No. 638,002. Patented Nov. 28, 1899.

J. W. BERRY.

FLUSHING APPARATUS.

(No Model.) (Application filed Feb. 10, 1898.)

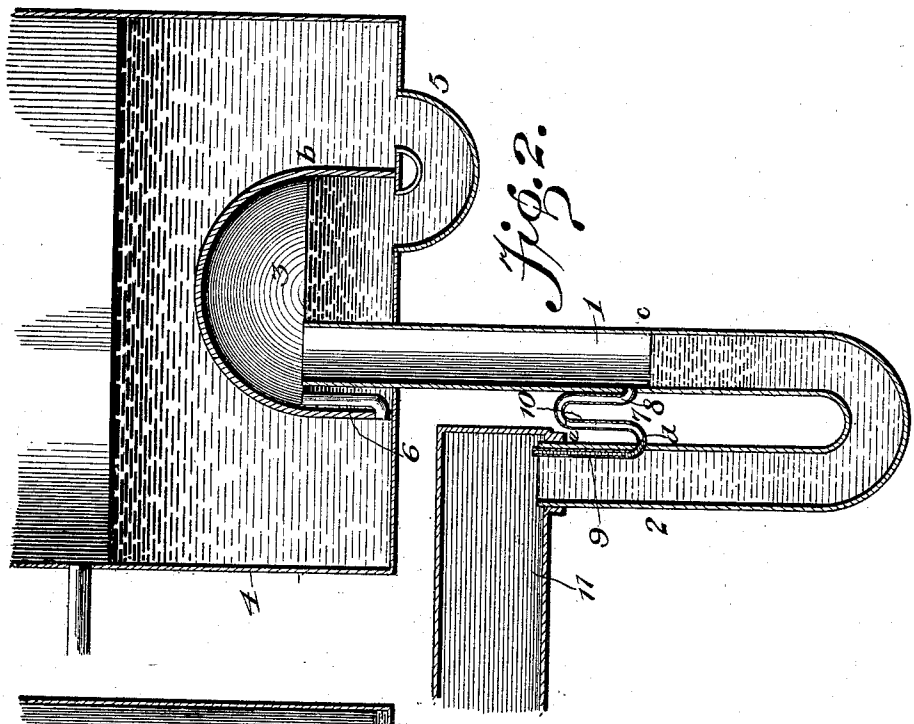


Fig. 2.

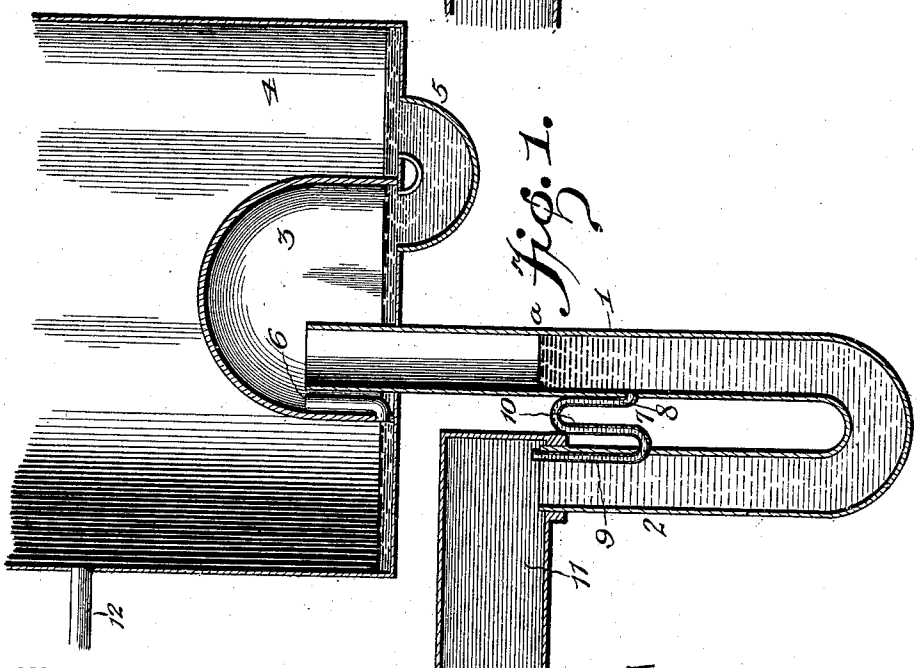


Fig. 1.

Witnesses
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UNITED STATES PATENT OFFICE.

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FLUSHING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 638,002, dated November 28, 1899.

Application filed February 10, 1898. Serial No. 669,813. (No model.)

To all whom it may concern:

Be it known that I, JAMES W. BERRY, a citizen of the United States, residing at Iowa City, in the county of Johnson and State of Iowa, have invented a new and useful Flushing Apparatus, of which the following is a specification.

My invention relates to a flushing apparatus designed particularly for use in connection with sewers, and the object in view is to provide an apparatus of the siphon type wherein the construction and arrangement of parts are such as to render the operations of "making" and "breaking" the siphon action certain, or, in other words, to insure certainty of operation when the surface of the water in the tank reaches a predetermined elevation and when the water which is being withdrawn by siphon action is depressed to another predetermined level.

A further object of my invention is to provide means whereby impurities of the water are carried out during the siphon action to prevent the accumulation thereof at the bottom of the tank, where the sediment may interfere subsequently with the accuracy of operation.

Further objects and advantages of this invention will appear in the following description, and the novel features thereof will be particularly pointed out in the appended claims.

In the drawings, Figure 1 is a sectional view of a flushing apparatus constructed in accordance with my invention, the water-levels being in the positions which they occupy when, the siphon action having been broken, the tank is about to be refilled. Fig. 2 is a similar view of the apparatus, showing the water-levels just prior to the discharge of the seal from the relief tube or trap, and hence before the making of the siphon action.

Similar reference characters indicate corresponding parts in all the figures of the drawings.

The siphon forming the main element of the flushing apparatus embodying my invention consists of a descending arm 1, an ascending arm 2, and an inlet-arm 3, the latter constructed in the form of a dome arranged upon the floor of a tank 4, whereby the lower edge of the dome may be sealed by a comparatively slight depth or film of water in the bottom of the tank. The inlet end of the descending arm 1 of the siphon projects upward through the floor of the tank into the dome or inlet-arm 3 and terminates in a plane approximately midway of the altitude of the dome, and in the construction of the apparatus in accordance with experiments which I have made I preferably dispose said inlet end of the descending arm 1 in a plane (indicated at *b*) such that the capacity of the dome between the plane *b* and the bottom or floor is equal to the capacity of the descending arm 1. Also communicating with the interior of the dome is an auxiliary inlet-conveyer 5, which may be constructed in the form of a semicircular elbow, as shown in the drawings, said conveyer communicating at its extremities with openings in the floor of the tank, respectively within and without the area of the dome, whereby water passes from the tank into the dome through this conveyer instead of passing under the lower edge of the dome or between the lower edge of the dome and the floor of the tank, as in the ordinary practice. This passage of the water through the conveyer 5 or the equivalent thereof is of advantage in that it enables me to arrange the dome with its lower edge in contact with the floor of the tank without interfering with the operation of the apparatus, (or, in other words, without interfering with a free communication of water from the tank to the dome,) and thus enables me to seal the lower edge of the dome by means of a comparatively shallow layer or film of water upon the floor of the tank. Furthermore, the use of said conveyer enables me to obtain such a forcible flow of water from the tank into the dome as to carry therewith those impurities which are ordinarily held in suspension in water, and thus prevent the choking of the channel by which the above-mentioned communication is attained. Furthermore, the inlet-arm or dome 3 is provided with a "sniff" 6, which in the construction illustrated consists of a tube of small diameter having its lower or inlet end located in the wall of the dome adjacent to the plane of the floor of the tank or the lower edge of the dome and its outlet end within the dome, approximately in the plane of the upper end of the descending arm 1 of the siphon. In

the ordinary practice a "sniff-hole" is provided in the inlet-arm of the siphon to recharge the descending arm of the siphon at the completion of the siphon action; but I have found in practice that as the water in the tank is discharged during the siphon action and the level of the surface thereof reaches the plane of the sniff-hole to "break" the siphon the water frequently interferes (by choking the sniff-hole more or less) with the admission of a sufficient quantity of air to properly supply the descending arm of the siphon. On the other hand, by employing the "sniff-tube," of which the upper or outlet end is elevated to or near the plane of the inlet end of the descending arm of the siphon, when the level of the water in the tank reaches the plane of the inlet end of the sniff-tube a free unobstructed passage is afforded through the sniff-tube to allow the necessary influx of air at the proper moment to completely charge the descending arm 1, and hence by this construction I am enabled to obtain a uniformity of operation which I have found impossible with the ordinary construction of sniff-hole.

The outlet or ascending arm 2 of the siphon is adapted to communicate with a sewer 11 or other conveyer to be flushed, and assuming that the tank is supplied continuously with water through an inlet 12 or the equivalent thereof the operation of the apparatus (assuming that the said ascending arm 2 is completely charged with water and that water occupies the descending arm 1 to an elevation, indicated at *a*, in the plane of the outlet end of the ascending arm, thus filling the main trap or elbow by which said descending and ascending arms are connected, and that the water in the tank and dome is at the level of the inlet end of the sniff-tube, as shown in Fig. 1,) is as follows: As the water rises in the tank it enters the dome through the conveyer 5, and hence rises in the dome toward the inlet end of the descending arm 1; but the rise of the water within the dome is less rapid than that in the tank outside of the dome, for the reason that the air contained in the dome is being forced by the water into the descending arm 1 of the siphon, and this air must displace a portion of the water in said arm 1. Obviously the air will be compressed in the upper portion of the dome or that portion above the level of the water therein and in the portion of the descending arm above the level of the water in the latter, and the extent of this compression will increase as the water in the arm 1 descends, whereby the air-pressure may be equal to the weight of a column of water of a height equal to the difference between the level of the water in the arm 1 and the level of the water in the arm 2. If the volume of air in the inlet-arm 3 of the siphon is sufficient to force the water entirely out of the descending arm 1 and blow the water out of the arm 2, the relief of pressure upon the surface of the water in the arm 3 will be sufficient to cause the water to overflow the upper end of the inlet-arm 1, and thus complete the siphon; but it has been found in practice that as the level of the water in the descending arm 1 approaches the main trap, by which said arm 1 is connected with the arm 2, (and particularly in siphons of large diameter,) air will leak from the descending arm 1 into the ascending arm 2 through the trap, such leakage being in the form of bubbles, and while each bubble relieves slightly the air-pressure in the arm 1 such relief is insufficient to cause the making of the siphon, or, in other words, to cause an efficient overflow of water from the inlet-arm 3 into the descending arm 1, with the result that there is a series of small discharges of water from the arm 2, and there is no siphon action. After a partial discharge of air by way of bubbles from the descending arm 1 the water falls back from the ascending arm 2, or the space formerly occupied by the discharged air is supplied by a small flow of water from the arm 3 into the arm 1 without starting the siphon. In order to avoid these partial discharges, and insure a positive starting of the siphon when the level of the water in the arm 1 is depressed to a predetermined point, I employ a relief-tube 7, consisting of vertical or approximately vertical inlet and outlet arms 8 and 9 and a connecting-arm 10, a small or auxiliary trap *d* being formed at the connected lower ends of the outlet-arm 9 and the connecting-arm 10. The inlet end of the inlet-arm 8 is in communication with the descending arm 1 of the siphon, the outlet end of the outlet-arm 9 is arranged adjacent to the outlet end of the ascending arm 2 of the siphon, and the trap *d* is arranged below the horizontal plane of the inlet end of the arm 8. Preferably the discharge end of the outlet-arm 9 of the relief-tube is elevated slightly above the plane of the outlet end of the ascending arm 2 of the siphon for a purpose hereinafter explained.

With the aid of this relief-tube the operation of the apparatus is as follows: When the level of the water in the descending arm 1 is depressed to the plane of the inlet end of the relief-tube, the pressure of the air in the upper portion of the arm 1 supports a column of water in the ascending arm 2 of the siphon and also a column of water in the outlet-arm 9 of the relief-tube. Said outlet-arm 9 of the relief-tube, however, is of greater length than the difference between the horizontal planes of the relief-tube inlet and the discharge end of the ascending arm 2 owing to the fact that the trap *d* of the relief-tube is arranged below the plane of said relief-tube inlet. Therefore the level of the water in the descending arm 1 may be depressed to the plane of the trap *d* or below the plane of the inlet end of the relief-tube before the level of the water in the descending arm of the relief-tube has been depressed to the plane of the trap *d*, and the air cannot blow out the contents of the relief-tube and escape until the levels of

the water have been still further reduced to overcome the resistance of the contents of the ascending arm of the relief-tube. In the drawings the difference in levels between the trap *d* and the relief-tube inlet at the lower end of the arm 8 of the relief-tube is slight; but even with this small difference if the water in the relief-tube is blown out by the pressure of air in the descending arm 1 when the level of the water in said arm 1 is in the plane of the trap *d* the pressure in the arm 1 will be relieved sufficiently to cause an inflow of water from the inlet-arm 3 to the arm 1 to complete the siphon; but it is obvious that to increase the certainty of operation of the apparatus the trap *d* may be dropped to any desired distance below the relief-trap inlet. The lack of certainty in the operation of an apparatus of this class depends upon the fact that when a relief of the air-pressure in the descending arm occurs the level of the water in said descending arm is liable to rise sufficiently to cut off further escape of air before the water in the inlet-arm 3 can effectually overflow the inlet end of the descending arm 1, and it is obvious that by so arranging the parts as to necessitate the depression of the water in the descending arm 1 to a considerable distance below the relief-tube inlet an efficient relief of air-pressure in said descending arm may be accomplished before the water can rise to close the relief-inlet.

In practice I prefer also to extend the outlet-arm 9 of the relief-tube to a point slightly above the level of the discharge end of the ascending siphon-arm 2, such extension being made with two objects. In the first place, by arranging the discharge end of the outlet-arm 9 above the level of the discharge end of the ascending arm 2 the efflux of water from the latter does not interfere at the proper point in the operation of the apparatus with the efficient discharge of water from the relief-tube to relieve the air-pressure in the descending arm 1, and, in the second place, such extension of the outlet-arm 9 increases the height of the column of water in said arm, which is counterbalanced by the air-pressure in the descending arm 1 of the siphon, and therefore the level of the water in said descending arm 1 must be depressed slightly below the trap *d* before the pressure of air in the arm 1 will be sufficient to blow out the water from the relief-tube. In other words, when the level of the water in the arm 1 reaches the plane of the trap *d* a further addition of water to the tank necessary to increase the pressure of air in the upper portion of the arm 1 will be necessary to overcome the weight of the column of water between the trap *d* and the discharge end of the outlet-arm 9, and hence there will be a still greater interval between the level of the water *c* (see Fig. 2) and the relief-tube inlet before the discharge from the relief-tube allows the relief of the air-pressure.

Owing to the small diameter of the relief-tube, I have found that the water in the descending arm 1 cannot be depended upon solely to refill the relief-tube, and thus to insure the efficient sealing of said relief-tube prior to the breaking of the siphon action I have found it desirable to elevate the discharge end of the outlet-arm 9 only slightly above the level of the discharge end of the ascending arm 2 of the siphon, whereby during the continuance of the siphon action water in passing from the arm 2 into the sewer 11 will overflow the discharge end of the outlet-arm 9 and a portion thereof will enter said outlet-arm. The inlet-arm of the relief-tube receives its charge after the siphon has been broken or after the discontinuance of the siphon action, it being obvious that the rise of the water in the descending arm 1 of the siphon to a plane above the upper end of the arm 8 of the relief-tube will insure the filling of the latter. Thus I am enabled to charge the relief-tube from both ends. Should this operation of charging the relief-tube from both ends result in confining a small column of air in the relief-tube, the operation of the apparatus as described will not be affected. The pressure of air in the descending arm 1 must be sufficient to overcome the resistance due to the weight of a column of water from the trap *d* to the discharge end of the outlet-arm 9, or, in other words, equal to the length of said outlet-arm 9, before the contents of the relief-tube will be blown out, and as a matter of fact said pressure of air in the descending arm 1 must under ordinary circumstances be slightly greater than that necessary to support a column of water equal to the length of the outlet-arm 9 owing to the frictional resistance offered by the walls of the relief-tube to the passage of water therethrough. Furthermore, when air has been caught in the relief-tube during the refilling thereof it is obvious that a compression of this confined air must be accomplished in order to apply sufficient pressure to the water to raise a column of a depth equal to the length of the outlet-arm 9.

It will be seen from the foregoing description that the inlet end of the arm 8 of the relief-tube is arranged in a depressed position or communicates with the descending arm 1 of the siphon at a point below the normal water-level in said siphon-arm, and thus the contents of the relief-tube are not exposed to the pressure of the air in the upper portion of the siphon-arm 1 until the level of the water in said siphon-arm has been depressed to the plane of said inlet opening or port of the arm 8. Any tendency of the air-pressure in the arm 1 to affect the contents of the relief-tube will serve simply to force water from the arm 1 into the relief-tube to increase the charge in the latter. Thus one object in view in connecting the inlet end of the relief-tube with the descending siphon-arm at a point below the normal water-level is to insure the efficient charging of the relief-tube. The ne-

cessity, however, for thus adapting the relief-tube to be charged after discontinuance of the siphon action from the contents of the descending arm of the siphon when the water therein is at the normal lever arises from the fact that the specific construction of the relief-tube which I employ is such as to prevent the siphon action of said tube. In other words, during the operation of the siphon, comprising the arms 1, 2, and 3, the relief-tube of my improved apparatus is idle, and hence provision must be made, as above set forth, for properly charging the relief-tube, and I have found in practice that this may be accomplished efficiently from opposite ends of the tube by exposing the discharge end of the relief-tube to the overflow of the discharge-arm of the siphon and so arranging the inlet-arm of the relief-tube as to be charged from the descending arm of the siphon when the water in the latter is at the normal level.

The upwardly-extending loop formed by the arms 8 and 10 of the relief-tube prevents a siphon action through the relief-tube or a flow of water through said tube during the operation of the siphon, and my improved flushing apparatus is so constructed as to prevent such a flow of water through the relief-tube in order to prevent the choking or clogging of the relief-tube by floating or suspended objects in the water. It is obvious that with the ordinary construction of flushing apparatus, wherein the relief-tube consists of an auxiliary siphon so constructed as to coöperate with the main siphon after the siphon action has been started, any floating objects or dirt carried by the water will enter the auxiliary as well as the main siphon, and owing to the small caliber of the auxiliary siphon an obstruction thereof is liable to result. It is my object in practice to employ a relief-tube of unusually small diameter, and in order to protect this relief-tube from foreign objects and accumulations, and thus insure the continued operation of the device, I have found it necessary to provide against the flow of water through the relief-tube during the operation of the siphon. Hence from its point of communication with the descending arm of the siphon the relief-tube extends in a direction opposite to that of water traversing the siphon and any solid particles or matter carried by the water will pass the inlet end of the relief-tube after entering the same. Furthermore, the upward-extending loop formed by the arms 10 and 8 of the relief-tube prevents any water entering the discharge end of the relief-tube by the overflow from the siphon-arm 2 (during the operation of the siphon) from escaping from the relief-tube by traversing the same to its inlet end. In other words, said loop forms a check to prevent a backward flow of water through the relief-tube during the operation of the siphon and maintain any water which has entered in the discharge-arm 9 of the relief-tube. Thus after the siphon action has been broken and the inlet-arm 8 of the relief-tube is charged from the siphon-arm 1 the relief-tube is ready for operation even should there be a space filled only by air between the blocks of water located, respectively, in the arms 8 and 9, as hereinbefore explained.

Various changes in the form, proportion, and the minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

Having described my invention, what I claim is—

1. A flushing apparatus having a siphon comprising an inlet-arm, a descending arm communicating at its upper end with the inlet-arm, and an ascending or outlet arm of less length than the descending arm, and a relief-tube having an ascending inlet-arm, in communication only at its lower inlet end with the descending arm of the siphon, at an intermediate point with said inlet end normally submerged, an ascending outlet-arm, arranged at its discharge end adjacent to the plane of the discharge end of the siphon ascending arm, and a descending arm connecting said inlet and outlet arms, substantially as specified.

2. A flushing apparatus having a siphon comprising an inlet-arm, a descending arm communicating at its upper end with the inlet-arm, and an ascending or outlet arm of less length than the descending arm, and a relief-tube having an ascending inlet-arm, in communication only at its normally-submerged lower inlet end with the descending arm of the siphon at an intermediate point, an ascending outlet-arm arranged at its discharge end adjacent to the plane of the discharge end of the siphon ascending arm, a descending arm connecting the ascending arms of the relief-tube, and a trap in said relief-tube arranged between the descending arm and the ascending outlet-arm and below the plane of the inlet end of the relief-tube inlet-arm, substantially as specified.

3. A flushing apparatus having a siphon comprising an inlet-arm, a descending arm communicating at its upper end with the inlet-arm, and an ascending or outlet arm of less length than the descending arm, a relief-tube having an ascending inlet-arm in communication at its lower inlet end with the descending arm of the siphon at an intermediate point, said inlet end being normally submerged, an ascending outlet-arm arranged with its discharge end slightly above the plane of the discharge end of the siphon ascending arm, a descending arm connecting the ascending arms of the relief-tube, and a trap interposed between said descending and outlet arms of the relief-tube, substantially as specified.

4. A flushing apparatus having a siphon comprising an inlet-arm, a descending arm communicating at its upper end with the in-

let-arm, and an ascending or outlet arm of less length than the descending arm, a relief-tube having an ascending inlet-arm in communication at its lower inlet end with the descending arm of the siphon at an intermediate point, said inlet end being normally submerged, an ascending outlet-arm arranged with its discharge end slightly above the plane of the discharge end of the siphon ascending arm, a descending arm connecting the ascending arms of the relief-tube, and a trap interposed between said descending and outlet arms of the relief-tube, and arranged below the plane of the inlet end of the relief-tube inlet-arm, substantially as specified.

5. A flushing apparatus having a tank, a siphon having a descending arm and a connected ascending arm, said descending arm extending at its upper end above the plane of the bottom of the tank, and an inlet-arm consisting of a dome inclosing the portion of the descending arm which is within the tank and seated at its lower edge upon the floor of the tank, an inlet-conveyer communicating at opposite ends with the interior of the tank respectively within and without said dome, and means for admitting air to the interior of the dome, substantially as specified.

6. A flushing apparatus having a tank, a siphon having a descending arm and a connected ascending arm, said descending arm extending at its upper end above the plane of the bottom of the tank, and an inlet-arm consisting of a dome inclosing the portion of the descending arm which is within the tank and seated at its lower edge upon the floor of the tank, an inlet-conveyer communicating at opposite ends with the interior of the tank respectively within and without said dome, and a "sniff-tube" having its inlet end arranged contiguous to the plane of the floor of the tank and at its upper end adjacent to the plane of the upper end of said descending arm of the siphon, substantially as specified.

7. A flushing apparatus having a siphon comprising an inlet-arm, a descending arm, and an ascending or outlet arm, and a relief-tube communicating with the descending arm at an intermediate point below the normal water-level therein and extending upward from its point of communication therewith, said relief-tube being of looped construction and having a trap located below the plane of its point of connection with said siphon descending arm, substantially as specified.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

JAMES W. BERRY.

Witnesses:

A. S. CRAMER,

JNO. OSBONE.