May 11, 1943. M. C. SCHWAB 2,318,637

LIQUID DISPENSING DEVICE

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Fig. 1.

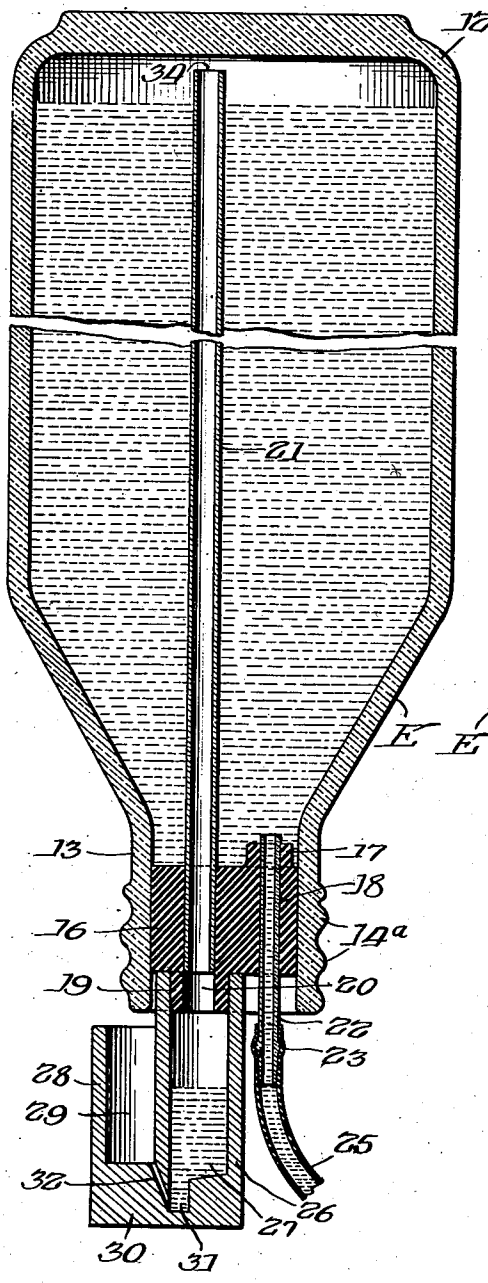
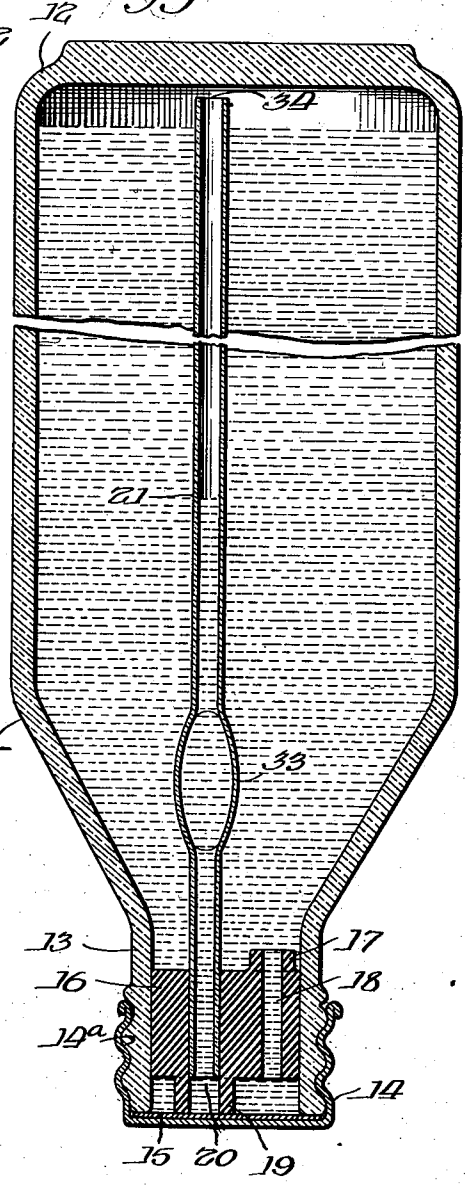


Fig. 2.



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Fig. 3.

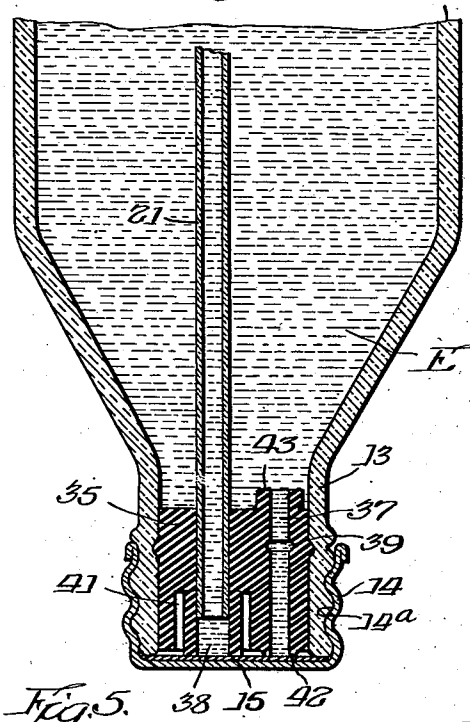


Fig. 4.

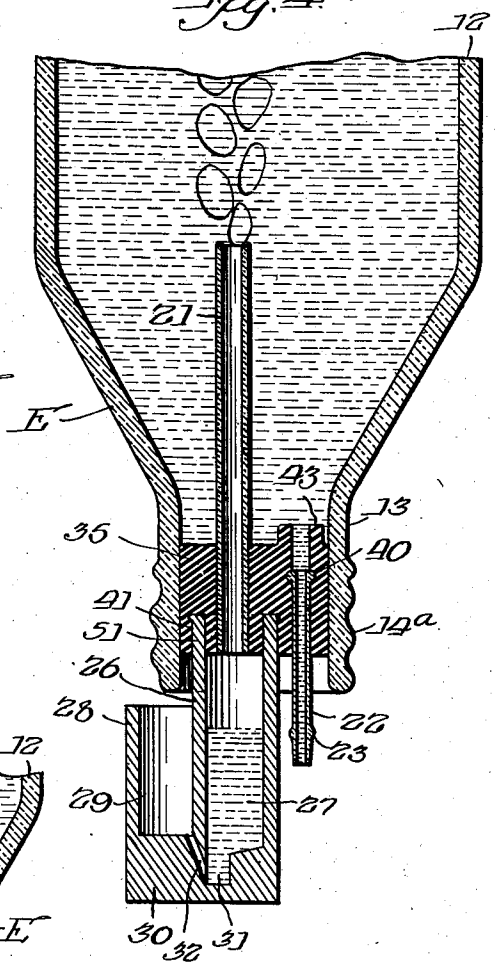
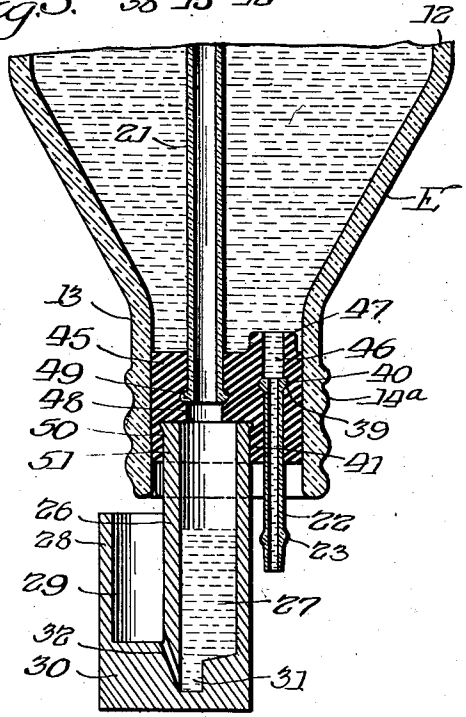


Fig. 5.



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Fig. 6

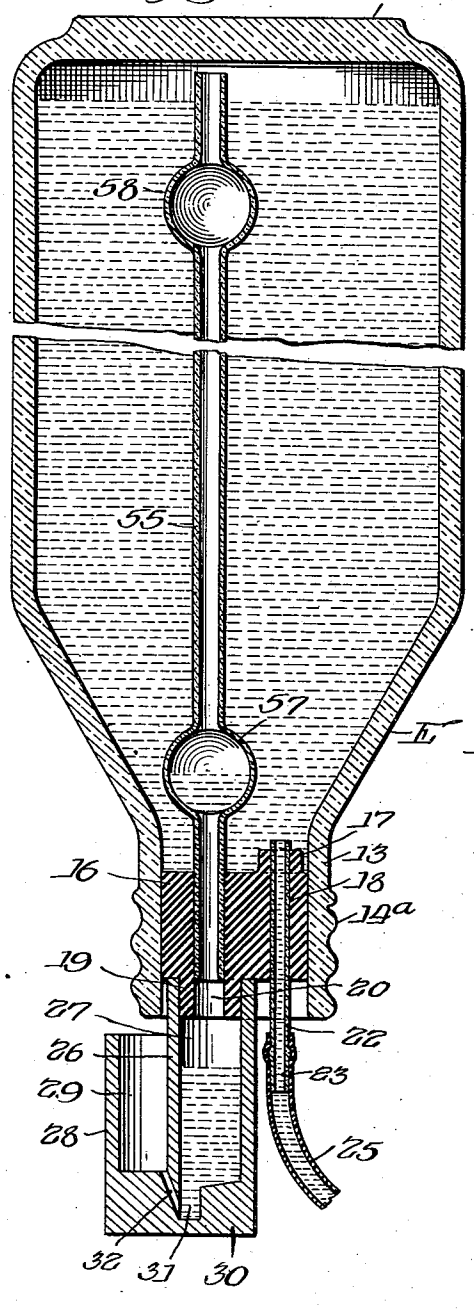
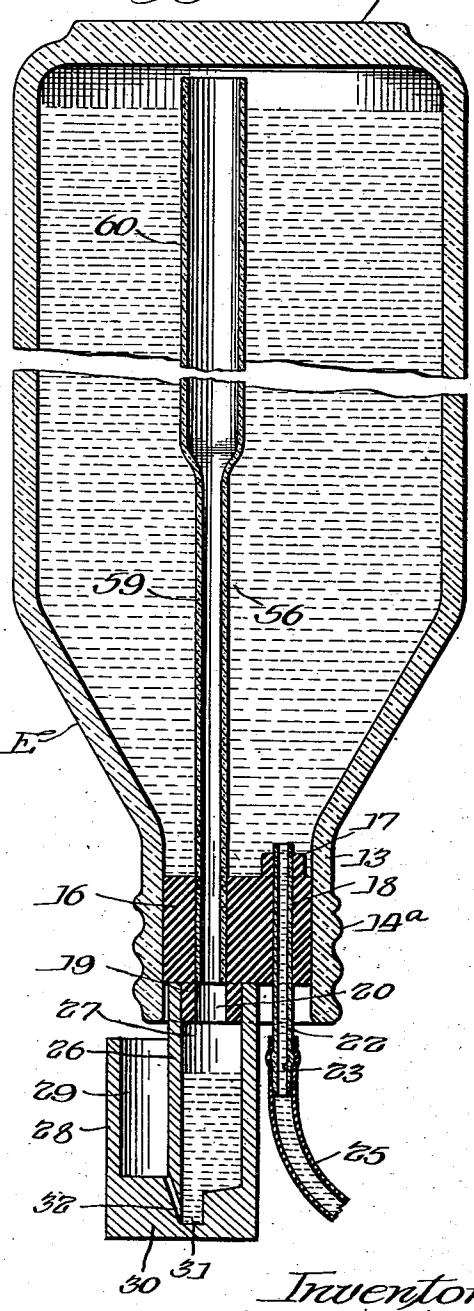


Fig. 7.



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Patented May 11, 1943

2,318,637

UNITED STATES PATENT OFFICE

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LIQUID DISPENSING DEVICE

Martin C. Schwab, Chicago, Ill.

Application August 23, 1938, Serial No. 226,269

10 Claims. (Cl. 128—214)

This invention relates to liquid dispensing devices and more particularly to devices for dispensing sterile liquids for subcutaneous or intravenous injections. In withdrawing liquids from containers generally, it is necessary that air be permitted to enter the container to replace the liquid withdrawn, and in devices to be employed for the purposes specifically herein pointed out, it is particularly important that the air entering the container upon withdrawal of the liquid be filtered in order to prevent contamination of the sterile fluids within the container.

The invention relates to liquid dispensing apparatus of the general character referred to in my copending applications Serial No. 58,649, filed January 11, 1936, issued to Patent No. 2,156,313 on May 2, 1938, and Serial No. 69,323, filed March 17, 1936, issued to Patent No. 2,156,314 on May 2, 1939, and is directed to certain improvements thereover.

In dispensing devices of this general type known to the art, it is customary to provide an air washing chamber in a cap removably mounted upon the top of the bottle. An object of the present invention is to improve and simplify the construction of the cap, which is preferably of such construction that it may be frictionally seated in a stopper in the neck of the liquid container. A feature of the present invention is that the device requires considerably less sterilization than similar devices known to the art and may be readily assembled for instant use by unskilled persons. My improved dispensing device may be delivered in a sealed package to hospitals or other users, and the device rendered ready for use by removing the seal, sterilizing the dispensing tube and air washing cap and inserting the cap and the dispensing tube in the stopper.

In certain of the liquid dispensing devices known to the art it has been found, particularly where considerable quantities of liquid are to be dispensed, that an insufficient washing of the incoming air is obtained. Accordingly, a further object of the invention is to provide a device in which a more thorough cleansing of the incoming air is obtained than in any of the devices known to the art. In certain embodiments of the invention this highly desirable objective is obtained by providing a plurality of air washing chambers. For example, the incoming air may be washed in a chamber depending from a stopper in the neck of the liquid container and also in a secondary air washing chamber forming a part of the air inlet tube within the container. The invention contemplates the use of a portion of the liquid to be dispensed as the media for washing incoming air, both in the primary and secondary air washing chambers.

A further feature of the invention is the provision of a sedimentation zone within the liquid container below the inlet of the liquid dispensing tube.

The assembly of my present device is readily sterilized and is capable of portable use as well as being sold as a part of the liquid container. Further objects are to provide a construction of maximum simplicity, economy and ease of assembly.

The invention will be readily understood from the following description in conjunction with the accompanying drawings wherein certain preferred embodiments of the invention are illustrated, in which:

Fig. 1 is a broken vertical sectional view of one embodiment of my invention, showing the improved air washing and dispensing assembly attached to a liquid container;

Fig. 2, a broken vertical sectional view of a slight modification, showing the container sealed in condition for delivery and without the air washing and dispensing assembly;

Fig. 3, a cutaway vertical sectional view of another embodiment without the air washing and dispensing assembly attached;

Fig. 4, a cutaway vertical sectional view of another modification of the invention somewhat similar to that of Fig. 3 and with the air washing and dispensing members attached to the container;

Fig. 5, a cutaway vertical sectional view of another embodiment of the invention somewhat similar to the embodiment shown in Fig. 4;

Fig. 6, a broken vertical sectional view of a further modification of the invention;

Fig. 7, a vertical sectional view of another embodiment of the invention.

Referring generally to the drawings, it will be seen that in all of the views the improved container and dispensing device are shown in the inverted position, and it is in this inverted position that all of the various embodiments illustrated operate.

Referring to Figures 1 and 2 of the drawings, wherein quite similar embodiments of the invention are shown, the reference character E indicates a container provided with a conventional body portion 12, and a neck 13, which may be provided with external screw threads 14a adapted to removably retain a screw cap 14. As shown

in Fig. 2, wherein the container is shown in its delivered condition, a seal is preferably interposed at the top of the cap to prevent leakage of the liquid. When the container is to be particularly used for dispensing fluids used in intravenous or subcutaneous injections, such as blood for transfusion purposes, physiological salt solutions, glucose solutions and other fluids in the field of medicine, the container may be employed as a package for these fluids which are retained in sterile condition and ready for use.

The neck of the container is provided with a stopper 16 preferably formed of rubber and serving as a support for the air washing member. The inner surface of the stopper 16 is provided with an upstanding boss 17. A bore 18 extends vertically through the stopper and through the boss member 17. The outer surface of the stopper is preferably equipped with a depending annular flange 19 forming the end of a cylindrical bore 20 extending vertically through the stopper. As shown in Fig. 2, the container is preferably packaged with an air inlet tube 21 mounted in the bore 20 of the stopper and extending to substantially the bottom of the container. The annular flange 19 extends to the gasket 15 and forms a seal therewith, preventing overflow of the liquid when the cap 14 is removed.

After the cap 14 and seal 15 have been removed, it will be seen that a liquid dispensing tube 22 may be readily inserted in the bore 18 of the stopper. The tubes 21 and 22 are preferably formed of glass, and a frictional engagement between the rubber stopper and the glass tubes will suffice to retain them in the proper position. It will be understood, however, that the tubes may be of metal, plastics, such as transparent resinous materials, hard rubber or glass, as may be deemed expedient. The liquid duct 22 is preferably provided with a beaded end 23 extending slightly below the bottom of the stopper 16, upon which a tube 25 provided with pinch means (not shown) to prevent premature flow of the liquid, is secured. As shown in Fig. 1, the inner end of the liquid duct 22 preferably extends somewhat above the top of the stopper, but in the event the duct is not properly inserted in the stopper, boss 17 forms a sedimentation zone below its upper level, preventing the draw-off of liquid within this zone which may possibly contain minute particles of foreign matter.

The improved cap 30, adapted to be removably secured to the stopper 16 after the closure 14 is removed as shown in Fig. 1, comprises a cylindrical body portion 26 forming an air washing chamber 27 and a wing portion 28 in which is formed an overflow chamber 29 open to the atmosphere at its top. The cap 30 may be formed of glass, metal or a synthetic resin, and is preferably transparent. The air washing chamber 27 has a depending well portion 31, and a duct 32 of constricted diameter extends downwardly from the bottom of the overflow chamber 29 into the well 31, connecting the overflow chamber 29 and the air washing chamber 27. The cylindrical walls 26 of the air washing chamber 27 are extended above the overflow chamber 29, and the inner diameter of the walls 26 is substantially the same as the outer diameter of the walls forming the annular depending flange 19. It will thus be seen that the cap 30 is frictionally secured to the rubber annular flange 19, and that an uninterrupted passage for incoming air is formed by means of the overflow chamber 29, duct 32, the air washing chamber 27 and the air inlet tube 21 which is open at its top, in the inverted position of the container.

The embodiment of Fig. 2 is substantially the same as Fig. 1, and it is to be understood that the cap 30 may be secured to the depending annular flange 19 of the stopper when the closure 14 and the gasket 15 are removed. The air inlet tube 21 of the embodiment of Fig. 2 is provided with an enlarged portion 33, which may be ovaloid, as shown, or may be substantially spherical, and is adapted to serve as a secondary air washing chamber.

In practice, the device is preferably delivered to the user in the package form shown in Fig. 2, containing sterile liquid to be dispensed. The closure 14 and the sealing member 15 are removed while the container is in an upright position, and the presterilized liquid dispensing tube 22 and the cap 30 are attached in the manner described.

In the upright position of the container, it will be apparent that the liquid to be dispensed will enter the tube 21 through its open end 34 and will approximately seek its level in the tube 21, which will be at a surface slightly below the neck of the bottle.

Upon inversion of the container E, the container is placed in a suitable holder (not shown), and it will be apparent that some of the liquid will drip or flow from the tube 21 into the air washing chamber 27, through the port 32 and partially enter the overflow chamber 29 until the atmospheric pressure on the liquid in the overflow chamber 29 equalizes the pressure of the liquid head in the chamber 27.

The overflow chamber 29 is preferably designed to hold less liquid than the washing chamber 27, since in operation all of the liquid in the chamber 29 will be returned to the washing chamber.

Upon releasing the flow control means (not shown) on the tube 25, the liquid within the container flows by gravity downwardly through the dispensing tube 22 and the conveyor tube 25 to an injection needle or to any other place of its employment which may be surgical, industrial or otherwise. When the level of the liquid in the container E reaches the upper end of the dispensing tube 22, the flow ceases and in case the dispensing tube does not extend above the boss 17, the boss serves to form a sedimentation zone below its upper level from which liquid cannot be conveniently removed.

As the container E empties, an area of reduced pressure is formed in the container at its top in the inverted position shown, and the atmospheric pressure on the overflow chamber 29 forces the liquid therein back through the port 32 into the air washing chamber 27. The incoming air through the chamber 29 and port 32 bubbles up through the wash liquid in the chamber 27 with considerable ebullition and receives a thorough washing and cleansing before passing upwardly through the tube 21 to the top of the container. Thus, when the air escapes into the container proper, it is free from dust, lint or other foreign material which may be entrained in the air and which are retained in the wash liquid. The overflow chamber 29 serves to collect the liquid and prevents it from spurting out into the open.

In employing the embodiment shown in Fig. 2, it will be seen that a portion of the liquid to be dispensed will be retained in the chamber 33, due to the rather constricted diameter of the air inlet tube, and that this liquid will provide a secondary wash for the incoming air or gas which

receives a preliminary wash in the chamber 27 of the cap 30. During the dispensing operation the liquid in the chamber 33 tends to gradually gravitate into the lower chamber 27, due to the pumping action of the incoming air, and the chamber 27 is of sufficient volume to contain all of the wash liquid.

The embodiments of Figs. 3, 4 and 5 are quite similar in construction to Figs. 1 and 2, in that they employ similar air inlet tubes 21, similar caps 30 depending from a stopper in the container and liquid dispensing tubes 22 also secured to the stopper. The embodiment of Fig. 3 is shown in the packaged form with the gasket 15 and closure 14. The stopper 35, preferably formed of rubber, is provided with a plurality of bores 37 and 38 extending vertically therethrough, and the stopper extends substantially to the top of the bottle in its upright position. The bore 37 is provided with an annular groove 39 adapted to form a seat for the beaded tip 40 of the liquid dispensing tube 22, as shown in Fig. 4. The bottom of the stopper, in the inverted position of the container, is equipped with an annular slotted portion 41 concentric with the bore 38. As shown in Fig. 4, the upper extended cylindrical walls 26 of the cap 30 are adapted to be frictionally seated within the annular slot 41. A small annular depending flange 42 surrounds the lower portion of the bore 37 and forms a liquid-tight seal with the disc 15. The upper end of the stopper 35 is provided with a boss 43 surrounding the bore 37 and forming a sedimentation zone within the container E below the upper level of the boss.

The stopper of the embodiment shown in Fig. 4 is similar to that of Fig. 3 but is of shortened height and, accordingly, does not extend to the top of the neck of the container E, in its upright position.

In operation, the constructions of Figs. 3 and 4 dispense liquid contained therein and wash the incoming air in the same manner as previously described in connection with the embodiment of Fig. 1.

The stopper 45, preferably formed of rubber, employed in the embodiment shown in Fig. 5, differs in certain details from the stoppers employed in the embodiments of my improved liquid dispensing device previously described. In common with the stoppers previously described, a bore 46 extends vertically through the stopper, is adapted to retain a liquid dispensing tube 22 and is provided with an enlarged boss 47 at its upper end. A second bore 48, spaced apart from the first mentioned bore, likewise extends vertically through the stopper and is provided at an intermediate point with a groove adapted to retain and form a seat for the beaded end 49 of the air inlet tube 21. The lower portion 50 of the bore 48 is of increased diameter, and of substantially the same diameter as the outer diameter of the upper portion of the cap 30, and, as shown in Fig. 5, the cap 30 is adapted to be frictionally retained in the lower portion of the bore 50. The cap 30 is similar in construction to the caps providing an air washing chamber 27 and a connected overflow chamber 29, previously described, but is provided with a somewhat elongated cylindrical wall 51. In operation, this embodiment of the liquid dispensing device functions in the manner previously described in connection with the operation of the embodiment of Fig. 1.

The embodiments of my improved liquid dispensing device shown in Figs. 6 and 7 are somewhat similar to the embodiment of Fig. 1, in that the containers are equipped with stoppers 16 having a plurality of vertical bores, adapted to support a liquid dispensing tube 22 and air inlet tubes 55 and 56, respectively, and a depending annular flange 19 adapted to removably support a cap 30 having a washing chamber 27 and overflow chamber 29. In the embodiment of Fig. 6 the open ended air inlet tube 55 extending substantially to the bottom of the chamber is provided with a plurality of enlarged portions 57 and 58. As shown, the enlarged portions 57 and 58 are substantially spherical, but it is to be understood that they may be ovaloid in shape. The enlarged chamber 57 is disposed adjacent the stopper 16, while the chamber 58 is adjacent the bottom of the container. It will thus be seen that in the upright position of the container the air inlet tube will house a greater volume of the liquid to be dispensed than will the air inlet tube 21 of Fig. 1. Accordingly, the air washing chamber 27 and the overflow chamber may be made a little larger than the corresponding chambers in Fig. 1, and it will be seen that, upon inversion of the container, a portion of the liquid to be dispensed will be retained in the chamber 57 and will serve to provide a secondary wash liquid for the incoming air, which receives a preliminary wash in the chamber 27, in the manner previously described in connection with the operation of the embodiment of Fig. 1, the operation of this embodiment being similar to that of Fig. 1. The expansion chamber 58 serves to prevent the possibility of any of the wash liquid being forced from the air inlet tube back into the container by a sudden unexpected upsurge of air within the tube 55.

In the embodiment of Fig. 7 the air inlet duct 56 extends substantially the length of the container and comprises, in its inverted position, a lower portion 59 and an upper portion 60 of greater diameter than the lower portion 59. The enlarged air inlet tube 60 serves to provide an increased volume of washing liquid above that provided in the embodiment of Fig. 1, and the enlarged portion 60 of the tube provides an elongated expansion chamber adapted to prevent overflow of the wash liquid into the container upon resurging of the air, causing violent ebullition of the washing liquid within the lower portion 59 of the dispensing tube. In operation, the dispensing devices of Figs. 6 and 7 function in the manner described in detail in connection with the embodiment of Fig. 1.

While the novelty of the construction has been emphasized in the field of medicine in the dispensing of parenteral and other fluids and solutions, it will be understood that my improved device is not limited to such use but that the dispensing device has a wide field of utility, which will be readily apparent to those skilled in the art.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention, as disclosed in the appended claims in which it is my intention to claim all novelty inherent in my invention as broadly as permissible, in view of the prior art.

Having thus described my invention and illus-

trated its use, what I claim as new and desire to secure by Letters Patent is:

1. Liquid dispensing apparatus comprising a container housing liquid to be dispensed and operable upon inversion, a stopper disposed in the neck of said container, a plurality of bores extending vertically through said stopper, a liquid dispensing tube removably inserted in one of said bores, an air inlet tube removably inserted in another of said bores and extending farther into said container than said liquid dispensing tube, and an air washing assembly removably secured to and depending from said stopper outside of said container and communicating with said air inlet tube, said assembly comprising an air washing chamber and an overflow chamber open to the atmosphere and connected to said air washing chamber, said air washing chamber being adapted to receive and retain a portion of the liquid to be dispensed upon inversion of the container, said liquid portion serving as a washing medium for the incoming air.

2. Liquid dispensing apparatus comprising a container housing liquid to be dispensed and operable upon inversion, a stopper disposed in the neck of said container, a liquid dispensing tube removably mounted within said stopper, an air inlet tube within said container and removably seated in said stopper, an annular slot in said stopper extending upwardly from the lower surface thereof and concentric with said air inlet tube, and an air washing assembly having elongated cylindrical walls, the upper portion of which are adapted to be frictionally retained in said slot, said assembly comprising an air washing chamber and an overflow chamber connected to said air washing chamber.

3. Liquid dispensing apparatus comprising a container housing liquid to be dispensed and operable upon inversion, a stopper disposed in the neck of said container, a pair of bores extending vertically through said stopper, one of said bores being provided with an annular groove at an intermediate point therein, a liquid dispensing tube having a beaded end removably carried in said bore, the beaded end of said tube engaging said groove, an air inlet tube removably disposed in the second of said bores, an annular slot extending upwardly from the lower surface of said stopper and concentric with said air inlet tube, and an air washing assembly depending from said stopper and communicating with said air inlet tube, said assembly comprising an air washing chamber and an overflow chamber connected to said air washing chamber, the walls of said air washing chamber being elongated and adapted to be frictionally retained in said annular slot.

4. Liquid dispensing apparatus comprising a container housing liquid to be dispensed and operable upon inversion, a stopper disposed in the neck of said chamber, a pair of bores extending vertically through said stopper, a liquid dispensing tube removably mounted in one of said bores, an air inlet tube removably mounted within said container in the upper portion of the other bore, the lower portion of said last mentioned bore being of increased diameter, and an air washing assembly depending from said stopper and communicating with said air inlet tube, said assembly comprising an air washing chamber and an overflow chamber connected to said air washing chamber, the walls of said air washing chamber being of substantially the same diameter as the diameter of the lower portion of said second mentioned bore and adapted to be frictionally retained therein.

5. Liquid dispensing apparatus comprising a container housing liquid to be dispensed and operable upon inversion, a stopper disposed in the neck of said container, a liquid dispensing tube removably carried in said stopper, an air inlet tube within said container and removably seated in said stopper, said air inlet tube being provided with a plurality of spaced apart chambers, the lower of said chambers, in the inverted position of said container, being adapted to serve as a supplemental air washing chamber and the upper of said chambers serving as an expansion chamber, and an air washing assembly removably secured to and depending from said stopper and communicating with said air inlet tube, said assembly comprising an air washing chamber and an overflow chamber connected to said air washing chamber.

6. Liquid dispensing apparatus operable upon inversion, comprising a container housing liquid to be dispensed, a stopper in the neck of said container, a plurality of bores extending vertically through said stopper, a liquid dispensing tube removably inserted in one of said bores, an air inlet tube removably inserted in the other of said bores and extending farther into said container than said liquid dispensing tube, a plurality of expanded portions spaced from each other in said air inlet tube within said container forming chambers adapted to retain a portion of the liquid to be dispensed upon inversion of said container and to wash said incoming air, and an air washing assembly removably secured to and depending from said stopper and communicating with said air inlet tube, said assembly comprising an air washing chamber and an overflow chamber connected to said air washing chamber.

7. Liquid dispensing apparatus comprising a container housing liquid to be dispensed and operable upon inversion, a stopper disposed in the neck of said container, a plurality of bores extending vertically through said stopper, a liquid dispensing tube removably inserted in one of said bores, an air inlet tube removably inserted in another of said bores and extending farther into said container than said liquid dispensing tube, and an air washing assembly removably secured to and depending from said stopper outside of said container and communicating with said air inlet tube, said assembly comprising an air washing chamber and an overflow chamber open to the atmosphere and connected to said air washing chamber, said air washing chamber being adapted to receive and retain a portion of the liquid to be dispensed upon inversion of the container, said liquid portion serving as a washing medium for the incoming air, the outer surface of said stopper being provided with an annular flange adapted to frictionally retain said air washing assembly.

8. Liquid dispensing apparatus comprising a container housing liquid to be dispensed and operably upon inversion, a stopper disposed in the neck of said container, a plurality of bores extending vertically through said stopper, a liquid dispensing tube removably inserted in one of said bores, an air inlet tube removably inserted in another of said bores and extending farther into said container than said liquid dispensing tube, and an air washing assembly removably secured to and depending from said stopper outside of said container and communicating with said air

inlet tube, said assembly comprising an air washing chamber and an overflow chamber open to the atmosphere and connected to said air washing chamber, said air washing chamber being adapted to receive and retain a portion of the liquid to be dispensed upon inversion of the container, said liquid portion serving as a washing medium for the incoming air, said air washing chamber being provided with elongated walls adapted to be frictionally secured to said stopper.

9. Liquid dispensing apparatus comprising a container housing liquid to be dispensed and operable upon inversion, a stopper disposed in the neck of said container, a plurality of bores extending vertically through said stopper, a liquid dispensing tube removably inserted in one of said bores, an air inlet tube removably inserted in another of said bores and extending farther into said container than said liquid dispensing tube, said air inlet tube being provided with an expanded portion within said container forming a chamber adapted to retain a portion of the liquid to be dispensed upon inversion of said container for washing said incoming air, and an air washing assembly removably secured to and depending from said stopper outside of said container and communicating with said air inlet tube, said assembly comprising an air washing chamber and an overflow chamber open to the atmosphere and connected to said air washing chamber, said air washing chamber being adapted to receive and retain a portion of the liquid to be dispensed upon inversion of the container, said liquid portion serving as a washing medium for the incoming air.

10. Liquid dispensing apparatus comprising a container housing liquid to be dispensed and operable upon inversion, a stopper disposed in the neck of said container, a plurality of bores extending vertically through said stopper, a liquid dispensing tube removably inserted in one of said bores, an air inlet tube removably inserted in another of said bores and extending farther into said container than said liquid dispensing tube, said air inlet tube extending substantially the length of said container, the upper portion of said tube, in the inverted position of said container, being of greater diameter than the lower portion of said tube within said container, anl an air washing assembly removably secured to and depending from said stopper outside of said container and communicating with said air inlet tube, said assembly comprising an air washing chamber and an overflow chamber open to the atmosphere and connected to said air washing chamber, said air washing chamber being adapted to receive and retain a portion of the liquid to be dispensed upon inversion of the container, said liquid portion serving as a washing medium for the incoming air.

MARTIN C. SCHWAB.