(No Model.) 4 Sheets—Sheet 1.

J. E. BOYLE.

PNEUMATIC FLUSHING TANK.

No. 461,213. Patented Oct. 13, 1891

Fig. 1.

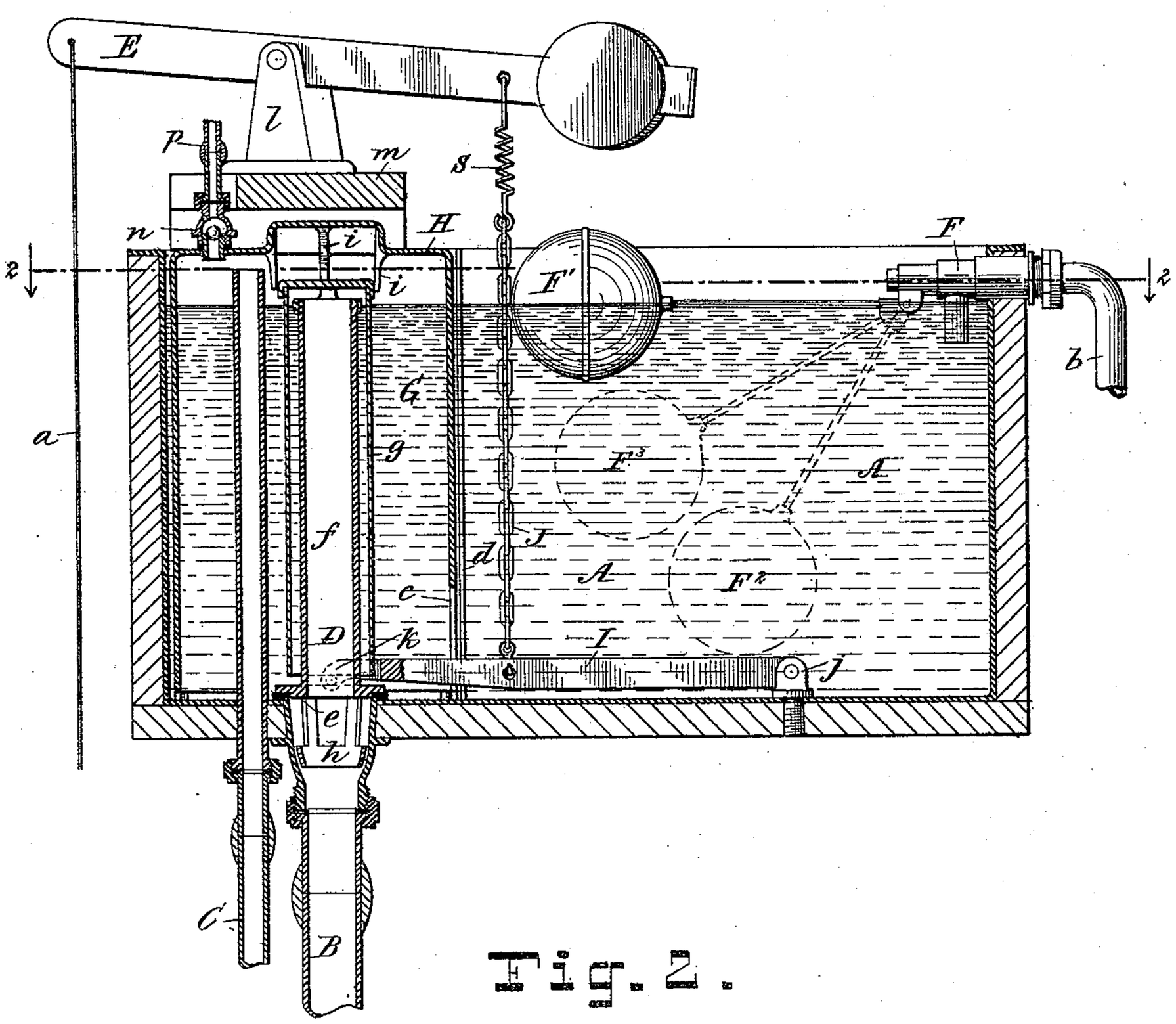
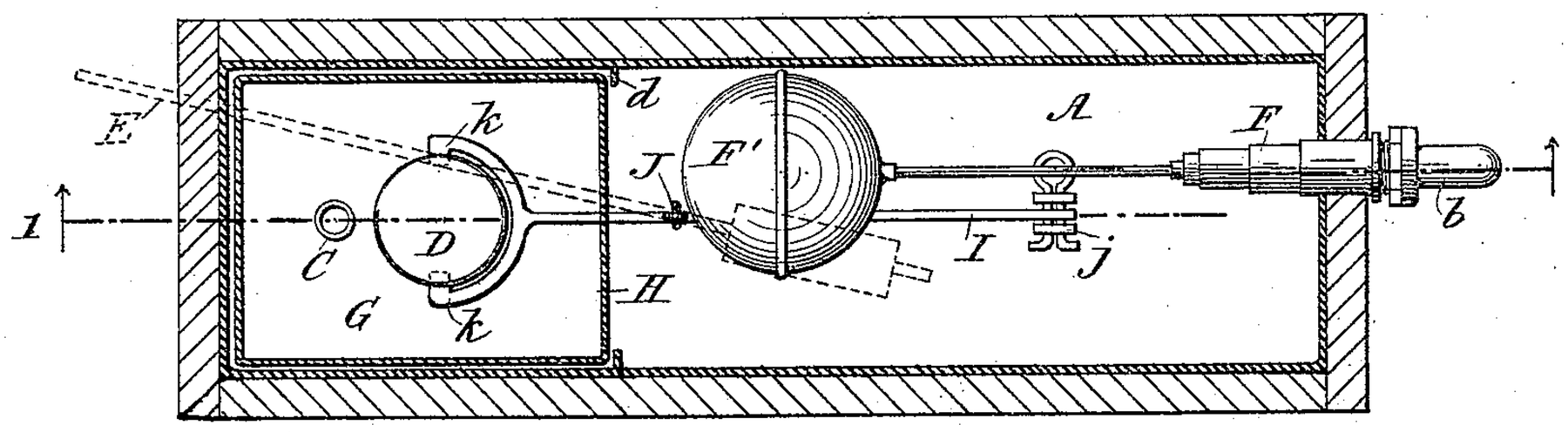


Fig. 2.



WITNESSES:

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By his Attorneys,

Arthur O. Brown & Co.

(No Model.) 4 Sheets—Sheet 2.

J. E. BOYLE.

PNEUMATIC FLUSHING TANK.

No. 461,213. Patented Oct. 13, 1891.

Fig. 3.

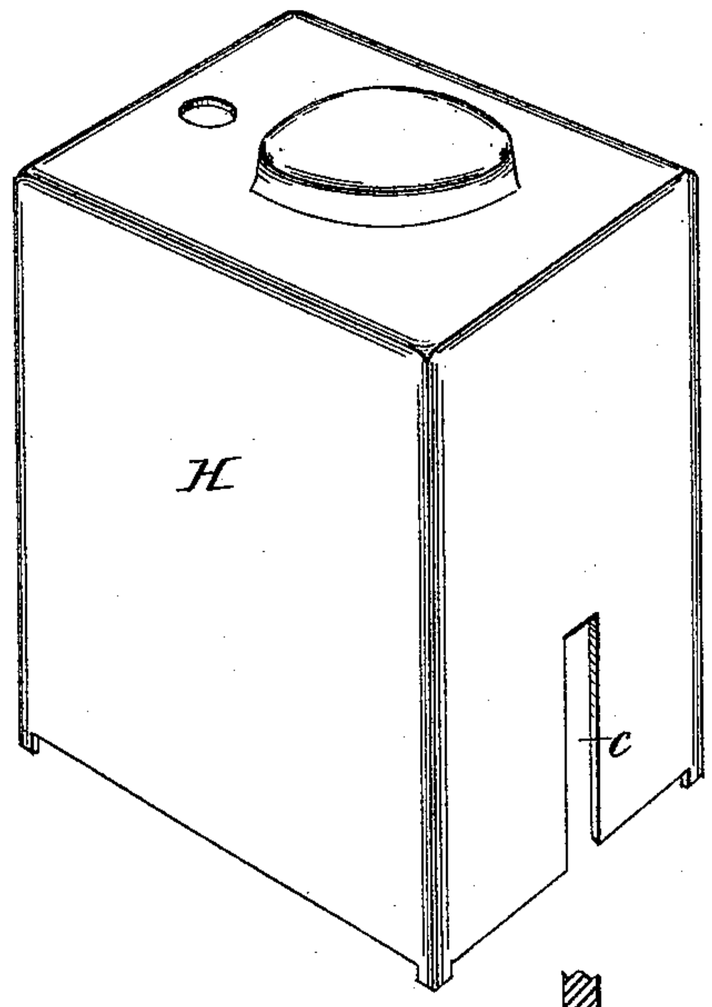


Fig. 4.

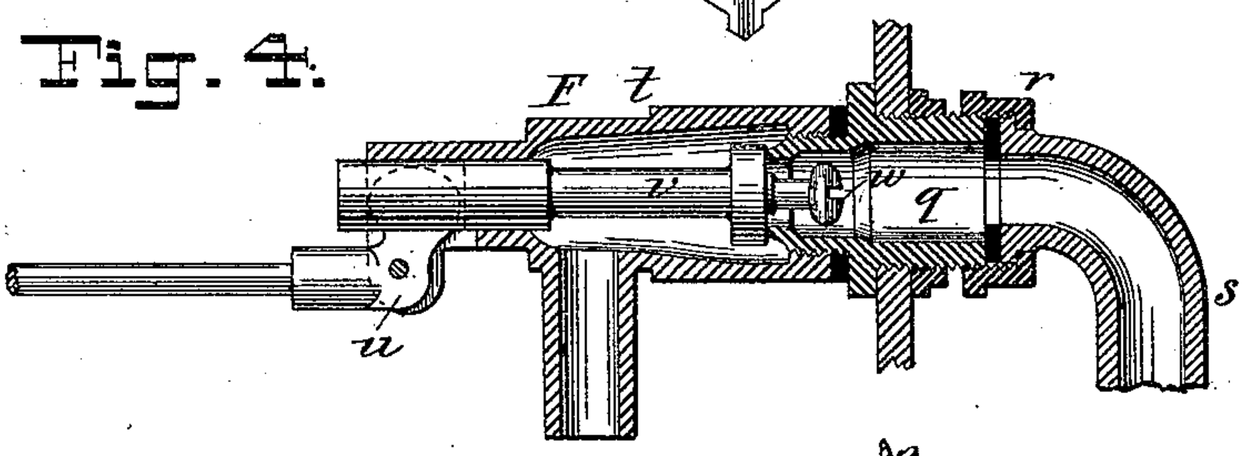


Fig. 5.

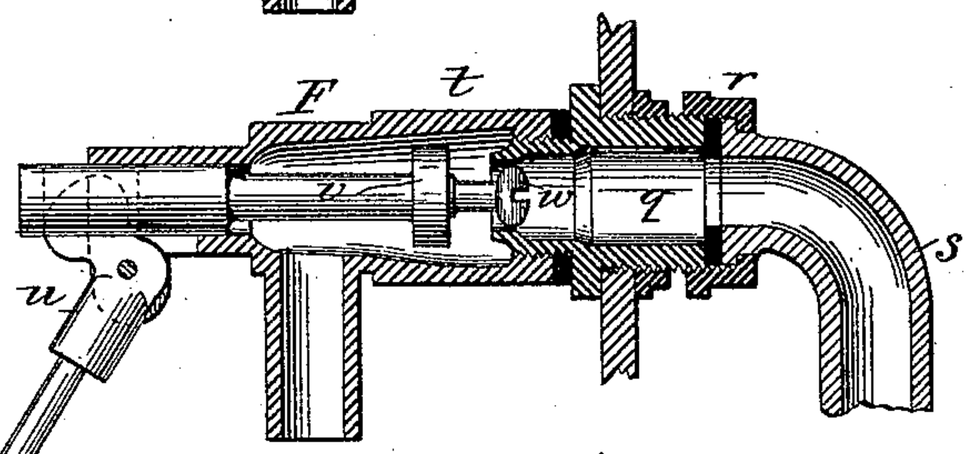
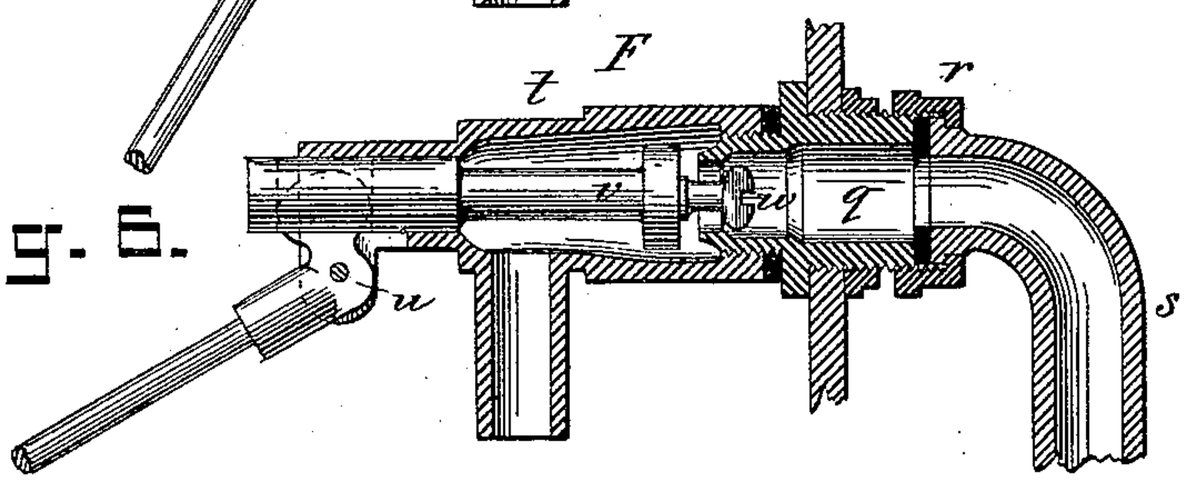


Fig. 6.



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(No Model.) 4 Sheets—Sheet 3.

J. E. BOYLE.

PNEUMATIC FLUSHING TANK.

No. 461,213. Patented Oct. 13, 1891.

Fig. 7.

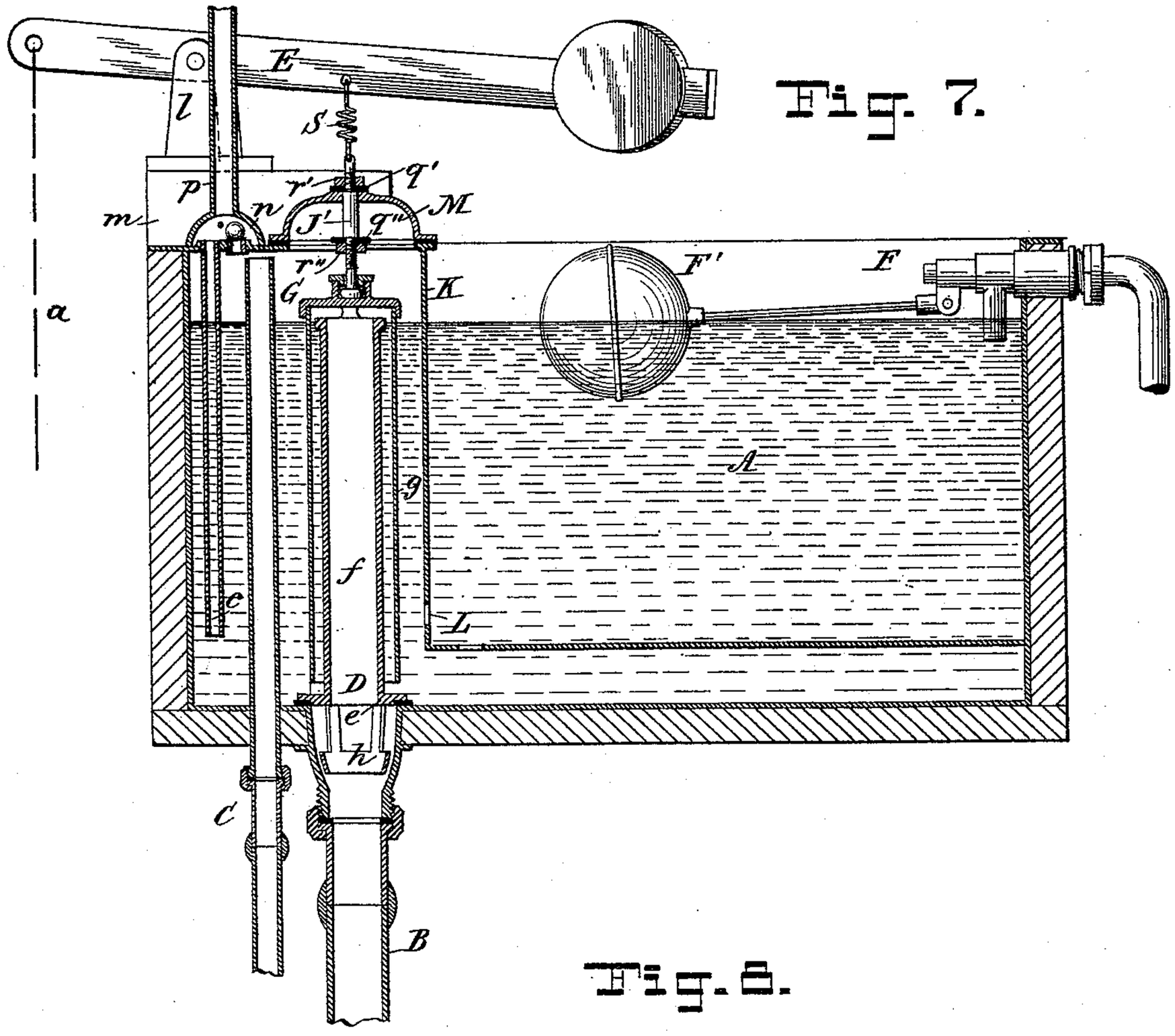
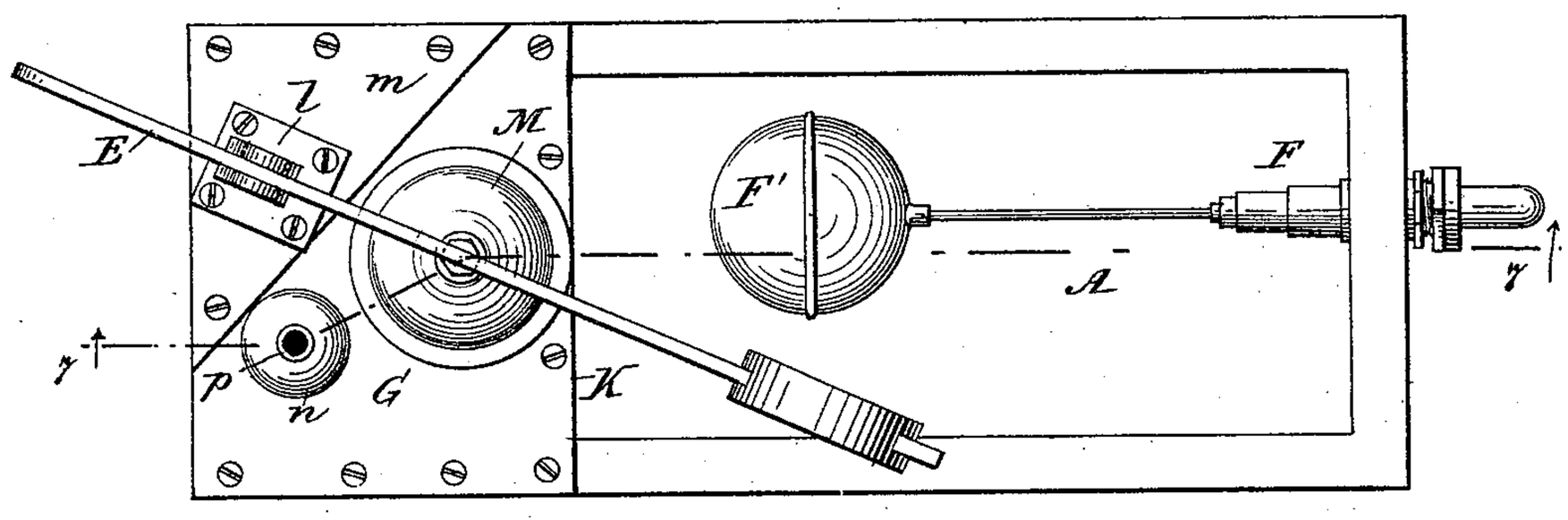


Fig. 8.



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(No Model.) 4 Sheets—Sheet 4.

J. E. BOYLE.

PNEUMATIC FLUSHING TANK.

No. 461,213. Patented Oct. 13, 1891.

Fig. 9.

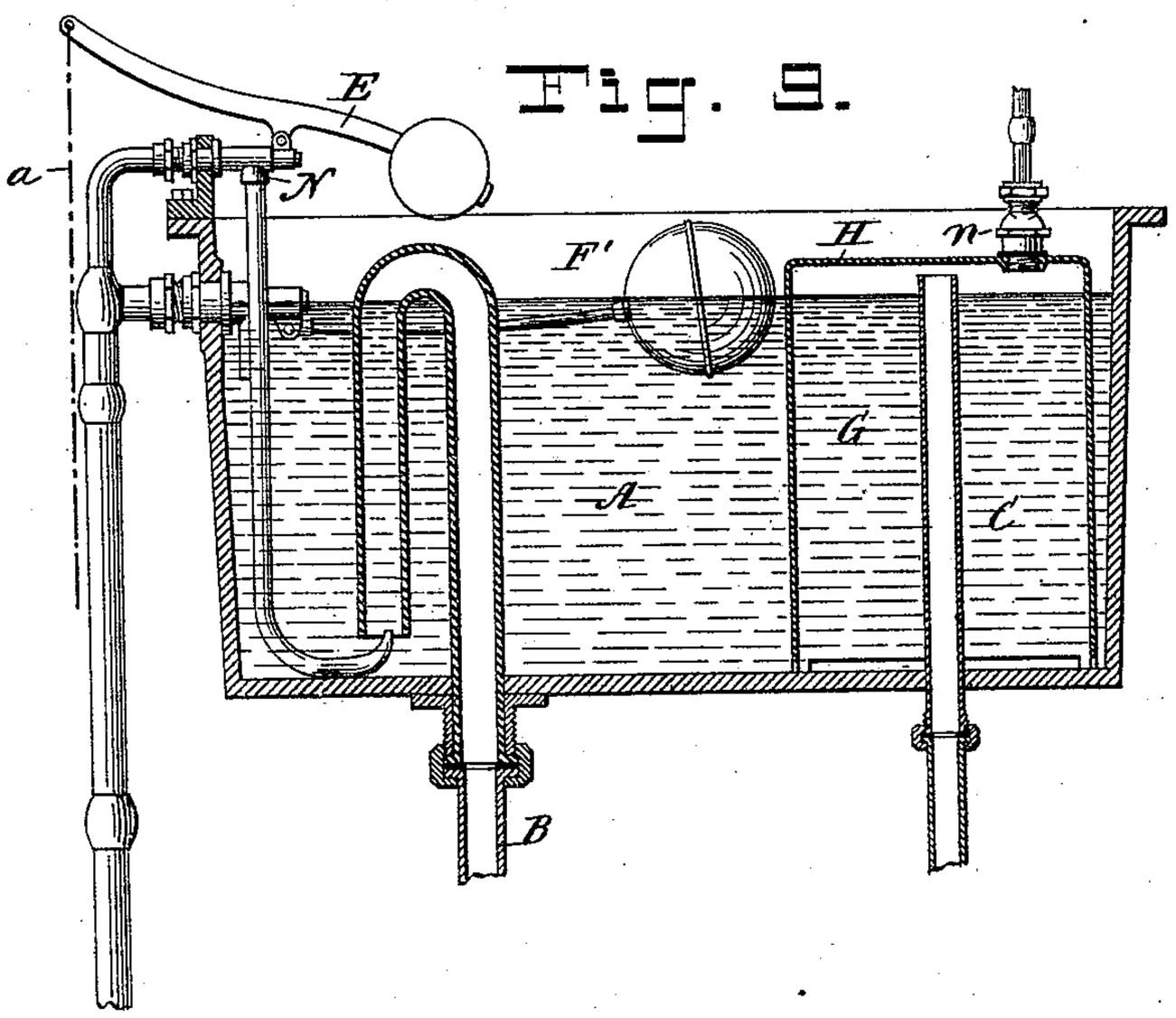
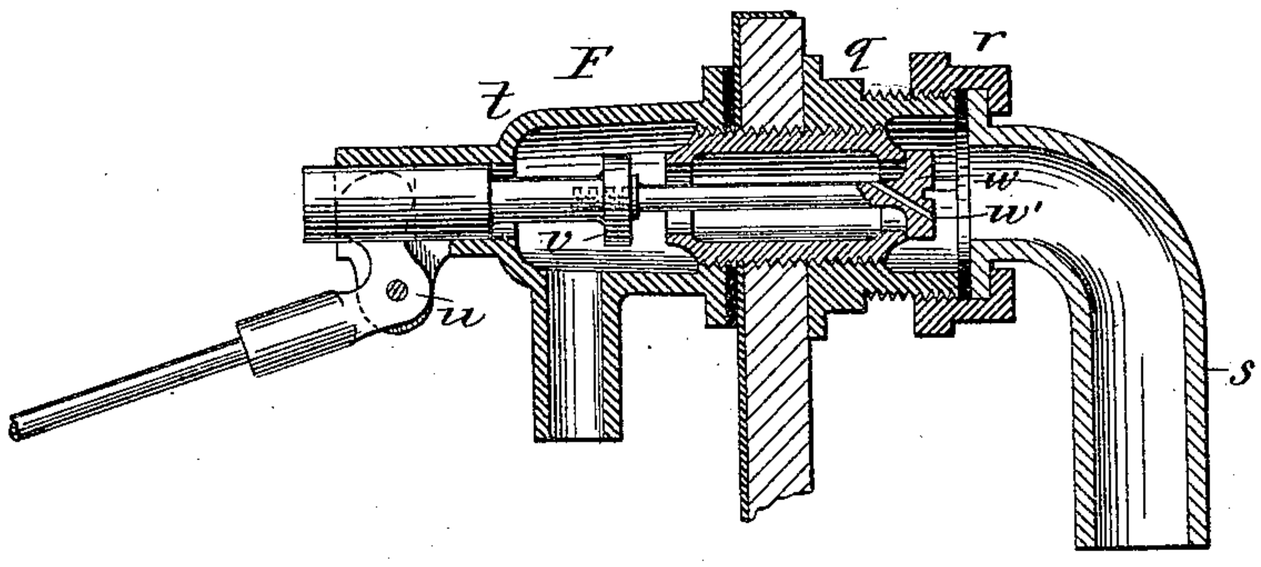


Fig. 10.



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UNITED STATES PATENT OFFICE.

JAMES E. BOYLE, OF BROOKLYN, NEW YORK; JAMES E. BOYLE, JR., ADMINISTRATOR OF SAID JAMES E. BOYLE, DECEASED.

PNEUMATIC FLUSHING-TANK.

SPECIFICATION forming part of Letters Patent No. 461,213, dated October 13, 1891.

Application filed June 6, 1887. Serial No. 240,357. (No model.)

To all whom it may concern:

Be it known that I, JAMES E. BOYLE, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Pneumatic Flushing-Tanks for Water-Closets, of which the following is a specification.

This invention relates to flushing-tanks for "double-trapped siphon-closets," or those wherein the soil-passage leading from the bowl is bent to form two traps with a confined air-space between them. In the flushing of such closets it is necessary to draw the air from this air-space in order to start the siphonic action, by which the contents of the bowl are carried out to the soil-pipe. The first closet of this class was invented by Peters & Donald, having been patented in Great Britain in 1874, and in this country June 27, 1882, by Patent No. 260,232. In their closet the flushing-tank has a vacuum-chamber, into which the flushing water is introduced from the reservoir, and from which, when the outlet-valve is opened, it flows to the bowl. An air-pipe extends from the confined air-space between the two traps and terminates at the top of the vacuum-chamber. When the flushing-water runs out of the chamber, it forms a partial vacuum in the upper part thereof and draws the air from the air-pipe and from the air-space, thus siphoning the bowl. After the flushing and siphoning have ceased the tank is refilled by a float-valve, and part of the entering water is conducted down to the bowl in order to refill the trap, this action being known as the "afterwash."

The first double-trapped siphon-closet that was introduced into use is the one known as the "tidal-wave" closet, which was patented by me March 28, 1882, by Patent No. 255,485. In this closet the vacuum is created by the running out of water from a closed vacuum-chamber, as in the Peters & Donald tank; but the afterwash is effected in different manner, namely, by "breaking the vacuum" in the vacuum-chamber when the flushing-water has nearly run out, thus arresting the siphoning and permitting the remaining water to run freely to the bowl and fill it. My present invention relates to pneumatic flushing-tanks of this character. In the tank of my said tidal-wave closet the vacuum-chamber is filled by an inlet-valve from a cistern or reservoir which holds a supply for several flushes, and it is emptied by opening an outlet-valve which communicates with the flushing-pipe. That construction is necessary whenever it is desired to flush the closet several times without the necessity of refilling the tank, as is the case whenever the water-supply is intermittent or irregular or subject to be cut off at times by the drawing of water on lower floors of the building; but it is not necessary in all cases, and for cheaper closets especially what is known as a "single-charge" tank, or one which has no reservoir and which consequently empties itself at each flush, is admissible. In adapting my said tidal-wave tank to supply a single charge at a time, the reservoir is omitted and the float-valve is constructed to discharge its water directly into the flushing tank or chamber, or into a compartment that has direct communication therewith. The closed vacuum-chamber and its outlet-valve to the flushing-pipe are retained. After each flush the flushing-chamber is refilled by the float-valve, which thus becomes essentially the "inlet-valve" of my said tidal-wave patent. My present invention provides a single-charge tank of simple, compact, and cheap construction. In my said tidal-wave tank the arrangement of the two valves is such that the closet is automatic in its action. The operating-lever is connected by a chain or wire to the seat of the closet, so that when the seat is depressed the inlet-valve is opened and the vacuum-chamber fills with water, and when the seat is released the inlet-valve closes and the outlet-valve opens, so that the water runs out to flush the bowl.

In my patent, No. 291,139, dated January 1, 1884, is shown a pneumatic tank which may be operated by a pull, the flush following immediately after the pulling of chain connected to the operating-lever. This tank has but one valve in addition to the float-valve, which keeps it filled, that one being the outlet or flushing valve. Its pneumatic action is due to the use of an injector in the flushing-pipe instead of to a vacuum-chamber. The after-

wash is secured in the same manner by breaking the vacuum, which is done by admitting air as soon as enough water has run out of the flushing-chamber or service-box to unseal an "air bell" or tube communicating with the air-pipe. My present invention adapts to the tidal-wave tank, or to a tank wherein the vacuum is created by means of a vacuum-chamber, the feature of the non-automatic operation or flushing upon the manual pulling of the lever, which is found in my said later patent. The abandonment of the automatic operation of the valves enables the tank to be simplified and consequently cheapened.

According to my present invention I provide a tank or cistern which holds usually one charge of flushing-water, (or which has a compartment holding one charge of water,) a float-valve for supplying water to said tank, and an outlet-siphon for emptying the tank, with means for starting the siphon at will. I prefer to employ a siphon-valve the momentary lifting of which will cause an outflow sufficient to start the siphon, which will then act after the valve is seated to draw water from the tank until it is emptied. Upon the emptying of the tank air enters the siphon and breaks the vacuum therein, thus stopping the siphonic action, after which the tank is refilled. To prevent the entrance of water from the float-valve so rapidly as to keep the siphon in action, I so construct the float-valve that when the float is dropped to its lowest position only a very small stream enters the tank; but when the float rises the water enters more rapidly to refill the tank until the normal water-level is re-established whereupon the valve closes, as in ordinary float-valves. The vacuum-chamber is formed by partitioning off a portion of the tank, or preferably by placing an open-bottomed box or air-bell in it in such way that it is removable to gain access to the working parts. The operating-lever is connected with the outlet-valve by mechanical connections extending beneath the bottom of the box. The vacuum-chamber communicates with the interior of the tank at its lower portion, or with the external air, in such manner that when the water-level descends to a predetermined point air enters the chamber and breaks the vacuum therein, so that the remaining water runs out as the afterwash to refill the bowl.

Part of my invention is applicable to flushing-tanks which are not pneumatic, such as those for use with ordinary hopper, pan, or wash-out closets.

Figures 1 and 2 of the accompanying drawings show the preferred form of my invention, the former view being a vertical longitudinal section of the tank cut in the plane of the line 1 1 in the latter, which is itself a plan in horizontal section along the line 2 2 in the former figure. Fig. 3 is a perspective view of the bottomless box or air-bell removed. Figs. 4, 5, and 6 are longitudinal sections of the float-valve on a larger scale, showing it in three different positions. Fig. 7 is a longitudinal vertical section of a modified construction of tank, and Fig. 8 is a plan thereof. Fig. 9 is a vertical longitudinal section of another construction of tank. Fig. 10 is a longitudinal section of a modified construction of float-valve. Fig. 11 is a vertical longitudinal section of a modified tank.

I will first describe the construction shown in Figs. 1 to 6.

Let A designate the tank or cistern, which has a capacity for holding one charge of flushing-water.

B is the flushing-pipe, which leads from the outlet of the tank down to the flushing-rim of the bowl.

C is the air-pipe, which extends up from the air-space between the two traps and terminates in the tank above the water-level.

D is the outlet valve or device for causing an outflow of water from the tank to the flushing-pipe and continuing the same until the tank is emptied.

E is the operating-lever, which is connected to the valve D, so that when it is pulled by a chain or wire *a* this valve is lifted and the flush takes place.

F is the float-valve, by which water is admitted to the tank from the service-pipe *b*, and F′ is the float thereof.

G is the vacuum chamber or compartment, which is formed within the tank A by means of a bottomless box or receptacle H, Fig. 3, which is placed in the tank over the air-pipe C, Fig. 1. Instead of making the vacuum-chamber of a capacity sufficient to hold the entire charge of flushing-water, as formerly, I now make it much smaller, so that its capacity shall equal only a half or a quarter the volume of the flush.

The box H is placed immovably in the tank, with its lower part resting on the bottom thereof or lifted slightly above the bottom. It is so constructed that the water may flow beneath it or into it from the external portion of the tank. At *c* it is notched or perforated at some little distance above the bottom to admit air into the vacuum-chamber during the flushing in order to break the vacuum and provide the afterwash. The box H is freely removable from the tank in order to get access to its interior. It is held in place therein by ribs *d d*, formed in the sides of the tank.

The outlet device D is a siphon-valve, in order that when the flow is once started it will continue until all the water in the tank has run out. The tank is then refilled by the float-valve to be ready for the next operation. The siphon-valve D consists of a packed disk or valve proper *e*, which when seated closes the outlet-opening. Through this disk passes a tube *f*, which extends thence up to just above the normal water-level in the tank, and over this tube is placed an outer tube *g*, which is

closed at its top and extends down nearly to the disk *e*. The tubes *f* and *g* are fastened together and constitute the siphon.

The valve D is guided in its vertical movement by a tubular skeleton guide *h* which enters the valve-seat, and by fingers *i i* projecting downward from the top of the box H and engaging the upper end of the tube *g*. The valve is lifted by means of a lever I, which is fulcrumed at one end to a standard *j* at the bottom of the tank, and extends thence horizontally, projecting beneath the box H, and its other end, which is bifurcated, has fingers *k k*, which take under the bottom of the tube *g*, as shown in Fig. 2. The lever I is connected to the lever E through the medium of a chain J, so that when the lever E is tilted it pulls the chain J and lifts the lever I, thus lifting the valve. Thus the valve is operated without passing a valve-stem or connection through the top of the box H, and the latter may be lifted out without disturbing the valve. The lever E is fulcrumed, as usual, to a standard *l*, which is mounted on a cross-board *m*. This board must be removed before the box H can be lifted out. The lever may, however, be mounted in other ways, so that it shall not interfere with the lifting out of the box. For example, it may be arranged over the opposite end of the tank, where it will be entirely out of the way of the box, or it may be fulcrumed directly to the top of the box.

When the connection between the lever E and the valve is made by a valve-stem or other device passing through a hole in the top of the vacuum-chamber, there is considerable difficulty in packing this hole in order to prevent the leaking of air into the vacuum, which, if it should occur to any considerable extent, would render the apparatus inoperative. This difficulty is avoided in my invention by connecting the lever E with the valve by means of a mechanical connection extending down beneath the box H. Any other connection which thus passes beneath the box or compartment instead of through it will come within the scope of my invention.

When the chain *a* is pulled, the levers E and I are tilted and the valve D is raised. The water then rushes down the pipe B and creates a partial vacuum in the tubes *f g*, whereupon water is drawn up the annular space between the two tubes, which constitutes the shorter leg of the siphon, and then down the tube *f*, which constitutes its longer leg. As soon as this siphonic action commences the valve G may be dropped to its seat, as the siphon will continue to draw the water from the tank until the water-level is lowered to the mouth of the tube *g*, whereupon the vacuum is broken and the outflow ceases. By this time enough water for one flushing of the closet will have run out. When the water-level descends to the notch or perforation *c*, air passes into the vacuum-chamber, thus breaking the vacuum therein and stopping the siphoning of water from the closet-bowl beneath. The subsequent outflow of water then constitutes the afterwash to refill the bowl. The higher the notch *c* extends the greater quantity of water will be delivered as the afterwash. In the construction here shown the notch *c* serves also as the opening in which the lever I plays while lifting the valve D. This construction is convenient and inexpensive, but is not essential.

When the tank has been emptied, it will be refilled from the float-valve, ready for the next operation. In so filling the water rising in the vacuum-chamber will encounter a confined mass of air therein and would compress it, thereby compressing the column of air in the air-pipe C and in the air-space between the two traps of the closet beneath, were not some means provided for the escape of the air. For this purpose a vent-valve or check-valve *n* is placed at the top of the vacuum-chamber, opening outwardly. This valve is very light and opens easily. From it a pipe *p* extends to a chimney or to the roof of the building, or is otherwise arranged, as is customary with "local vent-pipes."

In tanks which are emptied by a siphon and refilled by a float-valve difficulty has been experienced by reason of the stream of water entering by the float-valve continuing to supply the siphon, so that it is drawn out and carried down the outlet-pipe as fast as it enters the tank. This results from too large a stream being supplied by the float-valve, and it has been remedied by using a float-valve which delivers a smaller stream, so that the water shall enter the tank too slowly to supply the siphon; but this is attended with the disadvantage that the tank takes a long time to refill, so that another flush may be required before it is refilled. According to my present invention I provide a novel construction of float-valve, whereby the stoppage of the outflow through the siphon is insured, and yet the tank is rapidly refilled. To this end I construct the float-valve to deliver a very small stream when the float is dropped to its lowest position, at which time the siphon has emptied the tank, so that the water enters too slowly to supply the siphon, and the breaking of the vacuum therein is assured, and to deliver a large stream when the float is lifted slightly above its lowest position, so that the tank will then be rapidly refilled. The float-valve is also constructed, as usual, to shut off the water as soon as the level rises to the normal. To this end I construct the float-valve with the outflow-passage in its shell and the valve moving therein so shaped or constructed relatively to one another that when the valve is in the position to which it is brought by the lowest movement of the float the flow through the valve is choked by the restriction of the effective area of the outflow-passage. When the float is in its highest position, the valve is seated and the flow is cut off, and when the

float is in an intermediate position the valve occupies such a position relatively to the walls of the outflow-passage that the largest effective area is provided and the greatest outflow is attained to rapidly refill the tank. This result may be accomplished by several different but substantially equivalent constructions, the simplest and cheapest of which are the ones shown in the drawings, wherein the valve is formed with an obstruction or supplemental valve, which is so placed that when the main valve is moved by the float farthest away from its seat this obstruction comes into or against a contracted part of the outflow-passage and nearly fills or stops the same.

Figs. 4, 5, and 6 show the preferred construction of float-valve F. A thimble *q* is fastened to the tank, its inner end forming a valve-seat and its outer part being externally screw-threaded and receiving the union or coupling ring *r*, by which a spud *s*, to which the service-pipe is joined, is coupled to it. To its inner end is screwed the chamber *t*, which is formed with an outlet-spout and with bearings for the elbow-lever *u* and for the stem of the valve *v*. The construction thus far described is common. I have added to it a secondary valve or obstruction *w*, which is arranged on the outer side of the valve-seat, and is fastened to the valve *v*, so that it moves therewith. Fig. 4 shows the valve closed, the float F′ being in the position shown in full lines in Fig. 1. Fig. 5 shows the condition of the valve when the float is in the position shown in dotted lines at F^2 in Fig. 1. The obstructing-valve *w* is now moved into the seat, so that it nearly fills the same, and hence almost entirely cuts off the flow of water, reducing it to so small a stream that it cannot supply the siphon. Fig. 6 shows the valve when the float is in the position denoted by dotted lines at F^3 in Fig. 1. The valve is now fully open, since the obstruction *w* is not in position to reduce the flow, and the water is rapidly entering the tank.

Fig. 10 shows a modified construction of valve. The supplemental valve *w* seats itself when the float is in its lowest position, at which time the water enters the tank in a reduced stream by flowing through a small hole *w′*, drilled through the valve *w*.

To avoid any shocks or jerky movements in lifting the valve D, I interpose a spiral spring S between the pull and the connection with this valve. I prefer to arrange it between the chain J and lever E; but it may be otherwise placed.

My invention is susceptible of considerable modification without departing from its essential features. As examples of some of the changes that may be made I have introduced some additional figures in the drawings.

Figs. 7 and 8 show a tank wherein the vacuum-chamber is constructed by partitioning off a portion of the tank by means of a fixed bulk-head K. The flushing-compartment thus formed should contain water enough for a single flushing of the closet. Water enters it from the outer or reservoir portion of the tank through one or more holes L. The after-wash is provided for by means of an air-tube *c*, which dips into the water and opens above the valve *n*. The lever E is connected to the valve D through the medium of a valve-stem J′, working through a hole in a cap M, which is removable in case it should be necessary to take out this valve. The stem is provided with packings *q′ q″*, above and below the cap M, these packings being held in place by nuts *r′ r″*, screwed onto the stem. When the valve is down, one of these packings closes the hole through which the stem passes, and when the valve is raised the other packing closes the hole, thereby preventing leakage of air into the vacuum-chamber.

Instead of starting the siphon by opening a valve to which it is attached, any other known means of starting a siphon may be applied. Numerous means and devices for this purpose are now known in the art. Some of these devices act by suddenly raising the water-level in the tank, in order to overflow the siphon. As an example of one such means, I have shown in Fig. 9 a tank having a fixed siphon and a faucet or cock for admitting an overcharge of water to the tank when it is desired to flush the closet. This cock (lettered N) is operated by a weighted lever E, which is placed above the tank and tilted by a chain *a*. The cock is preferably arranged to inject a jet of water into the short leg of the siphon, so that it shall lift the column of water therein and overflow the siphon, thus starting the latter.

It is not essential that the outlet-siphon shall lead from within the vacuum-chamber. Fig. 9 shows a construction wherein the siphon is entirely outside of the box H.

The portion of my invention which relates to the construction of float-valves for siphon-tanks is not limited to pneumatic tanks, but is applicable to any siphon-tank. Fig. 11 shows an ordinary flushing-tank for flushing common pan, hopper, or wash-out closets. It is emptied by a siphon-valve D, operated by a lever E, and is refilled by a float-valve F, of the constructions shown in Figs. 4 to 6.

I claim as my invention the improvements in flushing-tanks defined as follows, substantially as hereinbefore specified, namely:

1. In a flushing-tank, the combination, with an outflow-siphon, of an inlet float-valve consisting of a float, a valve-shell formed with a valve-seat and outflow-passage, and a valve movable in said shell toward and from the seat connected to and moved by the float, arranged to be seated when the float is in its highest position, and the valve and outflow-passages constructed relatively to one another and to the float, so that the outflow is choked when the float is in its lowest position and is unobstructed when the float is in an intermediate position, whereby when the tank is emptied the inflow of water is so reduced

as to insure the termination of the siphonic outflow and as the water-level rises the inflow is augmented in order to rapidly refill the tank until when the normal level is attained the inflow is shut off.

2. In a flushing-tank, the combination, with an outflow-siphon, of an inflet float-valve consisting of a float, a valve connected to said float and moved thereby toward and against its seat as the float rises and away therefrom as the float descends, and a valve-shell formed with a valve-seat, and a contracted outflow-passage so formed and arranged relatively to said valve and the movement thereof that when the valve is farthest from its seat it obstructs the contracted portion of said passage and reduces the area of the water-way, whereby when the float is in its highest position the flow is cut off, when it is in its lowest position a reduced flow is admitted, and when it is in an intermediate position a full inflow is admitted.

3. In a pneumatic flushing-tank, the combination, with the tank, an outlet device for emptying it, an operating mechanism for manipulating said device, and a float-valve for refilling the tank, of a stationary bottomless box having a capacity equal to the volume of air to be exhausted inserted in said tank to form a vacuum-chamber and removable from it at will independently of said outlet device, and an air-pipe terminating within said box above the water-level.

4. In a pneumatic flushing-tank, the combination, with the tank, an outlet-valve for emptying it, and a float-valve for refilling it, of a vacuum-chamber formed in said tank inclosing said valve and communicating with the remaining portion thereof by an opening at or near the bottom of the intervening partition, an air-pipe terminating within said chamber above the water-level, and a mechanism for manipulating said outlet-valve, consisting of a lever above the tank and a mechanical connection between said lever and valve entering the vacuum-chamber through the said opening at or near the bottom of said partition, whereby the puncturing of the upper portion of the vacuum-chamber is avoided.

5. In a pneumatic flushing-tank, the combination, with the tank, an outlet-valve for emptying it, and a float-valve for refilling it, of an open-bottomed box placed removably in said tank, constituting a vacuum-chamber inclosing said valve and communicating with the remaining portion of the tank beneath its open bottom, an air-pipe terminating within said chamber above the water-level, and a mechanism for manipulating said outlet-valve, consisting of a lever above the tank and a mechanical connection between said lever and valve entering the vacuum-chamber beneath the said box, whereby the puncturing of the upper portion of the box is avoided.

6. In a pneumatic flushing-tank, the combination, with the tank A, outlet-valve D, and float-valve F, of the vacuum-chamber G, formed in the tank and communicating therewith through an opening *c* near the bottom of the intervening partition and inclosing the outlet-valve, an air-pipe C, terminating within said chamber above the water-level, the operating-lever E, the lever I at the bottom of the tank, passing through said opening *c* and engaging said valve D, and chain or connection J between said levers E and I, whereby the operating mechanism is connected with the valve without puncturing the upper portion of the vacuum-chamber.

7. In a flushing-tank, the combination, to form a float-valve, of the valve-shell, a contracted valve-seat therein, the valve adapted to close against said seat and provided with a supplemental valve or obstruction projecting through the valve-seat in position to come within the contracted seat when the valve is opened to the farthest extent, and the float connected to the valve and adapted, when raised to its highest position, to force the valve against said seat.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES E. BOYLE.

Witnesses:
GEORGE H. FRASER,
WILLIAM H. HANNAM.