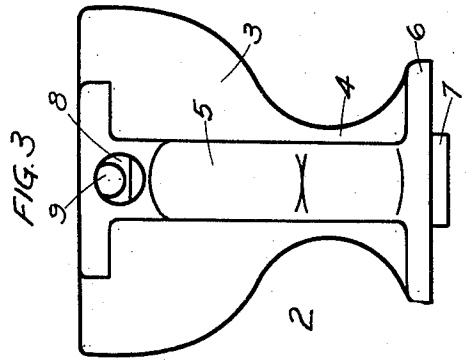
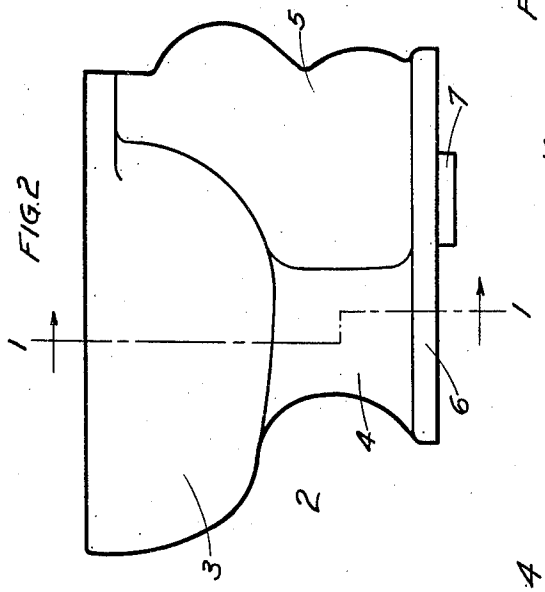
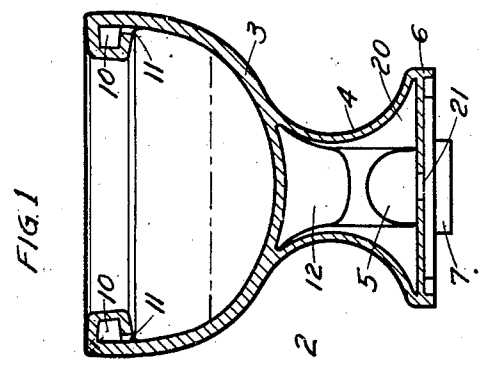
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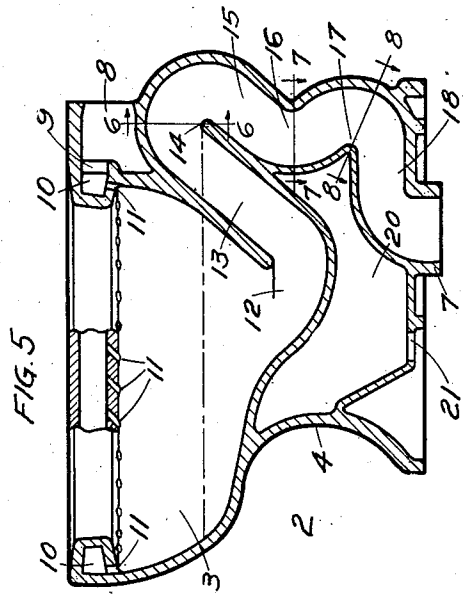
WATER CLOSET

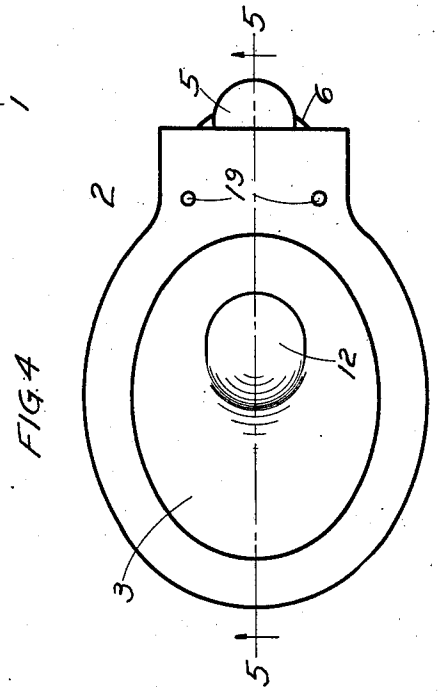
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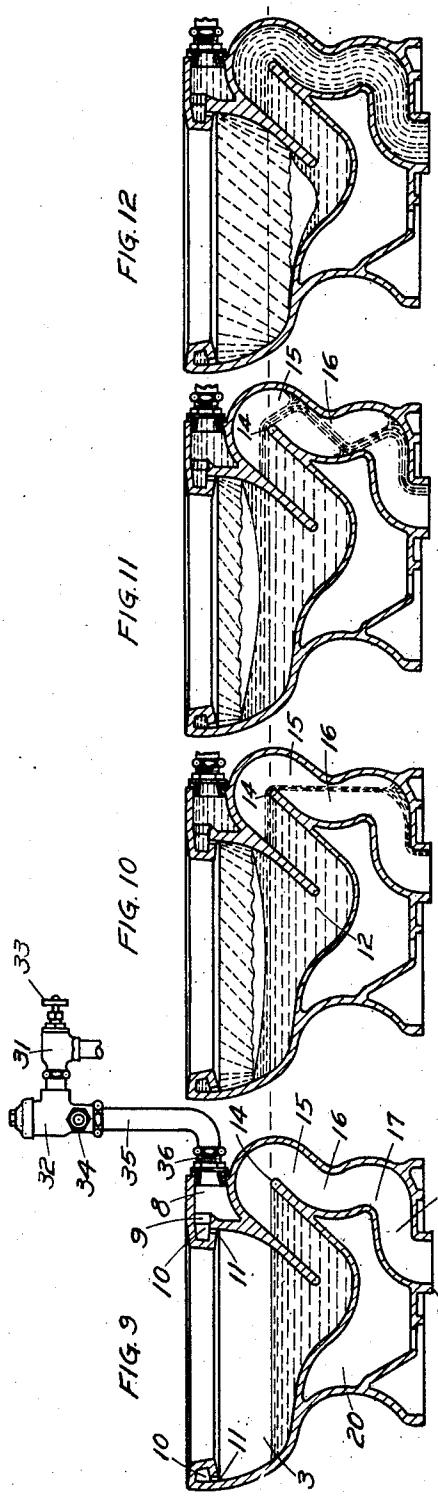


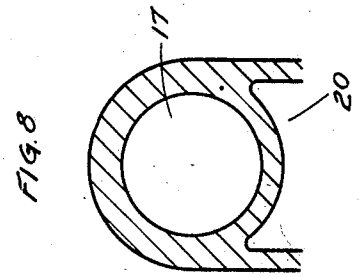
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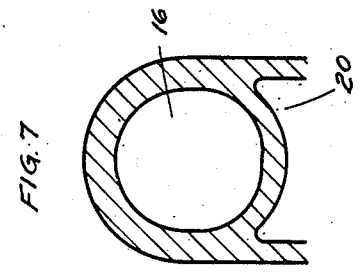
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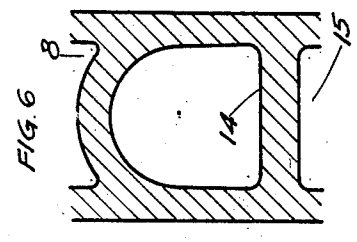
WATER CLOSET

Original Filed Nov. 22, 1938 2 Sheets-Sheet 2









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Patented Mar. 21, 1944 2,344,649

UNITED STATES PATENT OFFICE

2,344,649

WATER CLOSET

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Continuation of application Serial No. 241,791, November 22, 1938. This application February 20, 1942, Serial No. 431,744

3 Claims. (Cl. 4—69)

My invention relates to syphon water closets, and it has two general objects: (1) to provide a new and improved syphon water closet capable of being flushed effectively through a direct-connected flush valve by a relatively small supply-flow, such as that obtainable from the water-supply pipe of the average one-family dwelling; and (2) to include within the new and improved water closet such features of construction and operation as will result in a quiet flushing operation.

This is a continuation of my prior application filed November 22, 1938, Serial No. 241,791.

General Description

The two most serious drawbacks to the modern water closet are: (1) the high input rate of flow required to ensure an effective flushing, necessitates that large piping sizes (which are much more expensive than the smaller ones) be installed where direct-connected flush valves are to be used, and (2) the water closet is noisy in operation.

Whereas most water closets require that the rate of supply thereto be from twenty to thirty gallons a minute (an average of around twenty-five gallons a minute) the supply pipe leading into the average one-family dwelling from the street main cannot ordinarily supply more than ten to fifteen gallons a minute to any one fixture. As a result, the use of a direct-connected flush valve in the average small dwelling to supply water directly from the supply pipe into the water closet, is precluded.

Since water closets were originally designed to be flushed from an individual tank arranged to store a desired quantity of water which could be released into the water closet at any desired high rate of flow, the problem of developing a water closet to flush properly when supplied with a low rate of flow, was not originally present. When direct-connected flush valves came into general use, the available "tank" closets were made use of. The use of flush valves was, therefore, confined mainly to large buildings, such as schools, office buildings, and multiple dwellings, as in these buildings the large piping required to supply the total demand is able to furnish the high rate of flow required to flush the water closets.

The owners of most small dwellings have been restricted to tank closets because of the expense of installing the larger supply piping and larger water meters required for the larger rate of flow necessary where the usual water closet is flushed directly from the supply system. Moreover, many water companies have rulings which make it very difficult for builders or owners of single-family dwellings to install a larger supply pipe and water meter than is customary, possibly fearing that the larger piping in the homes will require larger street mains. It is readily apparent, therefore, that, since the supply capacity generally cannot be increased to that required by the water closets now in use or known, a new and improved water closet, capable of operation from a smaller supply flow, must be produced if small homes generally are to be given the advantages of direct-connected flush-valve operation.

I have found that the rate of flow through the trapway of the water closet must be greatly in excess of the low supply rate (eleven to fourteen gallons a minute) available in a large portion of small homes, and that this small rate of flow is not sufficient to maintain syphonic action indefinitely through the trapway, from which it is evident that the syphonic action started following the initial admission of water into the closet, is broken when the syphonic action has emptied the closet bowl of water. I have found further that the wetting, softening, and submerging of the dry, floating toilet paper, usually present when the water closet is to be flushed, is the most difficult part of a flushing operation with a low input rate of flow. Since this wetting, softening, and submerging of the toilet paper must be accomplished before or during the syphon discharge through the trapway, the completion and breaking of the syphonic discharge must be delayed until the paper has been thus prepared. I have found that this delay in the completion of the syphonic action can be accomplished best by such a revision of the trapway and crest as will delay the starting of the syphonic action by allowing a large build-up in the water level before the syphon is started. The trapway which I have found most desirable is one having as nearly as possible a uniform cross-sectional area throughout, and being as nearly circular as is practicable in the manufacture of earthenware, with a horizontal seal-retaining dam or crest having a length across the trapway substantially the same as the mean or effective width of the trapway.

As far as I am aware, all syphon water closets heretofore known or used have been provided with a concave crest and/or have been widened considerably at the top of the trapway where the dam or crest is located, and the length of the dam or crest has been therefore considerably

greater than the mean or effective width of the trapway. Such a widened construction tends to permit a syphon-inducing rate of flow to take place over the long dam or crest responsive to only a very small rise in the water level, thereby hastening the formation of syphonic action, when the supply rate is sufficient. However desirable a trapway with a wide upper portion and a correspondingly long dam or crest may be when used with a bowl into which a high rate of flow is to be supplied, such a construction of the trapway cannot be used when the rate of flow is low, for the two following reasons: (1) the starting of the syphonic action is not reliable, in that syphonic action starts with only a minimum amount of water in the bowl above the level of the dam or crest, which amount is almost immediately drawn down to the crest level, and the syphonic action often stops before it has fairly gotten under way; and (2) very often the full syphonic action gets under way very early, with the result that the syphonic action has run its course and the bowl is emptied before the input of water at the low rate of flow has succeeded in wetting, softening, and submerging the toilet paper contained in the bowl. The toilet paper, and possibly part of the excrement, is in this event either lodged in the entrance to the trapway or is left in the bowl.

In combination with the novel trapway and crest above mentioned, I have found it highly advantageous to introduce the water into the bowl through spirally disposed rim perforations, whereby the entering water acts upon the water contained in the bowl to set it into a circular motion. This circular motion acts in two advantageous ways: (1) it further delays the start of syphonic action by causing water to rise along the sides of the bowl and thus be stored above the static level effective over the well hole and in the trapway, which additional amount of stored water acts to prolong the syphonic action when it is once started; and (2) the swirling circular motion, by attaining considerable velocity by the time syphonic action starts and gets well under way, offers great assistance in the wetting, softening, and submergence of the paper.

There has been a considerable demand during recent years for relief from noisy water-closet equipment, resulting in the development of quiet flush valves and associated throttle or stop valves, such as, for example, the quiet flush valve and associated throttle valve disclosed in my application Serial Number 227,958, filed September 1, 1938. Even when this quiet flush-valve equipment is used, considerable flushing noises remain, for they are given off by the water closet itself.

In attacking the problem of producing a water closet capable of a quiet flushing operation, I have found that much of the noise formerly present is missing when the rate of flow into the water closet is reduced to that satisfactory for my new water closet above discussed, for the low rate of flow sufficing to flush this new closet exhibits less tendency to generate noise. Moreover, this low rate of flow can be still more quietly delivered by the quiet flush valve and its associated quiet throttle valve.

Another factor tending to promote quietness in my new closet, compared to others in common use, is that it is constructed so that all the water received is directed into the bowl through the rim perforations, no jet being used to drive the water through the upleg of the trapway, which jets, in water closets using them, result in noisy operation in the interval between the emptying of the bowl and the cessation of the supply flow.

Quiet entry of the water into the bowl is furthered by the previously mentioned spiral rim streams, for these rim streams strike the water surface in the bowl at a rather sharp angle, thereby causing a minimum of splashing. Moreover, the water in the bowl is soon set into rotation, and is thereafter moving horizontally away from the points at which it receives the rim streams. Therefore, such noise tendency as exists at this point is markedly lessened.

One further feature conducive to quietness is the large area of rim holes, compared to the low input rate of flow, whereby the expelled air and the water emerge at a low velocity. The area preferred is one large enough that the rim-stream velocity is so low that the entering water merges silently with the water contained in the basin. But, when this condition is fulfilled in a water closet with vertical rim punchings, so little motion is imparted to the basin contents that such paper as may be floating on the surface receives little direct disturbance and tends to remain dry and unsoftened. This latter situation, however, is overcome by the swirling action previously pointed out.

The foregoing and other objects and features of the invention will be understood more thoroughly upon a further perusal of the specification.

The drawings

Referring now to the accompanying drawings, comprising Figures 1 to 12, they show sufficient views of a water closet constructed according to the features of the invention to enable the invention to be understood. Figures 1 to 5 show various views of the preferred embodiment of the improved water closet; Figures 6 to 8 show cross sections of the trapway of the water closet taken along section lines indicated in Figure 5; and Figures 9 to 12 illustrate successive stages in a flushing operation.

More in detail, Figure 1 shows a front sectional view of the water closet taken along the line 1—1 of Figure 2;

Figure 2 shows a side elevation;

Figure 3 shows a rear elevation;

Figure 4 shows a top or plan view;

Figure 5 shows a side sectional view taken along the center line, as indicated by the line 5—5 of Figure 4;

Figure 6 shows the trapway in section at the line 6—6 in Figure 5, showing the width and contour of the crest 14;

Figure 7 shows a section of the trapway at the bend 16 therein, taken along the line 7—7 of Figure 5, looking down;

Figure 8 shows a section of the trapway looking down at the angle indicated by the line 8—8 in Figure 5, the section being taken at the choke 17 in the trapway;

Figure 9 shows the water closet with a flush valve 32 connected thereto through flush-tube 35 and spud assembly 36. Control stop or throttle 31 is interposed in the supply line to regulate the rate of flow when required. This control stop and flush valve are preferably of the quiet-throttling type illustrated in my patent application hereinbefore referred to. The water is illustrated as standing at the full-seal level, preparatory to a flushing operation;

Figure 10 shows the approximate water level and the path taken by a small stream overflowing the crest 14 about five seconds after the flush valve 32 has been tripped;

Figure 11 is a similar view taken about seven or eight seconds after the flush valve has been tripped; and

Figure 12 is a view taken about fifteen seconds after the tripping of the flush valve.

Detailed Description

The invention having been described generally, a detailed description will now be given.

Construction of the water closet

Referring now particularly to Figures 1 to 5, the illustrated water closet is indicated generally by the reference character 2. As seen best in Figure 2, the principal parts are the bowl portion 3, the pedestal 4, the trap-enclosing portion 5, the base 6, and the outlet 7. A further understanding of the outward appearance of the closet can be had from an inspection of the end view shown in Figure 3 and the top view shown in Figure 4. This water closet is of the usual size and overall dimensions, and is provided with seat-post holes 19, Figure 4, for the usual size and construction of hinged seat (not shown).

From the illustration in Figure 5, it may be seen that the water received at the spud pocket 8 passes through the rim-supply opening 9 and into the rim-channel 10 of the inwardly formed rim around the top opening into the bowl 3. From the rim channel 10, the water is supplied into the bowl 3 by way of a number of angularly disposed rim perforations 11. These rim perforations, seen best in the broken-away portion of the rim in Figure 5, are all preferably arranged in the same spiral (right-hand or left-hand) at an angle of between thirty degrees and sixty degrees from vertical. For a supply of ten to fifteen gallons a minute, about thirty-two one-quarter inch rim holes, in a left-hand spiral of about forty-five degrees, and evenly spaced around the rim of the bowl and close to the wall thereof, as illustrated, have been found to be quite satisfactory.

The bottom of the bowl 3 merges into the wall 12 (Figures 1, 4, and 5), from which extends the upleg 13 of the trapway, being the intake leg of the syphon. The upleg 13 continues to the crest 14, which is preferably as nearly horizontal entirely across the trapway as it can be made commercially, over which crest the trapway turns and continues as the downleg 15 thereof. The downleg 15 includes the bend 16, which is important to enable the water spilling over the crest 14 to be intercepted pursuant to the starting of the syphonic action. Following the bend 16, there may be the choke 17, whose cross sectional area is less (but preferably only slightly less) than that of any other portion of the trapway, in order to ensure the filling of the downleg and the prevention of the rising of air in the downleg when the syphon is about to be started. Between the choke 17 and the outlet 7, there is the horizontal offset 18 in order to bring the discharging water toward the front of the bowl to the usual and preferred position of the outlet 7.

As seen in Figures 1 and 5, the interior of the pedestal 4 is hollow, the enclosed space 20 being left inside the pedestal 4 and in front of the trap-enclosing portion 5 (see Figure 1) for economy of material, as well as to avoid the cracking which would be inevitable if this part of the structure were left solid. In practice, the liquid material (called slip) initially placed within the enclosed space 20 to enable the defining walls to solidify is drained out through the opening 21 as soon as the surrounding walls have acquired the requisite thickness.

The water closet illustrated herein has a trapway which throughout most of its length is about two and one-quarter inches in width and of the same height, and is as nearly circular in cross section (except at the crest 14) as can be conveniently approached in manufacture. As previously noted, the contour of the trapway is indicated at the crest 14, at the bend 16, and at the choke 17 in Figures 6, 7, and 8, respectively.

It has been found that a trapway so constructed according to the drawings passes a two-inch ball, the size of ball which can be passed being usually somewhat less than the nominal minimum dimensions of the trapway because of the presence in water closets, as actually manufactured, of small ridges where the various preformed pieces are cemented together with semi-liquid clay, and also because of variations resulting from settling and shrinkage of the soft structure after molding, as is well known to those familiar with the production of ceramic products.

By making the entire remaining portion of the trapway substantially uniform in cross-sectional area and only slightly, if any, larger than the nominal choke area, there is no portion of the trapway in which the matter carried by the syphoning water slows down and thus has a chance to form a jam.

Since the rate of flow through the trapway during syphonic action is greatly in excess of the rate of flow into the closet from the supply, adequate storage of water in the bowl must be provided for in order that the syphonic action be sufficiently prolonged to ensure thorough dependable carryout. About half of the required storage is provided in the basin 3 below the seal line, leaving the remaining storage to be provided in the space above the seal line, water being stored above the seal line following the tripping of the flush valve and before syphonic action starts, as the rate of flow over the crest previous to the start of syphonic action is much less than the rate of flow into the bowl.

The flushing operation

Referring now particularly to Figures 9 to 12, keeping in mind the construction of the water closet as hereinbefore pointed out, the succession of events during a complete flushing operation will now be described.

In Figure 9, the water closet is shown with the level of the water up to the normal seal line, which is the preferred water level at the beginning of any flushing operation.

When the flush valve 32 of Figure 9 is tripped, by an actuation of handle 34 thereof, water commences to flow at the preferred rate of about twelve gallons a minute through the flush tube 35 and into the spud pocket 8, which rate of flow is regulated by a suitable throttling adjustment of the handle 33 of control stop 31. From the spud pocket 8 the water passes through the rim-supply opening 9 and thence into the rim channel 10, the flow dividing and passing along the two sides of the rim channel in parallel. From the rim channel, the water comes down into the bowl 3 along the sides thereof through the spiral-

ly disposed holes 11 (see also Figure 5). Since, in the particular embodiment illustrated, there are thirty-two of the openings 11, and each opening is about one-quarter inch in diameter, the average velocity, by calculation, of the water passing through the rim holes is something less than two and a half feet a second when the rate of flow is twelve gallons a minute. This velocity is slightly less than the maximum theoretical velocity from a static head of water of one and one-quarter inches. By observation, the head of water in the rim, with an input rate of twelve gallons a minute, is a maximum of one and a half inches, measured from the bottom of the rim channel 10. The water therefore flows with almost perfect silence diagonally along the sides of the bowl 3.

Moreover, since the streams issuing from the rim perforations 11 strike the relatively stationary water in the bowl at a substantial angle from the vertical, the tendency to produce splashing and other noises is much less marked than when the water from the rim perforations strikes the stored water at substantially right angles.

Even the small rim-stream velocity above discussed is sufficient to start the water to swirling in the bowl after few seconds have elapsed. At the preferred rate of flow of about twelve gallons a minute, the observed swirling action in the bowl causes the water surface to become sufficiently concave that the water along the sides reaches a level of nearly an inch above the low point of the water surface near the center after the flushing operation is well under way.

Figure 10 illustrates the approximate conditions in the water closet a few seconds after the flush valve 32 has been tripped. In this drawing, it will be noticed that the water level has risen somewhat and that the water surface in the bowl has begun to assume its characteristic concave shape caused by the swirling action. Also, water has begun to spill over the flat crest 14. (See also Figure 6, taken along the line 6—6, Figure 5.) At this time, the increase in the static head above the well 12 and effective at crest 14 is sufficiently slight that the water spilling over the crest does not strike the back side of the downleg 15 of the trapway above the bend 16 to begin to prepare for the sealing action which precedes the starting of the syphonic action. Because of the concave shape assumed by the surface of the new swirling water, more water is stored in the bowl 3 than is represented by the increased static head over the well 12, for the water is higher along the sides than directly over the well.

In Figure 11, which shows the approximate water conditions present some seconds after those illustrated in Figure 10, it will be noted that the concavity of the water surface is still more pronounced than in Figure 10, and that the mean level of the water has risen to a higher point.

In the particular construction illustrated, it has been found that the water reaches its highest level (with the water surface above the well 12 at about one inch above the spill line) in about seven or eight seconds with the assumed rate of flow. In Figure 11, the effective static head is sufficient to enable the water to flow over the crest 14 with substantial volume and velocity, causing it to strike against the back of the downleg 15 above the bend 16, then rebound to again strike the front of the trapway below the bend 16, and again rebound to strike the back of the trapway at the bottom thereof. The water thus effectively seals the trapway in three places and stops the supply of air from below, enabling the slightly turbulent flowing water to carry out the major portion of the trapped air. The syphonic action in the condition illustrated in Figure 11 is on the verge of being started as a result of the illustrated triple seal newly formed by the rebounding stream.

At this point it should again be noted that the contour and width of the crest 14 are of great importance in the overall action of the water closet. This crest must be substantially as wide as the downleg of the trapway (see Figures 6 to 8) in order that the full width of the downleg be effectively sealed, while a greater width of crest acts to permit a syphon-inducing flow to occur sooner, hastening the start of syphonic action. The completion of the syphonic action is hastened to a still greater extent, for, when it is started sooner, its duration is less because less water has been stored. The action is then much less effective, as previously discussed. Moreover, any contour of the crest other than a straight horizontal line causes the trapway to require a higher rate of flow to start syphonic action, in that no sealing can occur until a sealing sheet of water is spread over the entire width of the trapway, and the excess flow at any low point in a non-level crest practically represents waste flow.

Assisted by the delay in the starting of syphonic action resulting from the narrow and flat crest construction, as well as from the slower build up of effective static head caused by the swirling action, the gentle but steady swirling of the bowl contents suffices to carry floating toilet paper (if present) around the bowl close to the sides thereof to subject it to the wetting influence of the down-pouring rim streams, so as to prepare the paper for final submergence preparatory to its being drawn into the well 12 and thence into the trapway.

It should be remembered that the removal of toilet paper from a water-closet is more difficult than the removal of soiled water and masses of excrement. Any excrement contained in the basin, and usually settled by gravity into the well 12, passes out through the trapway at an early stage in the flushing operation, while the carrying out of the paper is ordinarily delayed until a late stage, as the paper tends to float on top of the water until it has been more or less thoroughly wetted.

The swirling action of the bowl contents also secures a more or less circular distribution or alignment of the pieces of paper, resulting reliably in the wetted and softened pieces being drawn into the well and thence into the trapway one-after-another rather than as a single semi-wadded and unsoftened bulk.

Shortly after the time at which the view in Figure 11 is taken, full and vigorous syphonic action occurs, and a full-running trapway, as illustrated in Figure 12, results. When this occurs, the water level begins to be lowered, for the trap rate is about double the supply rate.

Figure 12 illustrates almost the final aspect of the syphonic action, the water level having been lowered almost to the bottom of the bowl, but the trapway is still running full, and the syphonic action is still in full progress. It is at about this stage in the operation that the final paper content is removed and drawn through the trapway, leaving only fresh water in the bowl 3, well 12, and upleg 13 of the trapway.

It may be pointed out at this time that the diagonal streams coming down the sides of the bowl 3 tend to form a miniature but effective cataract arising about the center line of the bowl 3 and near the front thereof and growing in volume and vigor as it proceeds back toward the well opening 12, the cataract however swinging slightly in a counter-clockwise direction as seen from the top. This cataract of comparatively vigorously flowing water enters the well hole 12 at the left side thereof and apparently assists materially in the final carrying out operation. It has a tendency to loosen any temporary, half-formed jams that may occur in the well 12 and at the entrance of the upleg of the trapway when the bowl has been overloaded with much more than the normal amount of toilet paper.

In observing the water passing from the outlet 7 of the trapway, it was noted that the discharge rate increases substantially near the end of the syphonic action, and remains at the increased value until the syphonic action is broken. When observing the flow conditions in the trapway (through a suitable opening made in the back wall thereof and enclosed with transparent material shaped to fit the outline of the trapway) it is noted that a small pocket of air remains near the top of the trapway above the crest 14 until the syphonic action is more than half through. This pocket of air continues to be diminished in size from the time syphonic action is started until it is suddenly carried out entirely near the end of the syphonic action, whereupon the high discharge rate above mentioned ensues and continues until the syphonic action is broken. This characteristic is highly advantageous, for it somewhat lessens the rate of flow during the first part of the syphonic discharge and is therefore a further factor in delaying the end of the syphonic action long enough to enable the paper content to become wetted and aligned, as previously noted. This is followed by the highest trap velocity at a time when the level of the water in the bowl is almost down to the minimum, and the conditions for the carrying out of paper and the like are the most favorable.

Following the condition illustrated in Figure 12, the water level is lowered sufficiently into the well 12 to admit air into the upleg of the trapway. In practice, the swirling water at the moment of the first admission of air to the upleg of the trapway gives enough up and down movement to the water level that a relatively small amount of air is admitted to the upleg of the trapway two or three times before the syphonic action is finally completely broken. The breaking of the syphonic action may require a second or so. The additional agitation given to the water contained in well 12 by the first air admission is sufficient to create a final extra carry-out power, when needed, following the first or preliminary admission of air to the upleg of the trapway.

Upon the final breaking of the syphonic action, averaging seventeen to eighteen seconds from the tripping of the flush valve, the admitted air permits the water in the downleg of the trapway to proceed unchecked, and permits the water which has been drawn into the upleg of the trapway to flow back into the well 12 and rise in the bowl 3. The water which is thus returned to the bowl is, of course, fresh water, as the water admitted from the rim perforations, particularly toward the last few seconds of the syphonic action, tends to overlie any soiled water which may be beneath, and thus only fresh water is being syphoned out in the last moments of syphonic action.

Following the said breaking of the syphonic action, such water as is supplied to the closet is retained in the bowl to seal the trapway and to place the water closet in readiness for further use. The flush valve is preferably adjusted to close off shortly after the water reaches the full-seal level, before there is sufficient build up to result in a second syphonic action. Alternatively, the flush valve may be arranged to deliver the last half gallon or so at a rate of flow below the minimum syphon-inducing rate.

Limits of operation

In determining the upper and lower limits of the supply rate for the illustrated water closet, the minimum capacity for carrying out was set arbitrarily at thirty separated sheets of toilet paper dropped onto the surface of the water just as the flush valve is about to be tripped. The operation was considered to meet the test only if every sheet was carried away at practically every trial. The paper used was regular commercial tissue from 2000-sheet rolls, each sheet about 4½" x 4½", and between .0015" and .0020" in thickness. A 2000-sheet roll of the tissue used weighs slightly more than a pound.

A supply rate of eleven and a half gallons a minute was found to be about the lower limit for the thirty-sheet test. But, a supply rate of ten gallons a minute easily carries out fifteen sheets reliably, which test should satisfy any but the most rigid requirements.

The upper limit of the supply rate is largely a matter of opinion, but is considered to be from fourteen to fifteen gallons a minute, although the carry-out action is successful at higher rates. The rise of the swirling water up the sides of the bowl begins to be more pronounced at the higher rates, with the possibility of annoyance to the user by dry floating paper as it is rotating with the swirl.

Although the minimum supply rate for reliable carry-out, determined as above set forth, in the construction shown, is from ten to eleven and a half gallons a minute, a rate of supply of less than eight and a half gallons a minute is sufficient to give enough build up of water above the seal line to induce syphonic action. The capacity for carrying out, however, is very limited near the lower limit of syphonic action, partly because the swirl effect caused by the angular disposition of the rim holes is largely lost, as the rim velocity is then very low. The lower limit of the supply rate therefore could be somewhat extended (at the expense of lowering the upper limit) by reducing the total area of rim holes (fewer or smaller rim holes) enough to give the required velocity of rim streams at a lower supply rate.

Conversely, the upper limit of supply rate may be extended as desired at the expense of the lower limit, by increasing the total area of the rim holes a more or less corresponding amount. This latter provision may be desirable for those installations where the correspondingly larger supply rate required is no handicap, but the silent and other features of the improved water closet are desired. This step leads naturally to the furnishing of a trapway of uniformly increased dimensions, where desired, as in hotels and the like. The larger trapway, when provided with sufficient storage and instantaneous supply rate to induce and maintain a good syphonic

action, would be even less subject to becoming stopped up.

From the foregoing, it will be seen that the improved water closet, when used with any suitable flush-valve installation, makes available to the small home and other places with normal piping the well-recognized advantages of flush valve operation, without necessitating the installation of large and expensive supply piping, and that it enables the flushing operation to be performed in almost complete silence.

There is here provided a water closet device comprising a bowl, a siphon trapway therein with a crest over which the water from the bowl is discharged, means for delivering water directly to said bowl from a direct street water supply main at a rate of flow not exceeding fifteen gallons per minute. There is means for delaying the starting of the discharge of water from the bowl during the first part of the operation of delivering water to the bowl, which consists in imparting to the water a circulatory movement around the inner face of the bowl so that centrifugal force acts to cause the water to reach a higher level in the bowl than the level of the crest, without a substantial discharge of water over the crest, thereby delaying the beginning of the discharge of the water from the bowl and building up a body of water in the bowl so that the bowl acts partially as a storage tank during the first part of the operation of delivering water to the bowl, said stored water acting with the water which is already in the bowl before the starting of the delivery of water to the bowl, and the water delivered into the bowl during the latter part of the operation of delivering water into the bowl, to produce a discharge of water from the bowl which at its maximum rate is substantially twice the rate per interval of time as the rate at which the water is delivered into the bowl during any given interval of time of the delivery period.

It will further be seen that the process of operating the device consists in delivering water into the bowl at a rate of flow not exceeding fifteen gallons per minute and delaying the starting of the discharge of water from the bowl during the first part of the delivery of the water thereto and imparting to the water in the bowl a circulatory movement around the inner face of the bowl to cause centrifugal force to act to cause the water to reach a higher level in the bowl without being discharged therefrom so as to delay the beginning of the discharge of the water from the bowl and build up a body of stored water in the bowl during the first part of the delivery of water into the bowl, then so combining the action of the water that is already in the bowl before the beginning of the delivery of water thereto, and the water subsequently delivered into the bowl during the delivery period, to produce a discharge of water from the bowl which at its maximum rate is substantially twice the rate per interval of time as the water being delivered into the bowl during any given interval of time of the delivery period.

What I claim is:

1. The method of flushing a toilet bowl which includes normally maintaining a substantial volume of water, in the bowl, in a static storage zone, delivering to the upper part of said storage zone a metered additional volume of water at a substantially uniform rate of flow substantially lower than the rate of flow of the water from the bowl during the flushing operation, initially retarding the movement of said additional water toward the discharge area of said storage zone and thereby building up a substantial additional volume of water in said storage zone, thereafter initiating a syphonic action from the storage zone, after a substantial additional volume of water has been delivered to the storage zone, and in response to said addition, syphoning from the storage zone the initially stored water and the additionally added water, at a rate of flow substantially in excess of the rate of flow of said additional water to the storage zone, continuing during said syphoning operation the delivery of said additional water to the upper part of the storage zone, and thereby increasing the volume of water to be syphoned during the syphoning operation, and terminating the flow of said additional water after the termination of the syphonic action, and after the delivery to said static storage zone of sufficient water to fill said zone for the next ensuing flushing operation.

2. The method of flushing a toilet bowl from a water supply source having a relatively small rate of flow of the order of 12 gallons per minute which includes maintaining a substantial volume of water, in the bowl, in a static storage zone, delivering to the upper part of said storage zone a metered additional volume of water at the normal rate of flow of said water supply, and at a rate of flow of the order of one-half the rate of flow of water from the bowl during the flushing operation, initially retarding the movement of said additional volume of water toward the discharge area of said storage zone and thereby building up a substantial additional volume of water in said storage zone through adding water at the normal rate of flow of the water supply, thereafter initiating a syphonic action from the storage zone after a substantial additional volume of water has been delivered from the water supply to the storage zone, and in response to said addition, syphoning from the storage zone the initially stored water and the additionally added water, at a rate of flow of the order of double the rate of flow of said additional water to the storage zone, continuing during said syphoning operation the delivery of said additional water from the water supply to the upper part of the storage zone, and thereby increasing the volume of water to be syphoned during said syphoning operation, and terminating the flow of said additional water after the termination of the syphonic action and after the delivery to said static storage zone of sufficient water to fill said storage zone for the next ensuing flushing operation.

3. In combination, in a water closet and means for flushing it, a bowl in direct flow connection with a water supply source of constant and relatively restricted flow of the order of 12 gallons per minute, said bowl having a waste outlet, a valve structure in the line of flow from the water supply source to the bowl, and means for actuating it, said valve structure being adapted, when actuated, to deliver a metered volume of water at a substantially constant rate of flow substantially less than the discharge rate of the bowl, the bowl including a water storage chamber of substantial capacity, a syphon trap extending from the bottom of the water storage chamber to the waste outlet, a flat horizontal crest extending entirely across the syphon trap, of a length equal to the mean diameter of the passage defined by the trap, means for delivering the entire flow of water released by the valve structure, to the upper portion of the storage chamber,

and for imparting to said water a swirling movement, about said storage chamber, adapted to delay the overflow of water over said crest until sufficient additional water has been delivered from the supply source to the upper portion of the storage chamber to cause gravitational action to overcome the centrifugal force of the swirling water, and means for terminating the flow of water through said valve after the termination of the discharge through the syphon trap and after the delivery of sufficient water to refill the bowl to a predetermined normal level.

WILLIAM E. SLOAN.