March 12, 1957 K. M. FREWIN 2,785,012

MEANS FOR MIXING SOLUTIONS WITH FLOWING LIQUIDS

Filed Nov. 22, 1954 2 Sheets-Sheet 1

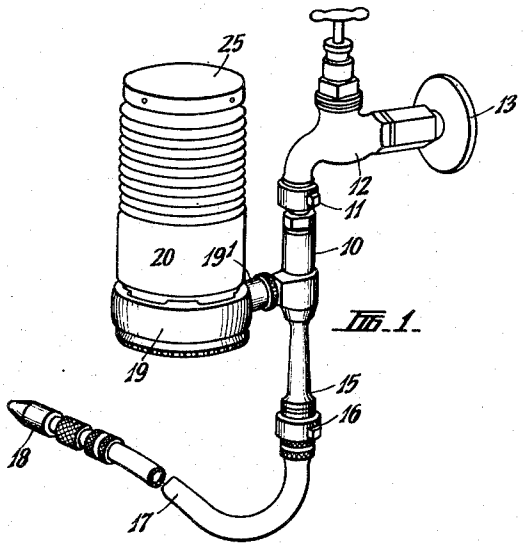

Fig. 1.

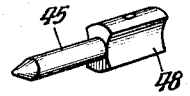

Fig. 10.

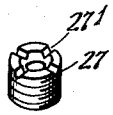

Fig. 6.

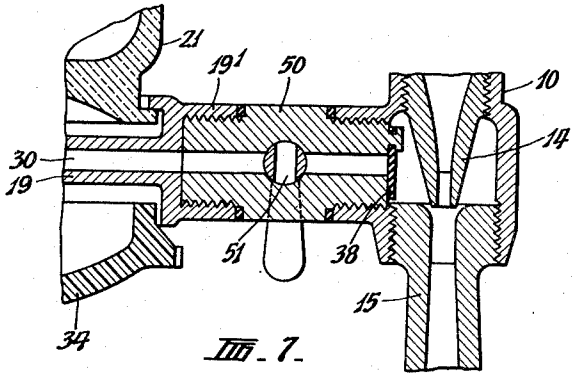

Fig. 7.

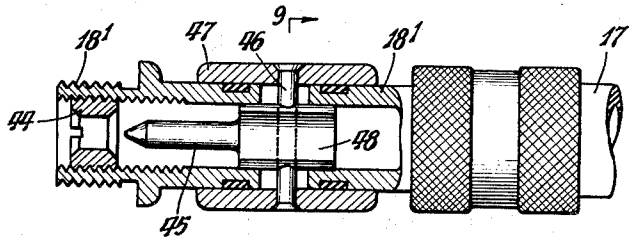

Fig. 8.

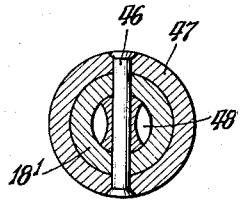

Fig. 9.

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2 Sheets-Sheet 2

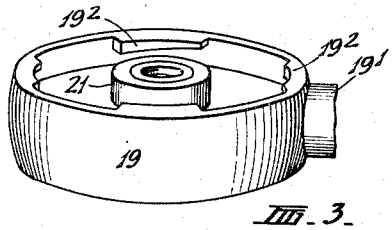

Fig. 3.

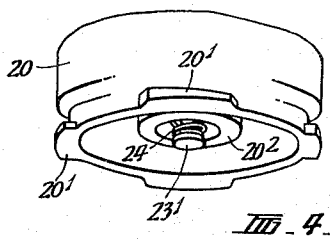

Fig. 4.

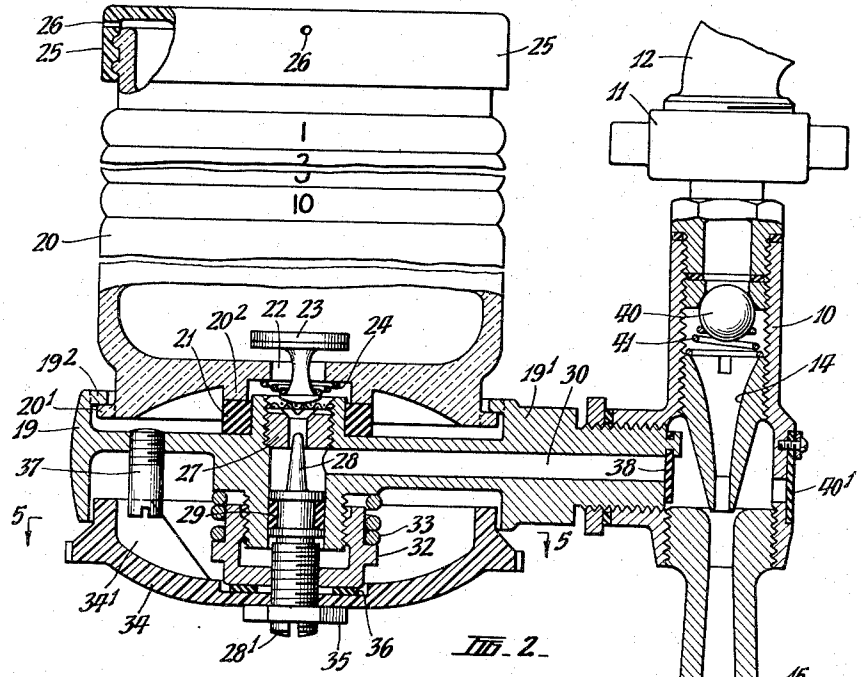

Fig. 2.

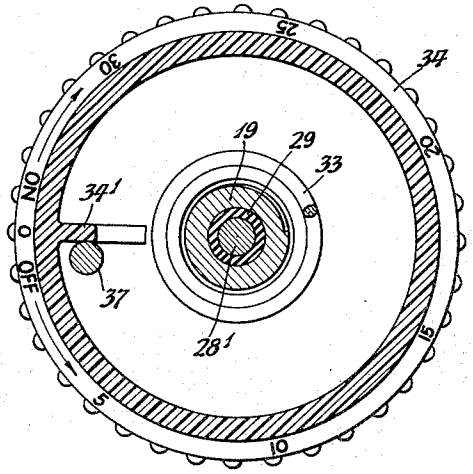

Fig. 5.

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MEANS FOR MIXING SOLUTIONS WITH FLOWING LIQUIDS

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Claims priority, application Australia December 3, 1953

12 Claims. (Cl. 299—84)

This invention relates to apparatus for continuously mixing a required proportion of a treatment liquid with a flowing body of water or other liquid.

The object of the invention is to provide improved apparatus for the aforesaid purpose which is simple and effective in construction and which is suitable for a wide variety of different uses.

Accordingly the invention includes mixing apparatus comprising a receptacle for a treatment liquid, a suction passage connecting the receptacle to a reduced pressure zone of a delivery passage through which water or other liquid flows under pressure and means for regulating the rate of flow of the treatment liquid through the suction passage to the said delivery passage.

Preferably non-return valves are provided for preventing reverse flows of liquid through the said suction and delivery passages.

The said reduced pressure zone is produced within the delivery passage by providing therein a venturi or other constriction to form a jet pump. Preferably the said jet pump comprises a converging nozzle and a separately formed coaxially arranged diverging nozzle, the said nozzles being adjustable towards and from each other to regulate the operation of the pump.

The said means for regulating the rate of flow of the treatment liquid preferably comprises a manually operable needle valve.

An important feature of the preferred embodiment of the invention resides in detachably supporting the receptacle on and above a holder therefor and in providing the bottom of the receptacle with a normally closed spring-actuated discharge valve which automatically opens when the receptacle is being connected to the holder whereby the treatment liquid may pass from the receptacle to the suction passage in the holder.

Preferably the holder and the adjacent lower end of the receptacle are formed with coacting projections such as interrupted screw threads to enable the receptacle to be quickly and securely attached and sealed to the holder.

The invention further includes the combination with mixing apparatus as above set forth of adjustable nozzle means at the downstream side of the aforesaid jet pump thereby the back pressure of the liquid mixture may be regulated to permit of the remote control of the discharge of the treatment liquid as hereinafter further described.

Another important feature of the invention resides in the construction of the apparatus as a unit which is adapted for ready attachment as such to a pipe line and which is simple and convenient to use.

Still further features of the invention are hereinafter set forth.

In the drawings:

Figure 1 is a perspective view showing a representative application of mixing apparatus embodying the invention in its preferred form.

Figure 2 is a view in vertical section of the apparatus shown in Figure 1.

Figure 3 is a view in sectional plan taken on the line 3—3 of Figure 2.

Figure 4 is a perspective view of a receptacle holder.

Figure 5 is a perspective view of the lower end of the receptacle.

Figure 6 is a perspective view of a plug.

Figure 7 is a view in sectional elevation and shows a modification.

Figure 8 is a view in longitudinal section of a discharge nozzle.

Figure 9 is a view in cross section taken on the line 9—9 of Figure 8, and

Figure 10 is a view in perspective of the valve member shown in Figures 8 and 9.

The mixing apparatus shown in Figures 1 and 2 comprises an upper tubular body member **10** of irregular T form provided at its upper end with a union fitting **11** by which it is detachably secured to a bib cock **12** on a water service pipe **13**.

The body **10** is screwthreaded internally for engagement by an external screwthread on a downwardly convergent nozzle **14**, the lower end of which projects slightly into the reduced upper end of a downwardly divergent nozzle **15** arranged coaxially therewith, this nozzle **15** being formed separately from the body member **10** and having a screwthreaded engagement with the lower end of the latter. The lower end of the nozzle **15** is fitted with a union **16** by which it is detachably connected to a flexible hose **17** having a discharge nozzle **18** at its opposite end.

The lateral branch of the body **10** is screwthreaded internally to receive the free end of a lateral branch 19^1 on a receptacle holder **19** of shallow cylindrical form arranged with its axis disposed vertically.

A vertical receptacle **20** for a treatment liquid is detachably supported on top of the holder **19** for which purpose the latter is provided at the top with a circular recess to receive the lower end of the receptacle and the wall of this recess is formed with a plurality of spaced inward projections 19^2 having inclined lower surfaces to engage corresponding outward projections 20^1 on the lower end of the receptacle. These coacting projections serve as interrupted screwthreads by means of which the receptacle may be quickly secured to and removed from the holder and which enable a concentric flange 20^2 on the lower end of the receptacle to be forced tightly against a rubber sealing ring **21** fitted centrally to the top of the holder.

The bottom of the receptacle is provided with a discharge opening **22** arranged centrally within the flange **20** and this opening is automatically closed, when the receptacle is detached, by means of a disc valve **23** formed with a depending stem 23^1, the projecting end of which is urged downwardly by a compression spring **24**.

The upper end of the receptacle is screwthreaded externally to receive a closure cap **25** provided near the upper end of its skirt with a plurality of air holes **26** whereby when the cap is partly unscrewed the upper end of the receptacle communicates freely with the surrounding atmosphere and thus permits liquid to flow freely through the discharge opening **22**. Preferably and as indicated in the drawings, the receptacle is formed of glass or other transparent material and is suitably calibrated so that the quantity of liquid therein may be observed.

The holder **19** is formed with an axial hole which extends completely therethrough and the upper end portion of this hole is screwthreaded to receive a plug **27** having a central hole of smaller diameter to coact with the upper end of a needle valve **28** formed on the upper end of a stem 28^1 which is screwthreaded at its lower

end and which projects from the holder. The stem is provided above the screwthread with a rubber sealing ring 29 to prevent downward leakage of the liquid.

A radial suction passage 30 formed in the holder and extending centrally through the lateral branch 19¹ thereof communicates at its inner end with the vertical axial hole immediately below the plug 27 and above the sealing ring 29.

The upper end of the plug 27 serves as a seating for a strainer disc of wire gauze and when the receptacle 20 is fitted to the holder, the receptacle discharge valve 23 is maintained in its open position by the depending stem 23¹ which rests on the strainer disc as shown in Figure 2. In order that the liquid discharge from the receptacle may pass freely through the strainer disc and into the central hole in the plug 27, the upper end of the said hole is preferably flared as shown in Figures 2 and 6, while the upper face of the plug is formed with a plurality of radial channels 27¹.

The projecting lower end of the needle valve stem 28¹ extends through a screwthreaded hole formed centrally in a cap 32 having an internally threaded skirt which engages a correspondingly screwthreaded boss on the lower face of the holder 19 and a compression spring 33 is interposed between the holder and a circumferential flange on the cap whereby the latter is normally retained in any desired position of adjustment.

A handwheel 34 which is preferably moulded from plastic material is arranged below the cap 32 and is clamped securely to the latter by a nut 35 fitted to the projecting lower end of the needle valve stem while a washer 36 of suitable frictional material is interposed between the cap and the handwheel whereby these parts are normally constrained to move in unison.

An eccentric stop pin 37 which depends from the lower face on the holder 19 coacts with a radial rib 34¹ on the upper face of the handwheel whereby the movement of the latter in either direction is limited to a little less than one complete turn. Thus when the handwheel is turned in either direction the screwthreaded cap 32 and the needle valve 28 are moved in unison therewith, whereby the latter is raised or lowered relatively to the plug 27 according to the direction in which the handwheel is moved. Preferably when the handwheel is turned to the limit of its movement in one direction the needle valve seats against the lower end of the plug and completely closes the central passage therein while when the handwheel is moved to its other extreme position the needle valve is opened to its maximum extent. It will be noted that the position of the needle valve relatively to the screwthreaded cap 32 may be adjusted by releasing the lock nut 35 and by then screwing the needle valve inwardly or outwardly, the lower end of the needle valve being provided with a sawcut for this purpose.

Preferably and as indicated in Figure 3 of the drawings, the periphery of the handwheel is provided with graduations arranged to register with an index line on an adjacent portion of the holder 19 and thereby facilitate the setting of the needle valve in any required position.

The free outer end of the lateral branch 19¹ of the receptacle holder is fitted with a flap valve 38 comprising a disc of flexible material attached to an eccentric projection on the end of said branch 19¹ so as to cover the discharge end of the suction passage 30. This flap valve 38 thus prevents the reverse flow of liquid from the body 10 into the holder 19 but readiy permits of the outward flow of liquid through the suction passage.

A ball valve 40 arranged above the downwardly convergent nozzle 14 within the upper portion of the body 10 is urged upwardly by a spring 41 whereby it normally engages a seating provided therefor in a tubular plug 42 disposed thereabove. This non-return valve therefore prevents the passage of liquid upwardly through the body 10 and into the cock 12 to avoid the risk of contaminating the service supply.

In addition the wall of the suction chamber at the lower end of the body 10 is preferably formed with a vent hole which is normally closed by a flap valve 40¹ or other suitable valve which automatically opens when the pressure in the chamber rises to a value which is less than that necessary to produce a reverse flow of liquid into the service pipe. See Figure 2. When the valve 40¹ is provided the non-return valve 40 may be omitted if desired.

It will be apparent from Figures 1 and 2 that the described apparatus comprises a self-contained unit adapted for rapid attachment as such as to a water supply service and that the receptacle 20 may be quickly and easily removed and replaced by a similar receptacle containing a different treatment liquid.

In use therefore, when the bib cock 12 is opened, water flows downwardly through the body 10 of the mixing device and thence into and through the hose 17.

Thus the water passes in the form of a high velocity jet from the reduced lower end of the convergent nozzle 14 into the reduced upper end of the divergent nozzle 15 thereby producing a low pressure zone in the suction chamber at the entrance to the latter. Consequently if the needle valve 28 is opened, liquid flows continuously from the receptacle 20 at a rate determined by the setting of that valve and thence through the suction passage 30 and past the flap valve 38 into the upper end of the divergent nozzle 15 where it mixes with the stream of water to produce a solution of the required concentration.

It will be noted that the relative position of the convergent and divergent nozzles 14 and 15 may be adjusted to obtain optimum results from the jet pump under the particular condition in which it is used.

The apparatus is capable of a wide variety of different applications and thus may be used in the home, for example, to deliver cleansing solutions to a kitchen sink or to a bath or shower or to deliver disinfecting or deodorising solutions to a toilet or the like. It may likewise be used for producing solutions for foam washing, particularly of motor vehicles while in addition it is capable of many useful applications for industrial and other purposes such as for gardening operations in which it may be used for the application of fertilisers, hormones or trace elements. For some of these purposes it is sometimes advantageous to attach the mixing device to the service supply by a flexible hose to enable it to be carried from place to place by the user and permit of the regulation of the dosage adjacent to the discharge nozzle.

However the incorporation of the treatment liquid may be remotely controlled by regulating the back pressure of the liquid at the discharge side of the mixing device so as to regulate correspondingly the pressure which exists in the low pressure zone of the jet pump. This result is preferably obtained by using a discharge nozzle 18 which is adjustable so as to vary the effective size of the discharge opening thereof.

Thus referring to Figures 8, 9 and 10 which show one suitable construction of adjustable discharge nozzle, the cylindrical casing 18¹ is provided internally near its discharge end with a longitudinally adjustable restrictor plug 44 formed with an axial hole of suitable diameter. An axially slidable control valve 45 arranged within casing 18¹ has a pointed forward end capable of projecting into the plug 44 while its rearward end is of larger diameter and is secured by a diametrical pin 46, which extends through longitudinal slots in the casing, to an external sleeve 47 which is slidable thereon. The said rearward end of the valve is formed with an opposed pair of longitudinal grooves 48 which constitute water-ways.

Thus as the control valve is moved forwardly so that the pointed end thereof enters the axial passage in the restrictor plug 44, the back prssure of the liquid is progressively increased whereby the pressure at the suction zone of the jet pump is correspondingly increased. Consequently when the back pressure is increased to a sufficient extent the discharge of the treatment liquid ceases

notwithstanding that water continues to flow though at a reduced rate through the discharge nozzle.

Thus it is possible, for example, when watering a garden by means of a hose, to regulate the back pressure by means of the discharge nozzle so that the mixing device is operative when required. It will be evident that in lieu of using a slidable valve as shown in Figures 8, 9 and 10, an equivalent result may be obtained in other ways, such as by means of an angularly movable valve member.

It will be apparent from the preceding description that receptacles 20 containing different treatment liquids may be successively attached to the holder of the mixing device to enable the latter to be used for a wide variety of different purposes.

In the minor modification shown in Figure 7, a connector piece 50 is interposed between the holder 19 and the body 10 of the mixing device and a plug valve 51 is incorporated therein so that the discharge of the treatment liquid may be positively prevented when required.

It will of course be evident that the mixing apparatus herein described instead of being connected to a bib cock or other outlet valve may be arranged at any suitable position within the length of a pipe line leading to a shower, toilet or other device and that such apparatus may be arranged at either side of a suitable valve for controlling the flow of the water or other liquid through the pipe line.

I claim:

1. Mixing apparatus comprising a convergent nozzle, a divergent nozzle arranged in coaxial alignment with the convergent nozzle with the discharge end of the latter arranged adjacent to the inlet end of the divergent nozzle, means adjustably connecting the nozzles whereby they are movable axially towards and from each other means forming a suction chamber around and communicating with the adjacent inner ends of the nozzles, means forming a holder which projects laterally with respect to the nozzles to support a superposed receptacle for a treatment liquid, means on the holder for releasably clamping the lower end of the receptacle thereto, a compressible sealing member on the holder to engage the bottom of the receptacle and form a liquid-tight seal around a discharge opening therein, the holder being formed with a suction passage to connect the discharge opening of the receptacle to the suction chamber, a valve mounted in the holder and coaxially with the receptacle, an actuating member for the valve, such actuating member being arranged below the holder whereby the said valve may be adjusted to regulate the flow of liquid through the suction passage, a non-return valve to prevent the reverse flow of liquid through the suction passage, the wall of the said suction chamber being formed with a discharge opening and a valve normally closing the discharge opening and arranged to open if the pressure in the suction chamber rises above a predetermined value thereby to prevent the reverse flow of liquid through the convergent nozzle.

2. Mixing apparatus comprising body means having therein a liquid delivery passage which is open at each end, the said passage including a convergent portion and a coaxially arranged divergent portion with the inlet end of the latter disposed adjacent to the discharge end of the convergent portion, the body means being formed with a suction chamber which surrounds and communicates freely with the adjacent ends of the said convergent and divergent portions of the said passage, the said body means having a laterally projecting portion forming a holder, a receptacle arranged above and supported on the holder, coacting means on the holder and receptacle for detachably securing the latter to the holder, a spring-loaded valve in the bottom of the receptacle, means on the holder and coacting with the said valve to retain the latter in its inoperative position thereby to uncover a discharge opening in the receptacle, the said body means being formed with a suction passage which communicates at one end with the said discharge opening and at its other end with the said suction chamber, a regulating needle valve mounted in the holder coaxially with the receptacle to control the rate of flow of the liquid through the suction passage, an angularly movable operating member for the valve disposed coaxially therewith and below the holder and stop means arranged to prevent the operating member from turning through more than one complete revolution.

3. Mixing apparatus comprising a body formed with a liquid delivery passage which is open at both ends thereof and which has a suction zone at an intermediate position therein, a holder projecting from the body, means on the holder providing an annular area for fluid tight sealing engagement with the adjacent end of a detachable receptacle for a treatment liquid, the said holder being formed with a suction passage which extends from the said suction zone to an inlet port within the said annular area, abutment means on the holder and within the said annular area for engagement by a discharge valve in the receptacle and a valve operable to regulate the rate of flow of the treatment liquid through the said suction passage.

4. Mixing apparatus comprising a body having a liquid delivery passage extending therethrough, the said delivery passage comprising a convergent nozzle and a divergent nozzle arranged in series, with the discharge end of the convergent nozzle disposed adjacent to the inlet end of the divergent nozzle, the said body being also formed with a suction chamber which communicates with the said adjacent ends of the nozzles, a holder projecting from the body, means on the holder providing an annular area for supporting, and effecting a fluid tight engagement with, the adjacent lower end of a superposed receptacle for a treatment liquid, means on the holder and disposed outwardly of the said annular sealing area for detachably engaging the receptacle and maintaining it in firm contact with the said annular area, the holder being formed with a suction passage which connects the suction chamber to an inlet port within the said annular area, abutment means on the holder and within the said annular area for engagement by a discharge valve in the bottom of the receptacle, a valve operable to regulate the flow of liquid through the suction passage and a non-return valve to prevent the reverse flow of liquid through the said suction passage.

5. Mixing apparatus comprising a body having a liquid delivery passage extending therethrough, the delivery passage having a suction zone arranged intermediate the ends thereof, a holder projecting laterally from the body, an annular member of compressible material on the holder for sealing engagement with the adjacent end of a receptacle for a treatment liquid, means on the holder and disposed outwardly of the said annular member for detachably engaging the receptacle and for pressing the adjacent end thereof firmly against the said annular member, the holder being formed with a suction passage which extends from the said suction zone to an inlet port arranged within the said annular member, an adjustable valve in the holder to regulate the flow of liquid through the suction passage, and a non-return valve to prevent reverse flow of liquid through the inlet end of the said delivery passage.

6. Mixing apparatus comprising body means formed with a liquid delivery passage which is open at each end, the said delivery passage comprising a convergent nozzle and a diverging nozzle arranged in coaxial alignment and wherein the discharge end of the converging nozzle is disposed adjacent to the inlet end of the diverging nozzle, the said body means being formed with a suction chamber which surrounds and communicates with the adjacent inner ends of the nozzles, the said body means also including a holder which projects laterally with respect to the axis of the nozzles, means on the holder, providing an upwardly facing annular area for fluid tight sealing engagement with the adjacent end of a receptacle for

a treatment liquid, upstanding means surrounding and spaced from the said annular sealing area for detachably engaging the receptacle and for pressing the latter into firm contact with said annular area, the said body means being formed with a suction passage which extends from the suction chamber to an inlet port located within the said annular sealing area, valve abutment means on the holder for engagement by a discharge valve in the adjacent lower end of the receptacle, an adjustable valve in the holder to regulate the flow of liquid through the suction passage and a non-return valve arranged to prevent the reverse flow of liquid through the suction passage.

7. Mixing apparatus comprising a body formed with a liquid delivery passage which is open at its opposite ends, a converging nozzle member adjustable axially within the said passage, a diverging nozzle arranged in coaxial alignment with the converging nozzle, the said diverging nozzle having its inlet end disposed adjacent to the discharge end of the converging nozzle, the body being formed with a suction chamber disposed adjacent to and communicating freely with the adjacent ends of the nozzles, a holder projecting outwardly from the body, a ring of compressible sealing material on the top of the holder for supporting, and effecting a fluid tight sealing engagement with the lower end of, a superposed detachable receptacle for a treatment liquid, an upstanding peripheral wall on the holder outwardly of the said sealing ring, inward projections on the said peripheral wall for retaining engagement with the said receptacle and adapted to press the latter firmly against the sealing ring, the holder being formed with a suction passage which extends from the suction chamber to an inlet port located within the sealing ring, abutment means on the holder and within the sealing ring for engagement by a discharge valve in the receptacle whereby the said discharge valve is open when the receptacle is attached to the holder, and a valve operable to regulate the flow of liquid through the suction passage.

8. Mixing apparatus comprising a rigid structure of generally T form having a liquid delivery passage extending through the head portion thereof, the said delivery passage comprising coaxially arranged convergent and divergent nozzles, the discharge end of the convergent nozzle being disposed adjacent to the inlet end of the divergent nozzle, the said head portion being also formed with a suction chamber which surrounds and communicates with the adjacent ends of the said nozzles, the stem portion of the structure constituting a holder, means on the top of the holder providing an annular area for supporting, and effecting a fluid tight sealing engagement with, a detachable superposed receptacle for a treatment liquid, upstanding means on the holder and located outwardly of the said annular area thereof for detachable retaining engagement with the receptacle, the said upstanding retaining means being adapted to press the receptacle firmly into sealing engagement with the said annular area, the structure being formed with a suction passage which extends from the said suction chamber to an inlet port located centrally within the said annular area, abutment means on the holder adjacent the inlet port for engagement by a discharge valve in the bottom of the receptacle, whereby the said discharge valve is open when the receptacle is connected to the holder, an adjustable valve operable to regulate the flow of liquid through the suction passage, a non-return valve arranged to prevent the return flow of liquid through the suction passage and a non-return valve arranged between the inlet end of the suction passage and the inlet end of the convergent nozzle to prevent the reverse flow of liquid through the latter.

9. Mixing apparatus comprising a body formed with a liquid delivery passage which is open at its opposite ends and having an intermediate suction zone, a holder projecting laterally from the body, a receptacle, for a treatment liquid, arranged above and supported by the holder, a ring of compressible material interposed between the receptacle and the holder and forming a fluid-tight seal therebetween, coacting means on the receptacle and the holder, disposed outwardly of the said ring and detachably retaining the receptacle to the holder the central portion at least of the bottom of the receptacle being disposed above the level of the rim thereof and being provided within the said sealing ring with a discharge opening, a spring actuated valve in the receptacle adapted to close the discharge opening when the receptacle is detached, an actuating stem depending from the valve through the discharge opening and having its lower end when fully projected disposed above the level of the said bottom rim of the receptacle, raised abutment means on the holder engaging the said stem and retaining the valve in its open position, the holder being formed with a suction passage which communicates at one end with the said suction zone and which terminates at its opposite end in an inlet port arranged within the said sealing ring and a valve operable to regulate the flow of treatment liquid through the said suction passage.

10. Mixing apparatus according to claim 9 including an angularly movable operating member for the said valve, the said operating member being disposed below the holder and substantially coaxially with the receptacle and stop means arranged to prevent the operating member from turning through more than one complete revolution.

11. Mixing apparatus according to claim 9 wherein the said coacting securing means on the receptacle and holder therefor comprise interengaging inclined members equivalent to interrupted screw-threads.

12. Mixing apparatus comprising a body having a liquid delivery passage extending therethrough, the delivery passage having a suction zone arranged intermediate the ends thereof, a holder projecting laterally from the body, a receptacle for a treatment liquid arranged above and supported by the holder and having a discharge opening in the lower end thereof, an annular sealing member of compressible material interposed between the holder and the lower end of the receptacle around the discharge opening in the latter, means on the holder and disposed outwardly of the said annular member for detachably engaging the receptacle and compressing the said sealing member, the holder being formed with a suction passage which extends from the said suction zone to an inlet port arranged within the said annular member, an adjustable valve in the holder to regulate the flow of liquid through the suction passage, a non-return valve to prevent reverse flow of liquid through the inlet end of the said delivery passage, a discharge pipe connected to the body to receive the liquid discharged from the delivery passage and adjustable restrictor means in the discharge pipe to permit of the regulation of the back pressure of the liquid within the said delivery passage.

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