Dec. 23, 1969 J. R. HOARD ET AL 3,484,873

TOILET STRUCTURE

Filed Nov. 1, 1967 3 Sheets-Sheet 1

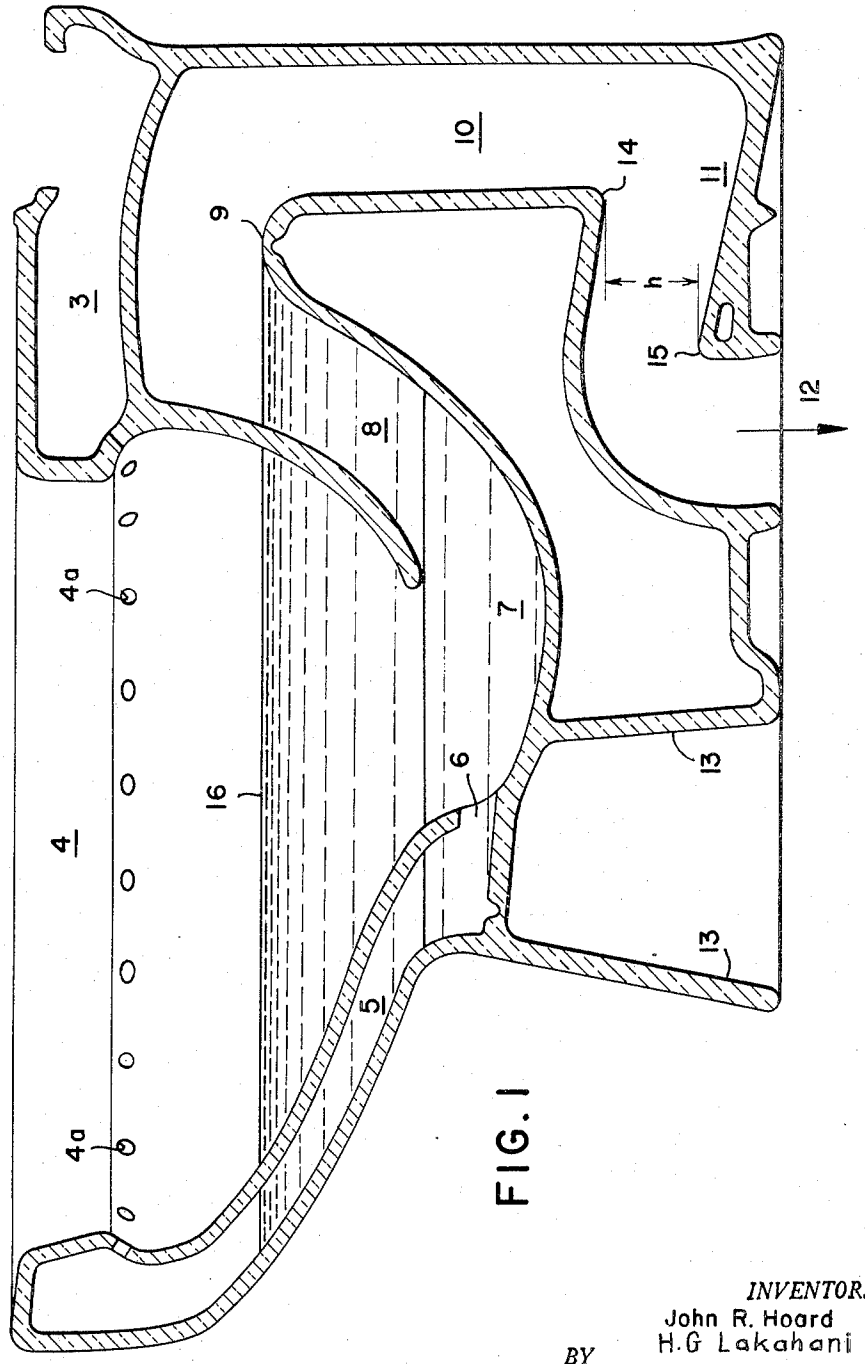


FIG. 1

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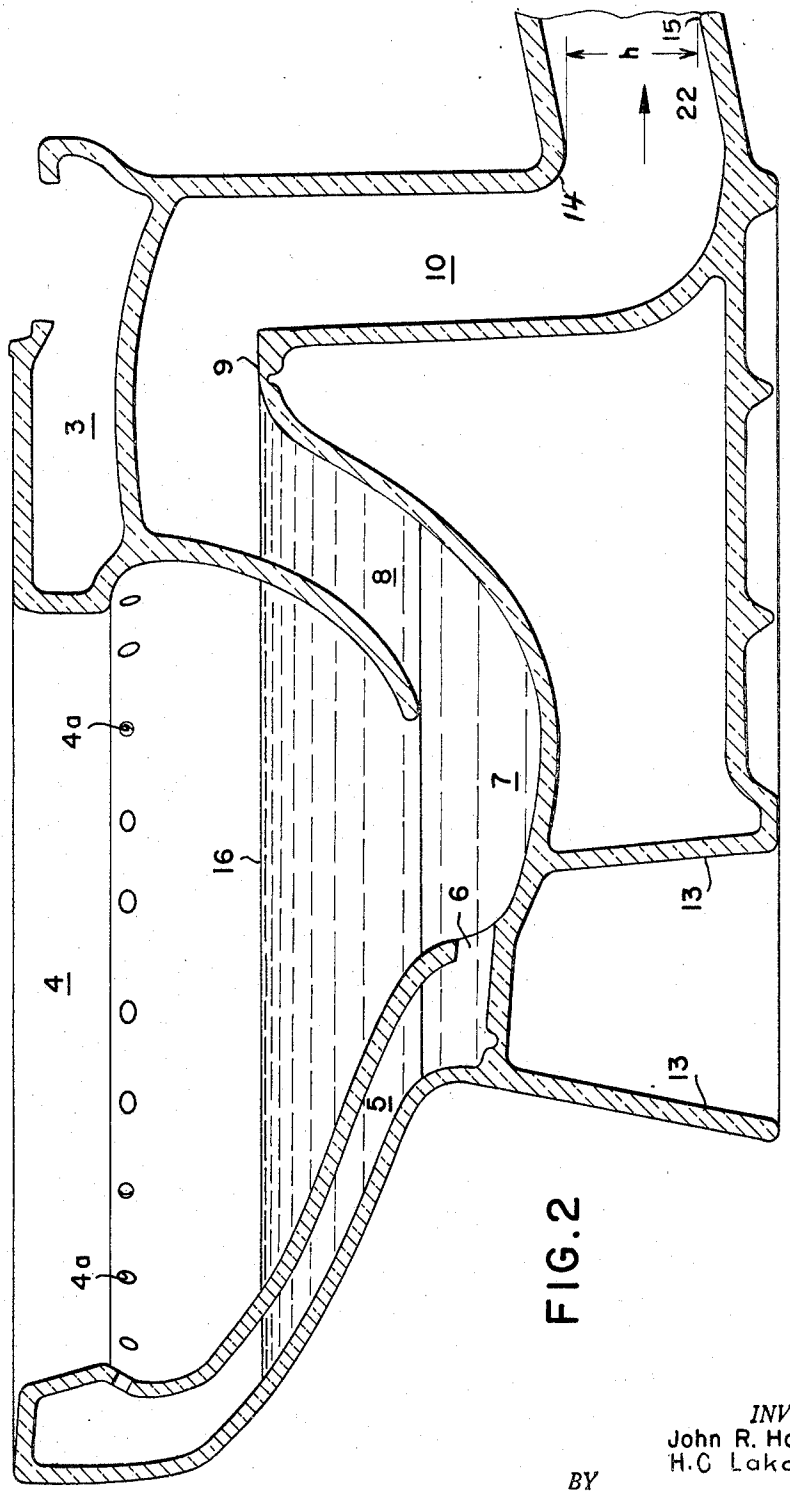


FIG. 2

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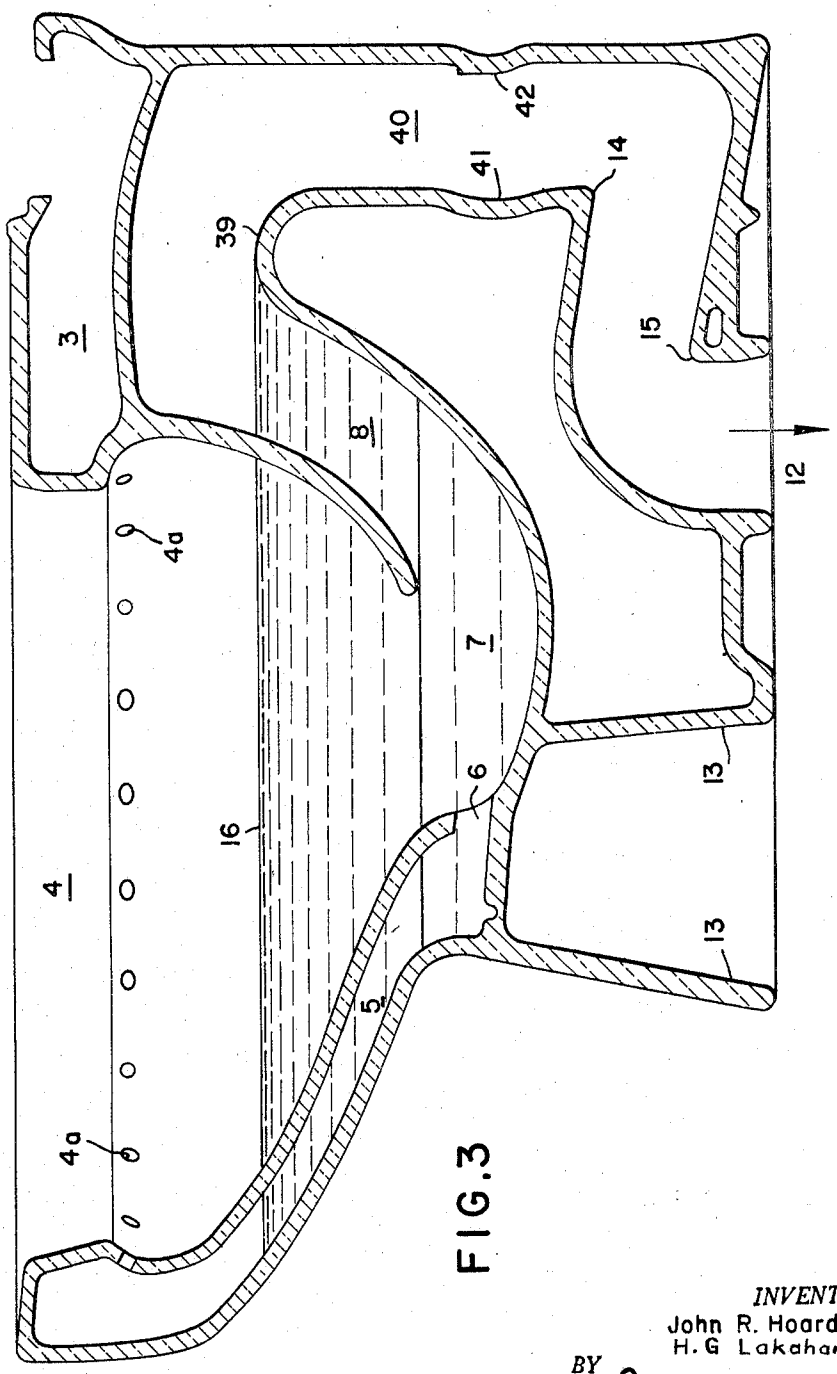


FIG. 3

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TOILET STRUCTURE

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Int. Cl. E03d *11/02, 11/18, 1/24*
U.S. Cl. 4—69 9 Claims

ABSTRACT OF THE DISCLOSURE

A toilet bowl construction of the siphon forming type. The arrangement is designed so as to require a minimum amount of water for its complete evacuation. The construction is one in which the down-leg passageway embodies a weir formation at its upper terminal and the construction also embodies a substantially horizontal passageway interposed between the down-leg passageway and the sewer system. The horizontal passageway also embodies a weir formation.

This invention relates to toilet bowls, sometimes referred to as water closets. More specifically, this invention pertains to toilet bowls of the siphon forming type.

The conventional siphon type of toilet bowl, whether it be one embodying a reserve water tank or a flushometer for the control of the flow of water through the bowl, has generally required some five gallons or more of water to complete a single evacuation. Such a large volume of water required for each evacuation quite naturally imposes a heavy drain on the water requirements of the locality, especially in localities such as cities or towns. Many measures have therefore been proposed over the years to conserve the water supply by limiting the flow of water to the essential services, and particularly including as essential services those for flushing toilet facilities. Even in such cases it has sometimes been necessary to restrict the amount of water required for such basic services.

In accordance with this invention, a toilet bowl arrangement has been devised which is capable of being evacuated to the same extent as a conventional toilet bowl, but with a supply of flushing water not appreciably greater than, and in some cases less than, one-half of the water requirements for conventional toilet bowl constructions. Thus, the toilet bowl construction of this invention can meet the water flushing requirements with some two and one-half or three gallons of water, in contrast to the conventional toilet bowl which requires some five gallons of water for the same purpose. As will be readily apparent, bowls of such construction and efficiency, if installed in sufficient numbers, will very markedly affect the water reserve requirements of all localities where they may be installed; e.g., cities and towns, etc., thereby effecting water savings which can be rendered useful for other perhaps equally important purposes. At the same time bowls so constructed introduce important monetary savings related to the cost of transporting the water requirements and in increased efficiencies in the use of the plant equipments and other apparatus required in connection with water closet operation. Another decided advantage with a toilet bowl embodying the construction of this invention stems from the reduction in the amount of material subjected to treatment by sewage treatment plants, such as private septic tanks and other types of municipal sewage systems.

The general arrangement of the toilet bowl of this invention is based in large degree upon material, significant changes in certain important physical proportions or contours or in the incorporation of certain features all for the purpose of producing a toilet bowl of high efficiency as already explained.

One of the features involved in the bowl construction of this invention resides in the employment of a crown weir which, in a floor discharge type of bowl construction, is preferably substantially circular in cross section and may have a carefully determined radius of a predetermined dimension and, in a wall discharge type of bowl construction, has a substantially 90° angular cross section.

Another important feature resides in the dimensions of the jet orifice of the bowl. The orifice may have an area which in a typical construction, is equivalent to a diameter of about three-quarters of an inch.

Still another feature resides in the swirl holes in the rim or flange of the bowl. Each rim or flange may have a plurality of carefully dimensioned swirl holes or cylinders, maybe 20 to 25 or even more, each of a diameter for example, of about one-quarter of an inch. Furthermore, each swirl hole or cylinder should be cast so that its axis is directed at an angle of some 35 degrees pointed downwardly with respect to the horizontal plane, that is, the plane of the bathroom floor. That is, all of the swirl holes or cylinders are pointed generally in the direction of what is sometimes called "the well" or the "bottom" of the bowl where water is retained between flushings.

Another feature of this invention importantly resides in what is familiarly called the horizontal leg passageway of the bowl construction. In accordance with this invention, the base of the horizontal leg is inclined upwardly and, furthermore, there is a predetermined vertical spacing between the peak of the base of the horizontal leg passageway and the point at which the down-leg passageway intersects the horizontal leg passageway.

The aforementioned features combine to produce a highly efficient toilet bowl designed to operate with a minimum of water requirements. Not all of the features would necessarily be embodied in all forms of the toilet bowl construction of this invention; some of the features are indeed more important than others to effectuate increased efficiency.

Stated generally and in somewhat different terms, the primary objective of this invention is to produce a siphon type of bowl construction which will materially reduce the amount of fluid required to completely evacuate it. This objective may be accomplished by employing some or all of the features above referred to in toilet bowl construction to the extent that such features are required to increase its water consumption efficiency for the purposes of complete and effective evacuation.

This invention will be better understood from the more detailed description hereinafter following, when read in connection with the accompanying drawing in which:

FIG. 1 represents a lateral cross sectional view of one form of toilet bowl construction, this construction embodying a floor exhaust or discharge outlet;

FIG. 2 represents a lateral cross sectional view of a similar toilet bowl construction, this construction employing a rear exhaust or discharge outlet; and

FIG. 3 illustrates a lateral cross sectional view of a modified form of down-leg for incorporation in either or both of the toilet bowl constructions of FIGS. 1 and 2.

Similar reference characters will be employed throughout the drawing to designate similar or identical parts.

Referring to the drawing, and more specifically to FIG. 1, the toilet bowl construction includes a main water passageway 3, to which a tank and flush valve combination may be associated, such as the tank and flush valve combination disclosed in the B. Hurko et al. Patent 2,773,268,

issued Dec. 11, 1956, or, in the alternative, to which a flushometer and water supply pipe (not shown) of well known construction may be associated. The main flow passageway **3** leads to a rim or flange **4** having a plurality of swirl holes or cylinders **4***a*. Each swirl hole or cylinder **4***a* may be directed downwardly at substantially the same angle from the horizontal plane. The main passageway **3** is connected via the rim or flange **4** to a jet passageway **5**, at the mouth of which there is a jet orifice **6**. The jet orifice **6** is adjacent to a well **7**. The up-leg passageway of the bowl is designated **8** and it reaches upwardly to a weir **9** which may be, for example, a crown weir having predetermined radius of, for example, one and one-quarter inches. The down leg passageway **10** of the bowl may have substantially vertical walls as one alternative, as shown in FIG. 1. The horizontal leg passageway is designated **11** and it connects with the discharge opening **12** which connects to the sewer system. The point **14** at which the horizontal leg passageway **11** and the down leg passageway **10** meet, is located at a carefully selected predetermined vertical distance *h* from the horizontal leg weir **15**.

The crown weir **9** will generally fix the normal upper level of the water in the bowl and this is shown at **16**. As the water level **16** tends to rise for any reason, water will flow over the weir **9**, through the vertical down leg passageway **10**, through the horizontal leg passageway **11**, then over the weir **15** and out through the exhaust port **12**.

When the flush valve or flushometer (not shown) is opened in order to evacuate the bowl, water will move rather rapidly through the main opening **3** and around a circular path formed by the rim or flange **4** of the bowl and into the jet passageway **5** and the rapidly moving water will then travel through the jet orifice **6**. While water is flowing through the jet port **6**, additional water will simultaneously be traversing the various swirl holes **4***a* and strike the water in and around the center of the bowl at the surface **16**. The confluence and joint action of water emerging both from the jet port **6** and from the swirl holes **4***a* will drive the conjoint streams through the up-leg passageway **8** and over the crown weir **9**, then through the opening of the down-leg passageway **10** of the trap, then along the horizontal passageway **11** over weir **15** and out through the exhaust port **12**. The water level **16** in the bowl will soon drop below the level of weir **9**.

In accordance with this invention, the flow of water over the weir **9** and into the down leg **10** produces, in effect, a screen or curtain as the water passes point **14**.

This screen or curtain of water causes the siphon to be initiated and the strength of the siphon is increased by the displacement of the entrapped air within the passageway **10**. The strength of the siphon can reach its maximum value when the water in passageway **10** completely displaces the entrapped air and reaches the top level of passageway **10**.

This suction results in driving the material within the bowl at a substantially higher flow rate through the up-leg section **8** over the weir **9**, through the down-leg passageway **10**, then through the horizontal leg path **11** and out through the discharge outlet **12**.

It will be observed that the reference character **13** designates the pedestal portion of the bowl. Its shape is of relatively little significance.

FIG. 2 is a bowl of substantially similar construction except that the exhaust port **22** is formed as a rear outlet. This embodiment also employs a similar but oppositely directed horizontal passageway **11** having a similar weir **15** and a vertical spacing *h* between points **14** and **15**. The crown weir of FIG. 2 has a 90° cross section. The water curtain or screen is formed as the water falls at point **14**. In other respects, however, the structures of FIGS. 1 and 2 are essentially the same and perform similar functions.

FIG. 3 shows a crown weir **39** which is not fully rounded. This non-circular construction has the effect of causing the water driven past the weir to approach the right hand side of the opening of the down-leg **40**. However, the down-leg passageway **40** has its walls shaped at **41** and **42** so as to deflect the water moving through the down-leg path **40** somewhat to the left, toward side **41**. This is done in order to create the necessary screen or curtain effect in the down-leg passageway. The construction of the down-leg **40** and its side walls **41** and **42** of FIG. 3 may be readily and conveniently applied to either of the bowl arrangements illustrated in FIGS. 1 and 2.

In one arrangement constructed in accordance with this invention, the crown weir **9** had a radius of approximately one and one quarter inches but obviously a range of radii may be suitably employed, preferably a radius of somewhere between one-half inch and three inches. The configuration of FIG. 3, as already noted, embodies a non-circular weir **39**, but a down-leg path of a particular configuration in its side walls, also as shown in FIG. 3, would be preferable for addition to such a weir.

In an arrangement constructed pursuant to this invention, the vertical spacing *h* between the uppermost point of the weir **15** and the lowermost point **14** of the horizontal leg path **11** measured about one and thirteen-sixteenths of an inch. This dimension was found to be particularly useful in maintaining a good siphoning action in the bowl operation. In the constructed arrangement, the jet port **6** was substantially circular in cross section and had a diameter of about three-quarters of an inch. This diameter may be increased or decreased, perhaps about one quarter of an inch either way, without materially affecting the efficiency of the operation of the bowl. Furthermore, in the arrangement put into use, the swirl holes **4***a* were of a diameter of about one-quarter of an inch and were directed downwardly at some 35 degrees from the plane of the horizontal. The number of these openings may be varied within pretty wide limits.

As already explained, some of the characteristics above noted are obviously more critical than others in the efficient operation of the toilet bowl of this invention. The greatest efficiency would accompany the employment of all of these features, but as to these features the number of the swirl holes **4***a*, the opening of the jet port **6**, the vertical dimension *h*, the particular configuration of the crown weir **9**, the shaping of the walls **41** and **42** of the down-leg **40** (FIG. 3), etc., may be varied within fairly wide limits and yet not seriously affect the desired efficiency.

In accordance with a main feature of this invention, the weir **15** in the horizontal leg path **11** is most important in the creation of good siphoning action in the bowl arrangement. Furthermore, the dimension *h* is especially significant in fixing the minimum flow rate at which siphoning action in the bowl arrangement will be initiated.

For explanatory purposes, but not for limiting the invention in any respect, the theory of operation will be briefly discussed. In the static condition, e.g., when there is no flow and water in the well of the bowl is merely stationary at the level **16**, there will obviously be no siphon effect present. However, when water impinges upon the well area **16**, water will flow over the weir **9** and through the down-leg **10**. The initial flow of water will tend to fill the section of the horizontal leg **11** up to the peak of the weir **15**. Additional water traversing the down-leg **10** will cause the flow to be started over the weir **15** and into the outlet **12**. If a sufficient amount of water traverses down-leg **10** in a given time interval, the level of water in the section of horizontal leg **11** will rise, and the rise in level will continue. Shortly thereafter, the down-leg **10** will effectively become sealed by the rising level of the water. Air in down-leg **11** will be replaced by water and the water level in the down-leg **10** will continue to rise well above point **14**. The siphon will be started almost simultaneously with rthe rising water level reaching the point **14**. The strength of the siphon will be increased approximately to the extent that the water level in down-leg **10** rises above point **14**. The greater the

siphon effect, the greater and more complete will be the evacuation of the bowl contents after such evacuation is started.

One of the most important features of this invention resides in the dimension *h* as already observed. It was determined, in accordance with this invention, that the smaller the dimension *h* was made (all other dimensions otherwise remaining unchanged), the smaller was the flow rate through the down-leg **10** needed to initiate the siphon. This dimension *h* therefore controlled the siphon action as well as the evacuating properties of the bowl arrangement.

While this invention has been shown and described in certain particular arrangements merely for the purpose of illustration, it will be understood that this invention may be employed in other and widely varied organizations without departing from the spirit of the invention.

What is claimed is:

1. A water closet comprising a bowl having a flanged raceway along its upper edge through which water may be transmitted for flushing purposes, said flanged raceway having a plurality of substantially equal cylindrical openings distributed along the periphery of the flanged raceway, the axes of the various openings being directed downwardly into the general region of the well of the bowl, a jet passageway extending from the flanged raceway to the well of the bowl, an up-leg passageway extending from the well of the bowl, a crown weir at the uppermost point of the upleg passageway, a substantially vertical down-leg passageway extending downwardly from the crown weir, substantially all of said down-leg passageway being continuously linear but having intermediate its extremities oppositely disposed substantially concave and convex regions extending over a relatively small section of said passageway, and a lineate substantially horizontal leg passageway having a weir at its bottom surface, the peak of which is spaced by a predetermined distance from the intersection of the down-leg passageway and the horizontal and the horizontal passageway.

2. A water closet in accordance with claim **1** in which the horizontal leg passageway is pointed upwardly at a predetermined angle to the peak of its weir.

3. A toilet bowl construction comprising a circumferential flange having a plurality of discharge openings for directing water toward the well of the bowl, a jet passageway extending between the flange and the well of the bowl for simultaneously discharging water at high velocity into the well of the bowl, an up-leg passageway for transmitting water upwardly from the well of the bowl, a substantially vertical down-leg passageway having substantially all of its opposite walls substantially linear but having intermediate its extremities oppositely disposed substantially concave and convex regions extending over a relatively small section of said passageway at intermediate points thereof so as to deflect water from one of the walls to the other, a weir interposed between the upper terminal of the up-leg passageway and the upper terminal of the down-leg passageway, and a substantially horizontal passageway having a weir at the bottom thereof for discharging water travelling through the down-leg passageway.

4. A toilet bowl according to claim **4** in which the horizontal passageway is composed of a continuous smooth surface forming a uniform passageway reaching to the peak of the weir in the horizontal passageway.

5. A toilet bowl construction comprising a circumferential flange having a plurality of discharge openings pointed toward the well of the bowl, a curved, jet passageway interconnecting the flange with the well of the bowl, a curved up-leg passageway extending upwardly from the well of the bowl, a substantially horizontal passageway having a weir therein, a vertical down-leg passageway between the upper terminus of the up-leg passageway and the horizontal passageway, substantially all of said down-leg passageway being continuously linear but having intermediate the extremities of its opposite walls substantially concave and convex regions extending over a relatively small section of said passageway at intermediate points thereof so that water will be deflected from one of its walls to the other, whereby in the overall operation of the bowl flushing water traversing the flange will be simultaneously discharged through the flange openings and the jet passageway into the well of the bowl, and then discharged through the up-leg, down-leg and horizontal passageways into the discharge opening of the bowl.

6. A toilet bowl construction according to claim **5** in which a weir interconnects the down-leg passageway and the up-leg passageway.

7. A toilet bowl construction according to claim **6** having, in addition, a sewer outlet connected to the horizontal passageway.

8. In a toilet bowl having a well into which water may be discharged at substantially high velocity when the bowl is to be evacuated, means for initiating siphoning action in the bowl, said means including a substantially vertical down-leg passageway substantially all of which is continuously linear, said down-leg passageway having intermediate its extremities oppositely disposed substantially concave and convex regions extending over a relatively small section of said passageway, and a lineate substantially horizontal passage leading from said down-leg passageway and having a weir therein at the end thereof, said weir being sufficiently high in order to substantially reduce the flow rate through said down-leg passageway to initiate said siphoning action, said lineate horizontal passageway having a predetermined vertical spacing between the upper and lower levels of the passageway.

9. In a toilet bowl according to claim **8**, the combination in which said vertical spacing is one and thirteen-sixteenths of an inch.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,484,873 December 23, 1969

John Roberts Hoard et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 39, cancel "and the horizontal"; line 62, "4" should read -- 3 --.

Signed and sealed this 23rd day of February 1971.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents