, on its way being split and retained in the bowl 1 by the upper threshold 12. During such a swirling downfall along a spiral, water travels no more than 1.5 circles inside the bowl, and then falls into the outlet hole 2 at the level of the water surface.

Claims

1. A water-flushed toilet pan with a rimless toilet bowl (1), with the supply of flush water in the rear top part of the toilet bowl (1), which includes an inlet pipe (8) terminated with an inlet hole (7) and a channel (9) located behind it, terminated with an outlet (10), wherein the outlet hole (2) to the trap (3) is located in the bottom part of the toilet bowl (1), the toilet pan having the first central plane (A-A), which, when the toilet pan is assembled, is parallel to the installation wall and abstractly divides the toilet pan through the centre of the outlet hole (2) into the front and rear section, which rear section adjoins the installation wall, as well as a perpendicular second central plane (C-C), which abstractly divides the toilet pan through the centre of the outlet hole (2) into the right and left section, and wherein the toilet bowl (1) has a top edge (6) that is a fragment of the top inner surface of the toilet bowl (1) with walls constituted essentially vertically, located directly below the external cover (5), above which top edge (6) an external cover (5) is installed, and the outlet hole (2) is shifted towards the rear of the toilet pan, and wherein the outlet (10) of the channel (9) is positioned asymmetrically to the second central plane (C-C), on the right or left side

of the toilet bowl (1), in its upper area, so that flush water flows into the toilet bowl (1) falling first on the rear section of the top edge (6), in a direction essentially horizontal and tangential with the inner surface of the toilet bowl (1), and then performs rotary motion inside the toilet bowl (1), and wherein the toilet bowl (1) on its inner side, correspondingly to the outlet (10) and just below the top edge (6) has a horizontally positioned upper threshold (12) created in the form of a bulge, **characterised in that**

the beginning of the upper threshold (12) is located at the level of the outlet (10), it further runs inside the toilet bowl (1) in a direction matching the one faced by the outlet (10), and the end of this upper threshold (12) is placed opposite the outlet (10), on the opposite side of the toilet bowl (1) relative to the first central plane (A-A),
wherein the toilet bowl (1) on the side opposite to the side comprising the upper threshold (12) is shaped in the form of a gentle arch,
wherein the top edge (6) is formed as a sector of a flat elliptical ring, this sector being placed directly above the upper threshold (12), in an area whose length measured horizontally corresponds to the length of the area occupied by the upper threshold (12),
and wherein below the upper threshold (12) and above the level of the water surface present in the operating state of the pan, the toilet bowl (1) has a lower threshold (13) in the form of a bulge, the beginning of this upperthreshold (12) being placed in the rear section of the toilet bowl (1), further running in a direction matching the one faced by the outlet (10), and the end of this lower threshold (13) being placed on the opposite side of the toilet bowl (1) relative to the beginning of this upper threshold (12), so that it is essentially located halfway around the perimeter of the toilet bowl (1).

2. The toilet pan according to claim 1, **characterised in that** the upper threshold (12) at its ending portion is gently flattened and passes into the curvature of the toilet bowl (1).

3. The toilet pan according to claim 1 or 2, **characterised in that** the height of the upper threshold (12) measured vertically is 4 mm, and the width of the upper threshold measured horizontally is 9 mm, whereas the radius of curvature of the upper threshold (12) in normal plane relative to the inner surface of the toilet bowl (1) is 13 mm, and the radius of curvature of the arc between the top edge (6) and the beginning of the upper threshold (12) at said plane is 17 mm.

4. The toilet pan according to claim 1 or 2 or 3, **characterised in that** the lower threshold (13) has a radius of curvature in normal plane relative to the inner surface of the toilet bowl (1) ranging from 32 to 66 mm.

5. The toilet pan according to any of the previous claims, **characterised in that** the lower threshold (13) is located below the halfway point between the upper threshold (12) and the level of water surface, preferably at 2/3 of the distance between the upper threshold (12) and the level of water surface.

6. The toilet pan according to any of the previous claims, **characterised in that** the channel (9) is inclined towards the inside of the toilet pan, so that its starting point (A) is placed higher than the ending point (B), the difference in the position between this starting point (A) and the ending point (B) being from 23 mm to 27 mm, preferably 25 mm.

7. The toilet pan according to any of the previous claims, **characterised in that** the first section of the channel (9) downstream of the inlet hole (7) is directed to the right or left side of the bowl and is slightly bent according to the shape of the top edge (6), and it further has a curve of approximately 180°, so that the outlet (10) is located on the right or left side of the toilet bowl (1) but directed towards the opposite side than said first section of the channel (9), meaning towards the left or right side, correspondingly.

8. The toilet pan according to any of the previous claims, **characterised in that** the cross sectional area of flush water inlet hole (7) is 15.5 to 16.5 cm^2, preferably 16.04 cm^2.

9. The toilet pan according to any of the previous claims, **characterised in that** the cross sectional area of the channel (9) in the part between the inlet hole (7) and the curve is 16 to 17.5 cm^2, preferably 16.81 cm^2.

10. The toilet pan according to any of the previous claims, **characterised in that** the channel's (9) cross section is flattened, which means it is longer in vertical direction and narrows down more at the outlet (10).

11. The toilet pan according to claim 9 or 10, **characterised in that** the channel's (9) cross section is

12. The toilet pan according to claim 10 or 11, **characterised in that** the relation of the height of the vertical outlet (10) to the width of that outlet (10) is 4.0 to 4.12, preferably 4.06.

13. The toilet pan according to claim 12, **characterised in that** the height of the outlet (10) is 68 to 74 mm,

preferably 71 mm, and the width of the outlet (10) is 17 to 18 mm, preferably 17.5 mm.

14. The toilet pan according to any of the previous claims, **characterised in that** the channel (9) has a curve with a radius of curvature of 27 to 40 mm.

15. The toilet pan according to any of the previous claims, **characterised in that** the lower threshold (13) is located at least 15.5 cm, preferably 17.3 cm, from the top edge (6) of the bowl (1), the distance being measured in a straight line (vertically) from the verge of the top edge (6) of the bowl to a level where the lower threshold (13) is located.

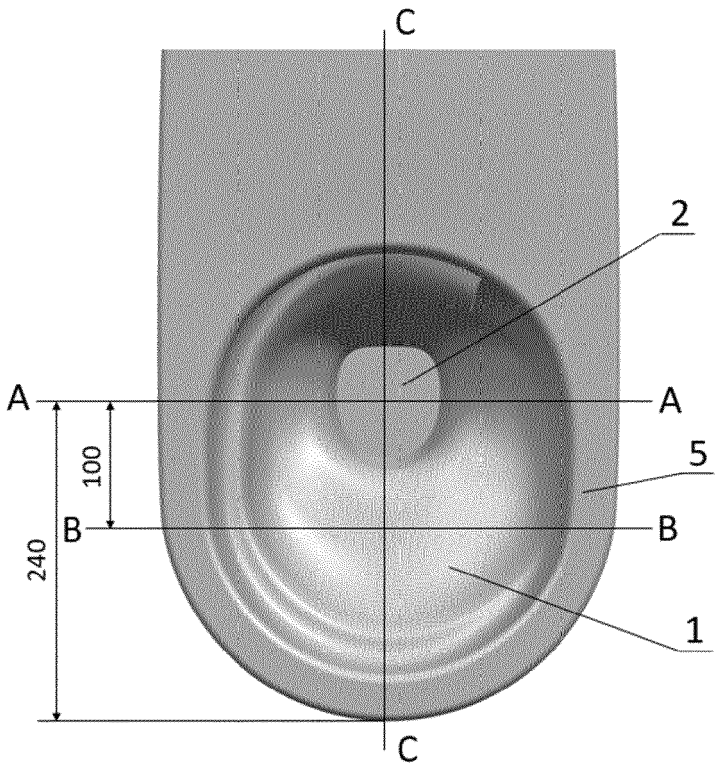

Fig. 1

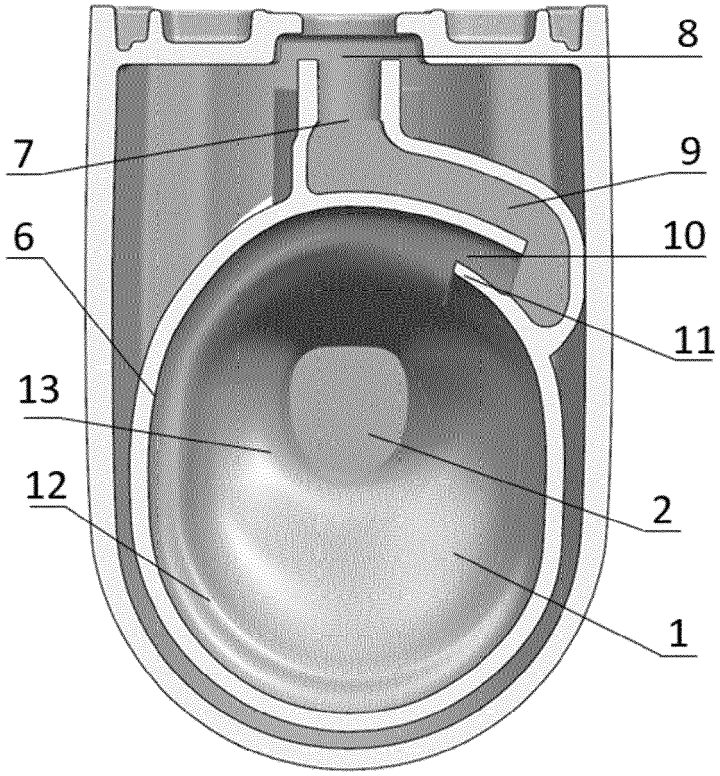

Fig. 2a

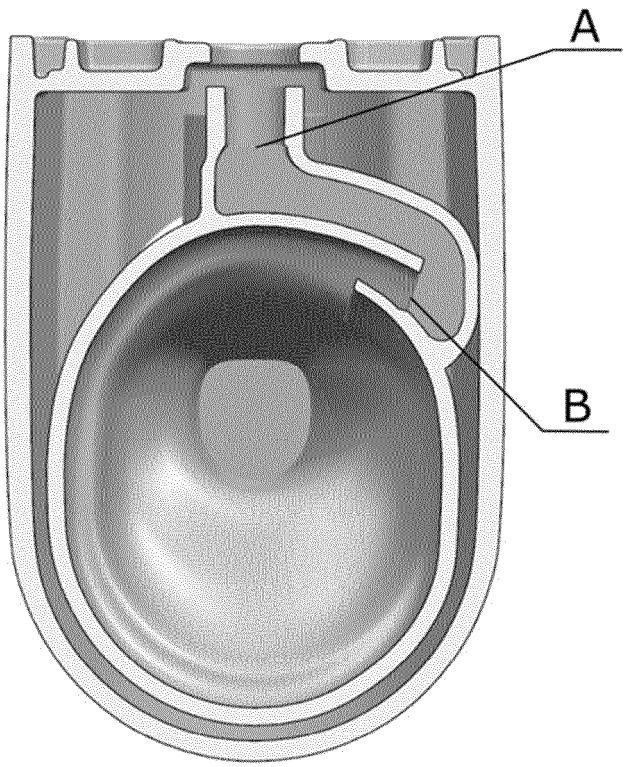

Fig. 2b

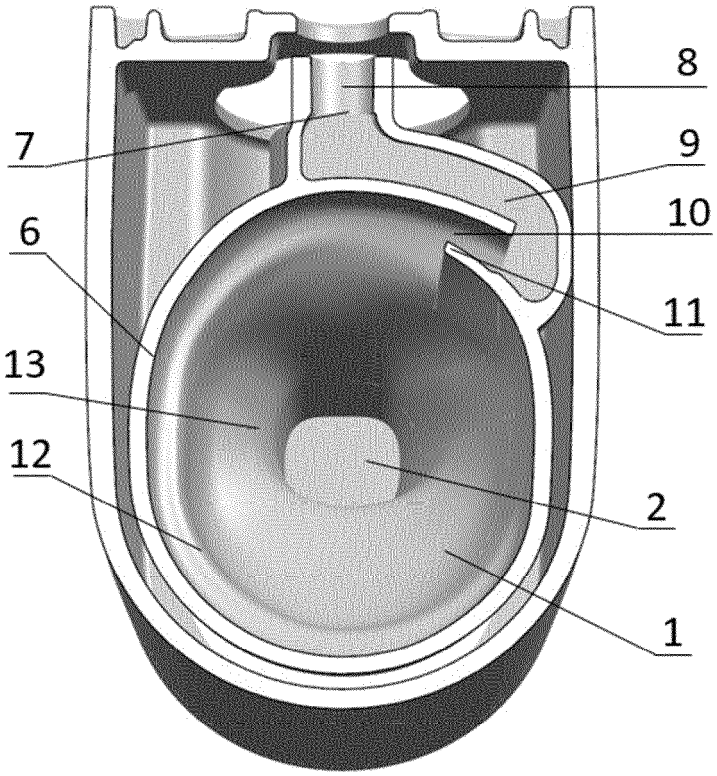

Fig. 3

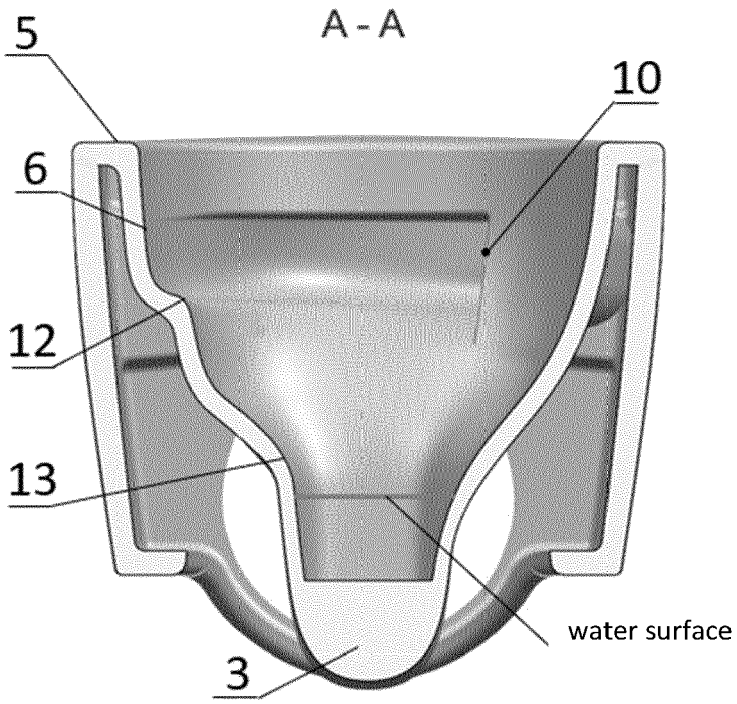

Fig. 4a

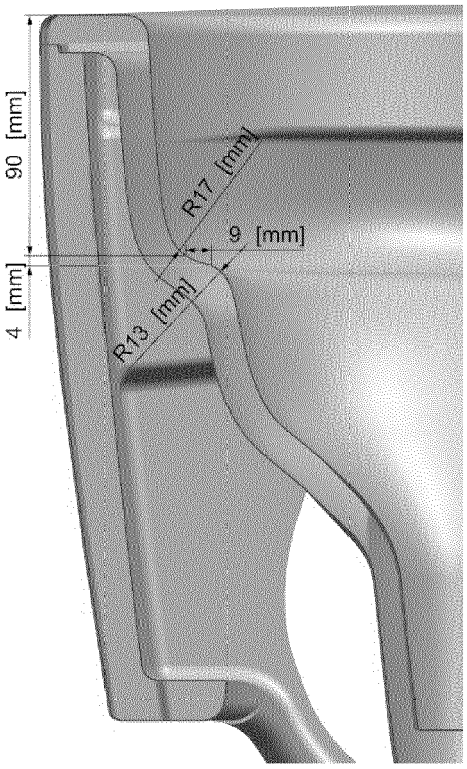

Fig. 4b

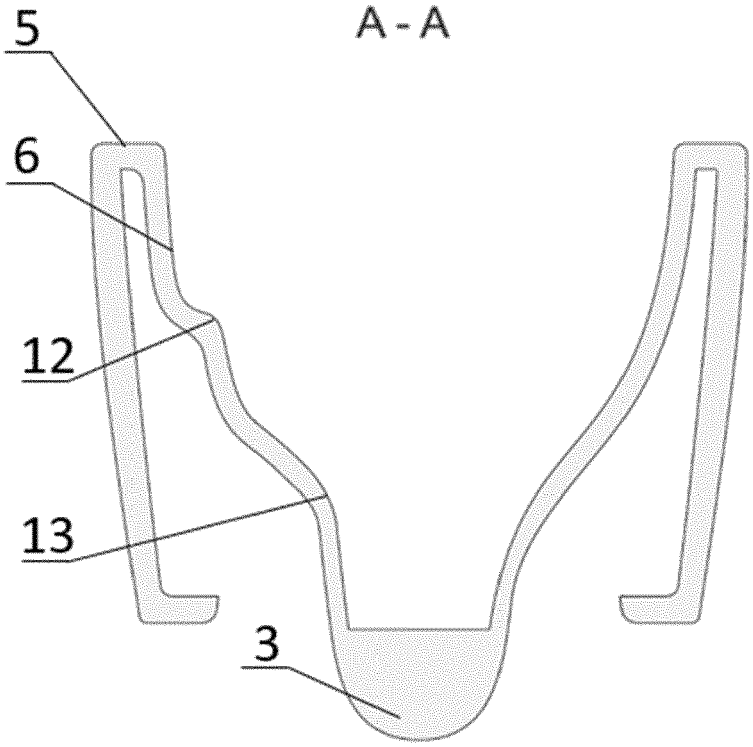

Fig. 5

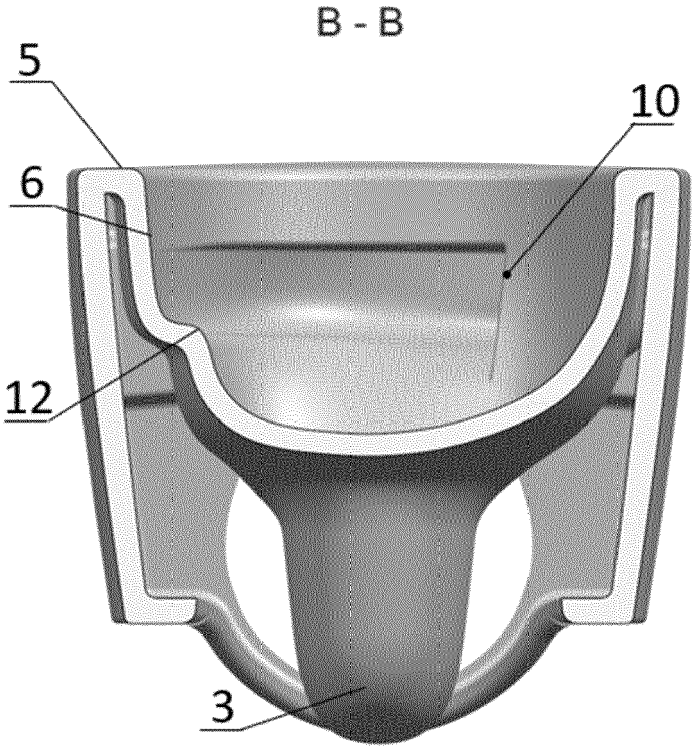

Fig. 6

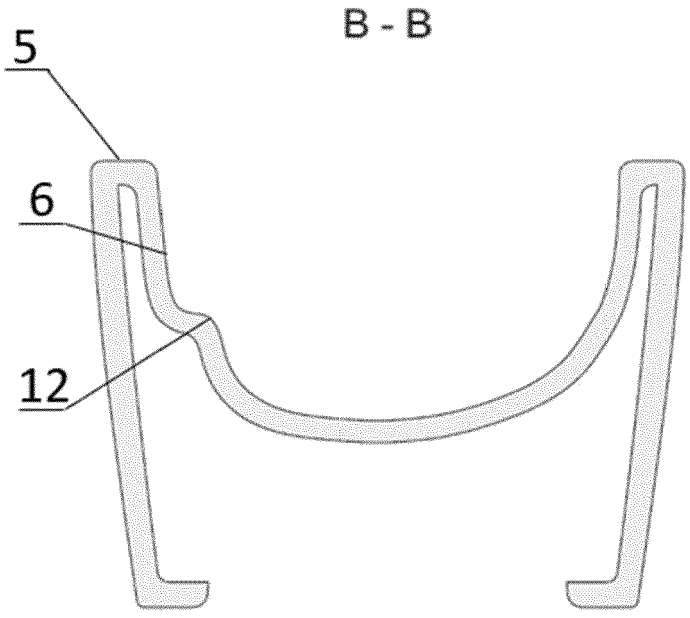

Fig. 7

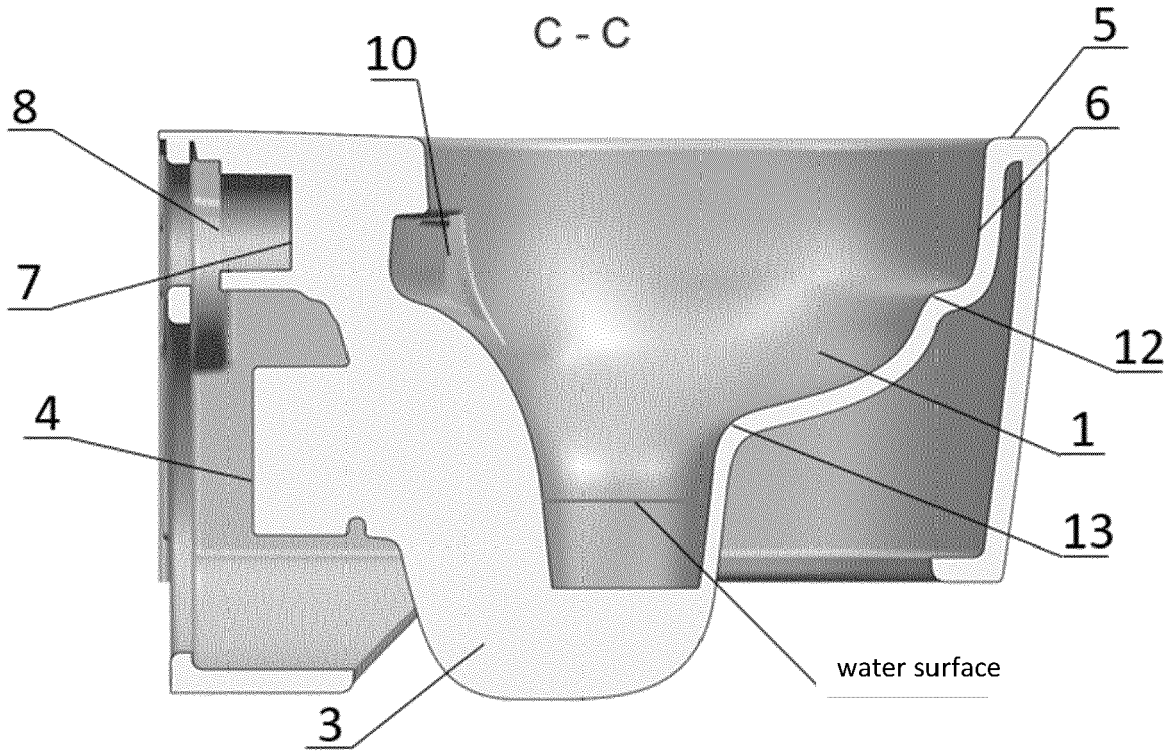

Fig. 8

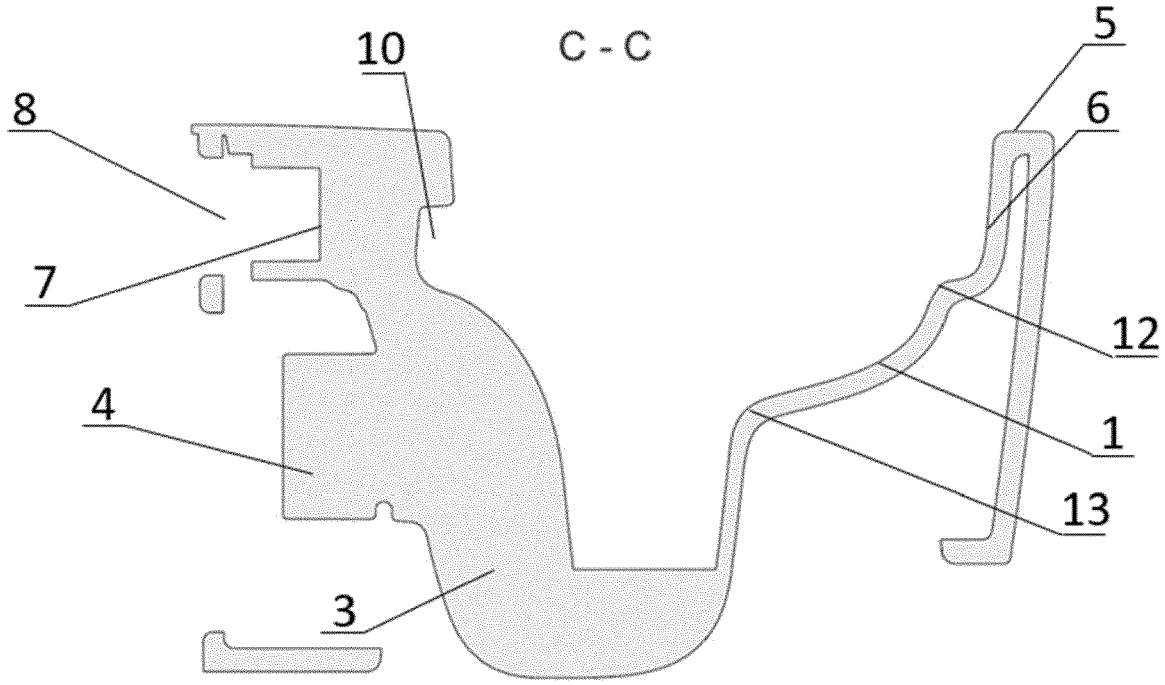

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 2392

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 20 2021 106357 U1 (CERSANIT S A [PL]) 17 December 2021 (2021-12-17) * paragraph [0037] - paragraph [0061]; figures 1-17 *	1-15	INV. E03D11/08
A	US 2018/135290 A1 (KASHIRAJIMA SHU [JP] ET AL) 17 May 2018 (2018-05-17) * the whole document *	1	
A	US 10 676 908 B2 (TOTO LTD [JP]) 9 June 2020 (2020-06-09) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)

E03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 December 2022	Horst, Werner

CATEGORY OF CITED DOCUMENTS

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14-12-2022

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REFERENCES CITED IN THE DESCRIPTION

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