W. E. BYER.

LIQUID DISPENSING APPARATUS.

APPLICATION FILED MAR. 9, 1910.

1,174,674.

Patented Mar. 7, 1916.

2 SHEETS—SHEET 1.

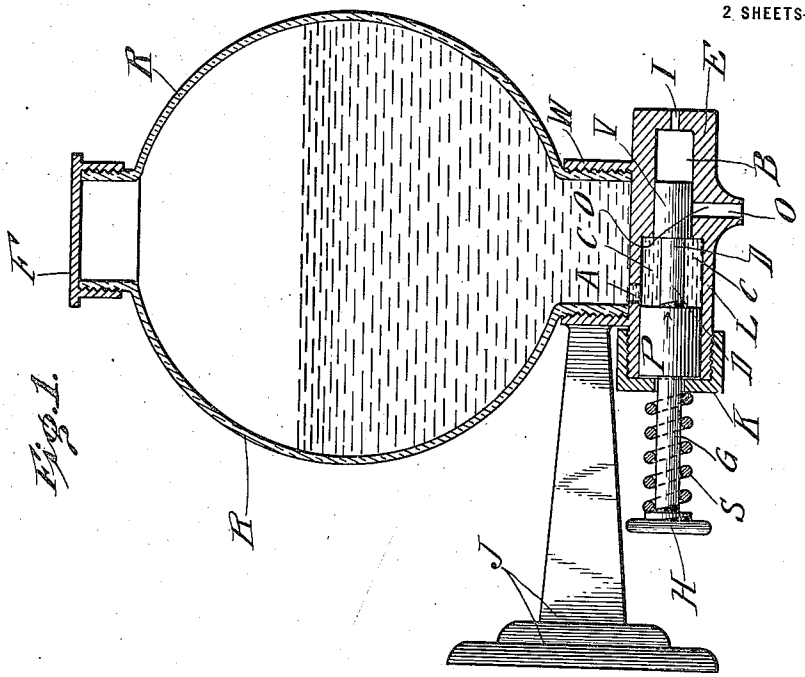


Fig. 1.

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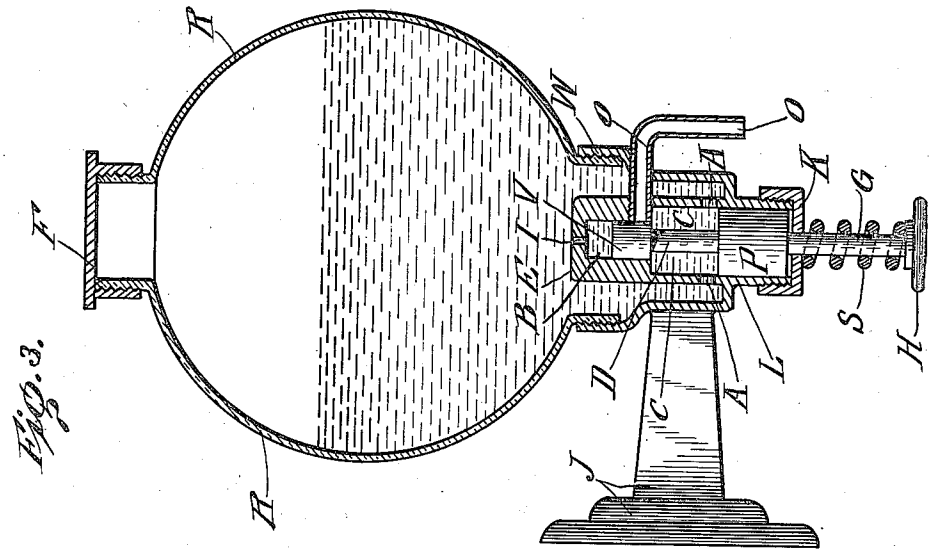


Fig. 3.

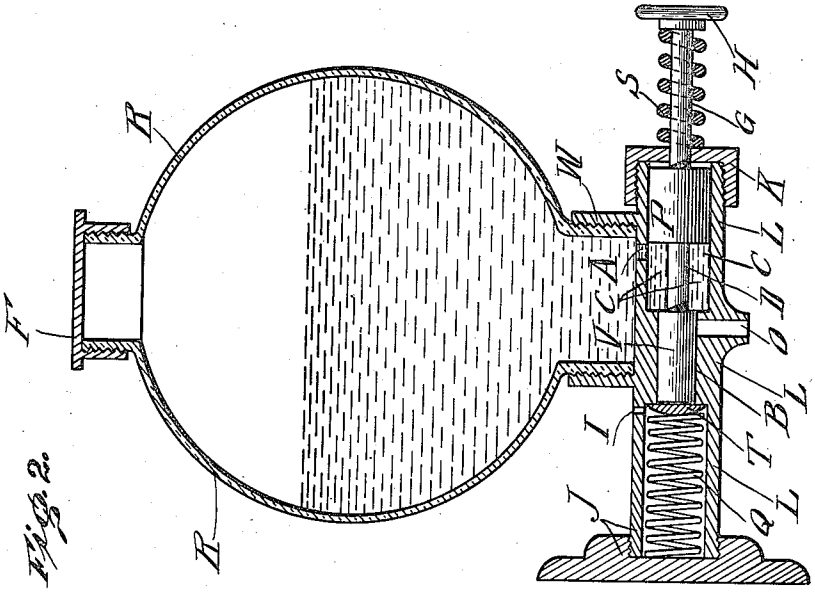


Fig. 2.

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UNITED STATES PATENT OFFICE.

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LIQUID-DISPENSING APPARATUS.

1,174,674. Specification of Letters Patent. Patented Mar. 7, 1916.

Application filed March 9, 1910. Serial No. 548,153.

To all whom it may concern:

Be it known that I, WILLIAM EDWIN BYER, a citizen of the United States of America, and a resident of Jersey City, New Jersey, have invented certain new and useful Improvements in Liquid-Dispensing Apparatus, the principles of which are set forth in the following specification and accompanying drawing, which disclose the form of the invention which I now consider to be the best of the various forms in which the principles of the invention may be embodied.

This invention relates to improvements upon apparatus for dispensing liquid, such for example, as liquid soap for the toilet; and more particularly such apparatus of the type wherein the liquid is discharged positively under pressure as distinguished from gravity discharge.

The object of the invention is to produce important improvements upon such apparatus heretofore proposed for such purposes, whereby the liquid is prevented from being discharged under pressure so abruptly as to cause a wasteful spattering action, and whereby the discharge passages shall be kept substantially free from the liquid after the successive discharge operations.

The invention consists of the improvements hereinafter described and claimed in the specification and shown in the drawings.

The drawings disclose the forms of the invention which I consider to be the best present forms of the various possible embodiments of the invention.

The three figures of the drawings show three arrangements in which the invention may be embodied, each figure being a vertical section of an operatively complete device, and showing normal condition ready for useful operation. It is believed that an ordinary skilled mechanic can make and use the apparatus from the drawings and description herein.

The essential novel operation of the apparatus is substantially the same in all three figures, but it will be described, for simplicity, with reference to Figure 1, of which R is a reservoir for the liquid to be dispensed and composed of suitable material, such as glass or metal, and having a top filling opening and cover F. From reservoir R the liquid passes through inlet-passage A to the cylindrical charging chamber or piston C, to fill the space therein around the rod D between the cylindrical piston-valves P and V. From chamber C the liquid passes to chamber B, upon the operation of valve V therein; and from chamber B, the liquid passes to discharge passage O. In reverse operation, liquid which has not been discharged but which is left in passage O and chamber B, is drawn back into piston-chamber C, in readiness for the next discharge operation.

In normal condition the chamber C is filled with liquid, chamber B and passage O being free of liquid. This liquid in chamber C is forced into delivery chamber B by the forward movement of cylindrical piston P, said movement of liquid being permitted by the simultaneous movement of piston V which thereby leaves a space in chamber B to receive the liquid from C. In this operation, piston P acts also as a valve to close inlet A. Also piston V acts as a valve to open the inlet opening to outlet passage O. Thereafter, the movement of piston P in chamber C also forces the liquid out, under pressure, through passage O by way of chamber B.

The back stroke of pistons P and V results as follows: First, a tendency to suction back of piston P causes the undischarged liquid to be drawn back into chamber C. Then valve V closes its inlet to passage O and shuts off chamber C from chamber B, thus doubly checking flow of liquid from C to O until the next discharging operation.

As is shown, the cylindrically-hollow valve-chamber B contains valve V. Piston V has a diameter materially less than piston P. The result of this construction is that when piston V moves forward to provide a space in B to receive liquid from C, liquid from chamber C is discharged from B and ejected from O, under the pressure of piston P. Although a definite quantity of liquid is discharged under the piston pressure each time the apparatus is operated, the chamber C is not a measure of the charge, as will be described.

The moving parts (in all the figures) reciprocate in, and the valve chambers C, B are located in, a cylindrical casing L on

which is mounted a support W for reservoir R. Piston P preferably has a close working fit in cylinder L, and so has piston-valve V in its engagement with the inside wall of chamber B where the valve action is effected.

The end of cylinder L is provided with a screw cap K through which the operating rod G extends. Also, passage O enters B through the lateral wall of delivery chamber B, and valve V acts (in addition to shutting off the chambers B and C from each other), to open O to B on its forward stroke, and on its return, to close O from B, as an additional check against leakage from C to O.

The operation may be by any suitable means, such as rod G with operating end or handle H, and spring S which automatically effects the back-stroke of P and V. Operating end H may be operated manually, or by the float of the common flush tank in the case where the apparatus may be stocked with a disinfecting fluid.

If desired, the apparatus can be supported by a wall bracket, such as J. With this arrangement of bracket-support J, and operating button H, the user's hand under O and receiving the soap therefrom, may be used to operate handle H to force the liquid from the outlet of passage O.

Where chamber B is closed at end E, a small air passage or relief opening I may be provided, to facilitate the reciprocation of valve V in chamber B, especially when the valve has a tight working fit with the wall of the chamber. This relief opening need have no special form and may be effective if it be simply a looseness between the parts of the structure which will permit the desired relief.

The return spring may be located around operating rod G and bear between cap K and button H, or, as at Q, (Fig. 2) it may be located in a hollow of cylinder L extended to form a part of, or to adjoin bracket J. In this case the right-hand end of spring Q bears against a member T, which is independent of delivery chamber B, and valve V may extend through B to normally abut T, as shown (Fig. 2) so that in operation, spring Q will be compressed by the left-hand movement of member T and the parts will be returned to normal position entirely by spring Q or by springs Q and S acting together to effect the return. In cases where button H and discharge O are arranged as in Fig. 2, both hands of the user may be employed, one to operate button H, and the other to receive the charge of liquid soap from the outlet O.

A vertical arrangement of movable parts can be employed, as shown in Fig. 3. Here chamber B, and the entrance to passage O from chamber B, are located above chamber C. This arrangement permits the more convenient use of a single hand for both operating the apparatus and receiving the soap; this being due to the vertical arrangement of parts P, D, V and the opening downward of passage-tube O, whereby the operating movement of button H is such that the operating hand approaches directly toward the outlet orifice of tube O.

Having now described generally the construction and mode of operation, I will describe in detail the specific novel operation and construction of all three disclosed embodiments of the invention, with particular reference to Fig. 1, as before, for convenience; first noting that, irrespective of and in addition to the advantageous operations to be described, the construction itself is simple, consists of a minimum number of parts, and is easy to manufacture and to maintain in operative condition.

Outlet passage O is normally free and is kept normally free, of liquid. The construction is such as to permit the liquid discharge by the preferable operation of the user's hand, and not by a spring, so that the function of the spring S is to tend to hold and to normally hold V in position to close the inlet to passage O and diametrically completely fill that part of chamber B which is adjacent to C, thereby normally insuring against liquid draining from C into O by way of B, after the parts have been returned to their normal condition after a discharge operation. As will be described in detail, passage O, after a discharge operation, is positively and promptly freed of the column of liquid remaining in it, by means of the suction action which results from the return-stroke of the piston P caused by the operation of the spring. Thus, the normal condition is that outlet passage O is free of liquid and is insured against any normal draining of liquid into or out of it. That is, no liquid is permitted to remain in O, as the result of a discharge operation, whence it would thereafter slowly drain out and be wasted or else remain in part and cause more or less stoppage, or both. Also, at no time is liquid permitted normally to drool into O from piston chamber C. Liquid is contained normally only in chamber C and reservoir R. The desirability of this continued, clean condition of passage O, explains the preference, in embodiments of this invention, of having the discharging operation occur before the immediately-subsequent recharging operation, instead of having these two immediately successive operations occur in the reverse order. In operating and constructing this invention, therefore, it is preferred to have chamber C normally filled with liquid, to have the operation by the user result in the discharge to the user's hand, and then immediately to have the spring restore the parts to their normal condition.

As piston P moves in the direction to pro-

duce a forcible discharge from the outlet of passage O, it closes communication with the reservoir, which may be effected in any suitable manner, as by closing inlet A, as shown. Meanwhile, piston V has been moved forward to be in readiness to commence its action of opening outlet O at the proper time. Outlet O is opened not later than the reservoir-communication has been closed, because chamber B is smaller than chamber C, and the space between the pistons is air-tight, so that the apparatus could not be operated in accordance with the invention, if there were no arrangement which permitted of the disposition or utilization of the liquid which occupies the space between the two pistons during the time in which that space is becoming smaller as the pistons advance, the pistons being kept a constant distance apart by means of rod D. As soon as piston V has begun to open the inlet to passage O, the liquid which has now been moved by piston P into chamber B against piston V, begins to enter the inlet to O. But, as chamber B is of less diameter than chamber C, and as rod D maintains a uniform space between the two pistons, the effective volume of the space between the pistons is progressively diminishing as they advance; and also as the diameter of outlet O is less than that of chamber B, the result is that the liquid is forced by the action of piston P to enter O positively under pressure, whether the inlet passage O is below the liquid level in chamber C, as in Figs. 1 and 2, or above said liquid level as in Fig. 3. Moreover, passage O is sufficiently constricted throughout its length (being shown to have the same diameter throughout its length) to cause the liquid to be forcibly discharged from it under substantially the same pressure as that on the liquid which enters it. On account of this forcible discharge from outlet O, and because this is the delivery outlet lying directly adjacent to the hand of the user, means are provided to prevent such an abrupt discharge as to cause a spattering of the liquid against the user's hands which would tend to splash the liquid and waste it. This means is as follows: Piston V, as described above, completely fills chamber B diametrically, and therefore prevents liquid from entering that chamber save as space is provided therein by the forward movement of said piston V. Thus piston V prevents the liquid from reservoir R from completely filling the entire chamber B, in addition to C, which, if permitted, would result in permitting piston P to cause a too abrupt discharge from the bottom or outlet opening of passage O. The result of this construction is that, although the liquid is forced from O under pressure of P, yet as soon as piston V begins to open O, (when the opening to passage O is very small although rapidly increasing in size), the movement of V serves to prevent too rapid a movement of liquid into and through passage O, first because V completes the opening of O very rapidly as piston P continues to press the liquid forward, and second, (and of great importance), the forward movement of V results in increasing very rapidly the effective liquid capacity of chamber B. That is, as the top or inlet opening to O is being rapidly opened by the forward movement of V, the effective liquid capacity of B (and therefore, of B and O) is being increased by that portion of the volume of B which is measured by its entire diameter, in one direction, and in the other direction, by the entire diameter of the inlet-opening into passage O. In effect, therefore, during the progressive action of the complete opening of the inlet to passage O, its capacity is very greatly added to by the effective increase in capacity of chamber B; and this increase is not only progressive and simultaneous with the action of V in opening passage O, but also with the action of P in forcing liquid into passage O. Also, in Fig. 1 specifically, where the left-hand end of piston V moves in its forward stroke beyond the right-hand side of the inlet to passage O, the effective capacity of chamber B to the left of piston V continues to increase even after passage O has been completely opened. If no such relief were provided, piston P would force the liquid very violently through the very small opening into passage O which exists when the latter is first opened by V, and this violent action would continue as the opening to O increased (although to a less degree), on account of the great disparity between the diameters of P and O. There is thus here provided a partial counter-action, consisting of the increase of capacity of B, which acts as a relief against too great effective pressure by piston P which would result otherwise from the great disparity between the diameters of C and O; the net result being that said otherwise abrupt action of piston P is tempered, modified or compensated, and the liquid (although always positively forced through and out of the bottom or outlet opening of passage O, as the result of the larger diameter of passage C relative to B and of B relative to O), is caused to be more gently forced out of O on to the hand of the user than would be the case if the entire liquid charge in chamber C were discharged during the forward stroke of piston P. This gradual forcing action of the liquid is, of course, assisted by the preferred operation of causing the discharging operation to be effected by the hand of the user on H, instead of by a quick-acting spring. Thus the total net resultant operation at the bottom or outlet opening of passage O is a compromise between a drool and a spatter,

which consists of a gentle but forcible discharge during the forward stroke of the pistons.

At the end of the forward stroke of the two pistons, that part of the liquid soap which remains undischarged under the pressure of the piston P, exists instantaneously as a viscous body which fills passage O and also the space between the constantly-separated pistons. Immediately upon the release of handle H by the user, the spring S starts to restore the parts to their normal positions, and the commencement of the return stroke of piston P starts a tendency to create a vacuum in chamber C which results in the sucking of said undischarged liquid body in B and O, back into chamber C, where it is added to by more liquid from reservoir R, in readiness for the next discharging operation.

In detail, the return-stroke action is as follows: When the two pistons are at the end of their forward strokes, (the spaces between them and in passage O being filled with said undischarged body of liquid), said space between the pistons is air-tight save for the bottom or outlet opening of passage O below the column of liquid soap remaining in that passage. As soon as the spring begins to move piston P back, there is a powerful tendency to create a vacuum in chamber C due to the greater relative diameter of chamber C and piston P, and due also to the constant spacing between the two pistons, and also to the air-tight condition of that space. The result of this is to pull back into chamber C the viscous body of liquid in chamber B and passage O.

In embodiments like Fig. 1, where the forward stroke carries the left-hand end of piston V beyond the right hand side of the opening to passage O, the suction at the beginning of the return-stroke acts on part of the liquid which remains in B to the right of O as well as on the rest of the remaining liquid which lies in B to the left of that and also in the liquid column in passage O; and the back-stroke of piston V compensates for and fills the space in B which has just previously been occupied by a corresponding volume of the undischarged liquid, so that no partial vacuum can be established in B which might result in drawing air in through O before all the liquid in B had been sucked back into C. Thus the body of undischarged liquid is kept in one coherent mass and all of said liquid is sucked entirely back into piston-chamber C. This action results also in preventing the back-stroke of piston V from forcing any liquid out from passage O (and prevents any discharge by gravity) additional to the definite charge which was forced out by the forward stroke of piston P.

As soon as piston V. starts to close passage O and progressively decreases the effective opening to O, the disparity between the diameters of piston-chamber C and O is greatly increased, with the result that the suction on the remaining liquid column in O is greatly increased.

At whatever time, (relative to the beginning of the closing of the inlet to passage O), in any case or in various embodiments of the invention, the actual suction of the liquid column from O may commence (as distinguished from the liquid in B to the right of O in Fig. 1), the suction is effective on the undischarged body of liquid in B and O as a whole, as soon as piston P begins its return stroke. And in any embodiment, as soon as V starts to close O, that part which remains as a viscous liquid column in O, of the entire body of undischarged liquid, is necessarily sucked back into chamber B, and, together with the liquid remaining also in B, is sucked back into piston-chamber C; piston V acting, at all times during its return stroke, to cause its volume to compensate for the liquid sucked back into piston-chamber C, with just the right degree of compensation, but not to such extent as to stop the effective continuation of the suction action. Thus piston V, in neither its forward nor backward strokes, functions to actually positively force the liquid; for in its forward stroke it merely permits the forcing of the liquid by P, although since V fills chamber B diametrically, it acts negatively as a relief means to prevent such forcing by P from being too abrupt; and in the backward stroke of piston V, it permits the sucking of the liquid by piston P, although since it fills chamber B diametrically, it acts positively to give effect to such suction by decreasing the effective capacity of chamber B at a less rate than the simultaneous increase of capacity of chamber C.

In each case (the forward and the backward strokes of piston V), the action of this piston V is essentially directed to control the movement of liquid in passage O, in one direction or the other; and in each such case its effect is due to the fact that its diameter, and that of chamber B in which it has a working fit, is less than that of chamber C and piston P, so that on the forward stroke of piston V, it reduces the volume (and therefore, the rate of flow in the given time) of the liquid forced through and out of passage O; and on its backward stroke said piston V is the means which directly causes the net result of a sucking back of the undischarged liquid which remains not only in passage O, but also in chamber B.

The definite quantity of liquid which is forcibly discharged at each operation is not measured by the volume of the space between the two pistons at the instant when the res-

ervoir-communication is cut off; but it is measured by that volume reduced by the volume of the body of liquid in B and O which remains undischarged at the end of the forward stroke, that is, the liquid which remains in passage O and in the space between the two pistons.

The principal advantages of the invention, additional to the practical requirements that a definite amount of liquid be discharged at each operation and that that discharge shall be positive and under pressure, and not dependent on gravity, are first—that although each discharge is forced out under pressure, the discharge is not so abrupt as to cause wasteful spattering; and second—that after the discharge, and by the return-stroke, the undischarged liquid which has been forced out of the piston chamber on the way to the outlet of the discharge passage, is positively sucked back into the piston-chamber in readiness for the next discharge, and for the purpose of preventing normal drooling from the outlet passage and of keeping it free from the viscous liquid, as well as insuring that the next discharge shall be of the same definite quantity as the preceding one.

I am aware of the patents to Hoffmann *et al.* No. 889,306, to Morrill Nos. 743,093 and 835.162, and to Helmold *et al*, No. 804,468, but none of these discloses the construction which I claim; and I am also aware of the patent to Morrill No. 911,834 (Reissue No. 13,898) but that also lacks any disclosure of the construction here claimed. I believe that I am the first to produce a liquid-dispensing construction, as specified in the appended claim, wherein are employed two pistons and the construction and arrangement are such that at each forward stroke, there is delivered to the user, under piston pressure, a definite proportion of the liquid which lies between the two pistons at the commencement of such stroke; and wherein the construction and arrangement are such that upon the return-stroke, the liquid which has been forced from the space between the pistons but which has not been delivered to the user, is returned to that space, under piston suction.

I claim:—

In a liquid-dispensing apparatus of the pressure-discharging type, the combination with a casing formed with two communicating differently-diametered chambers and with a means of communication between the larger one of said chambers and a liquid reservoir; of a reciprocable piston having a working fit in said larger diametered chamber and constructed and arranged to control said reservoir-communication, and normally located to open said communication; said casing being also formed with an outlet-passage through the lateral wall of the smaller-diametered chamber, the outlet opening of which passage is the delivery outlet of the apparatus; and a second piston, having a working fit in said second and smaller chamber, and constructed and arranged to normally close the lateral opening to said outlet-passage; said casing and small piston being constructed and arranged to permit the forward movement of said smaller piston in its action of opening said lateral outlet-passage, but to prevent the passage of liquid at any time to that portion of the smaller chamber which is beyond said smaller piston; means for initially moving the two pistons and thereby closing the reservoir-communication and opening the outlet-passage, said means including a spacing device located between the two pistons; and a spring constructed and arranged to automatically effect the return-stroke of said pistons; said casing and pistons being constructed and arranged to cause the space between the two pistons to be air-tight, save for the liquid inlet and outlet; all whereby, at each initial stroke of the pistons, a definite proportion of the liquid which lies between the two pistons at the commencement of said initial stroke, is forced out of said delivery passage, to the user by the pressure of said larger piston; and whereby, at each return stroke, the liquid, which just previously has been forced from between said pistons into said delivery passage, but not forced out of that passage, is withdrawn into the space between the two pistons by the suction of said larger piston.

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