

Feb. 11, 1947.

E. J. RIES ET AL

2,415,534

LIQUID MIXING DEVICE

Filed Feb. 18, 1944

2 Sheets-Sheet 1

Fig. 1

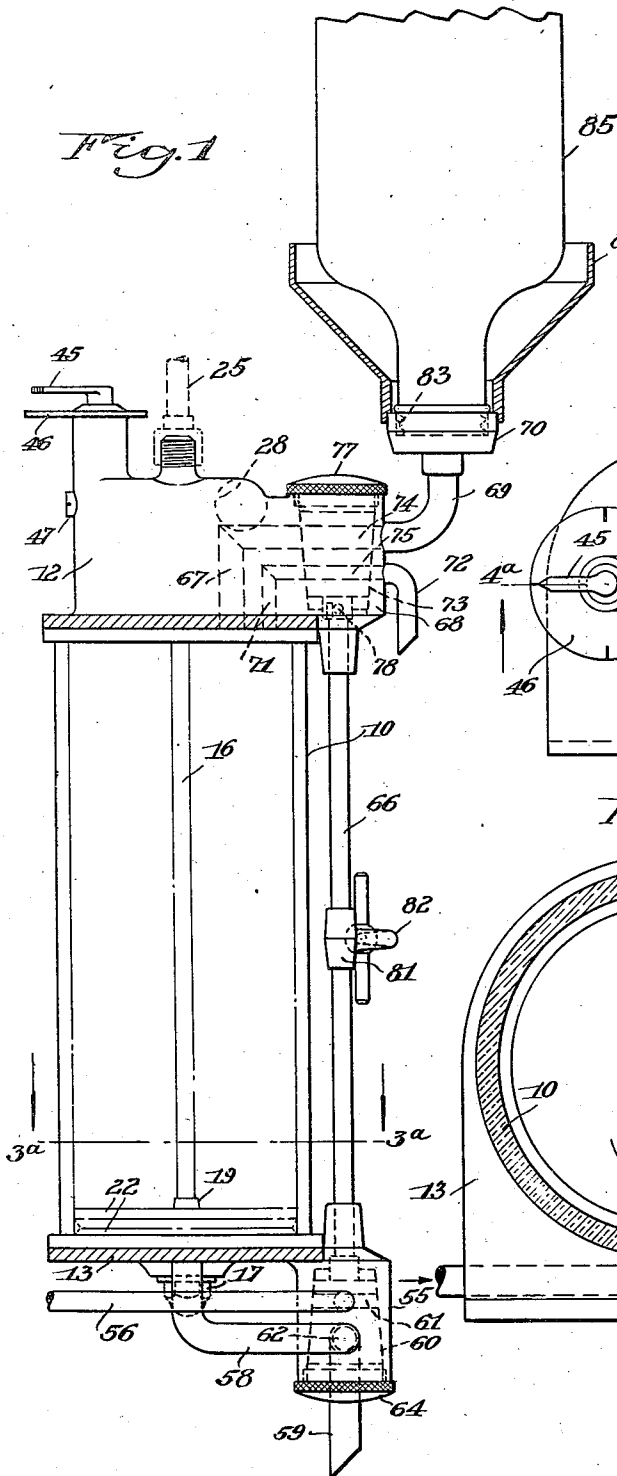


Fig. 2

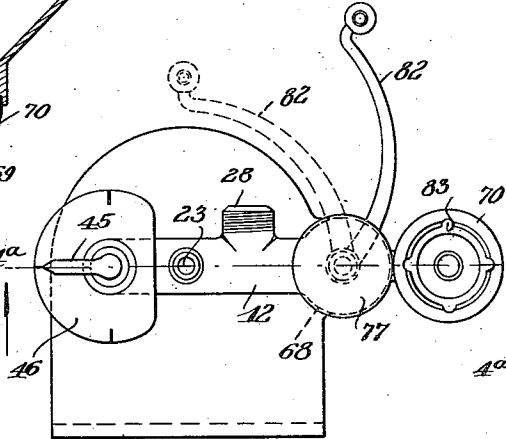
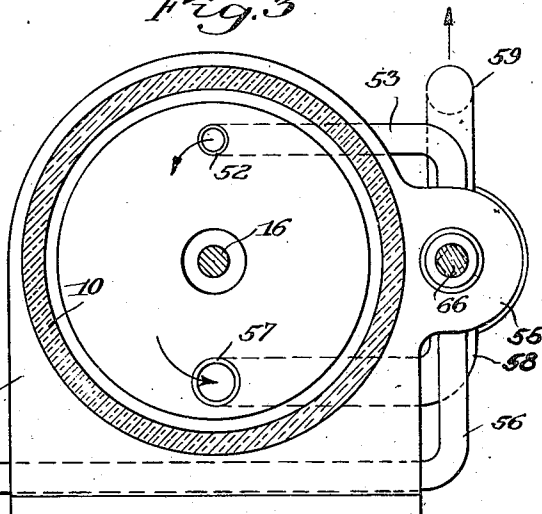


Fig. 3



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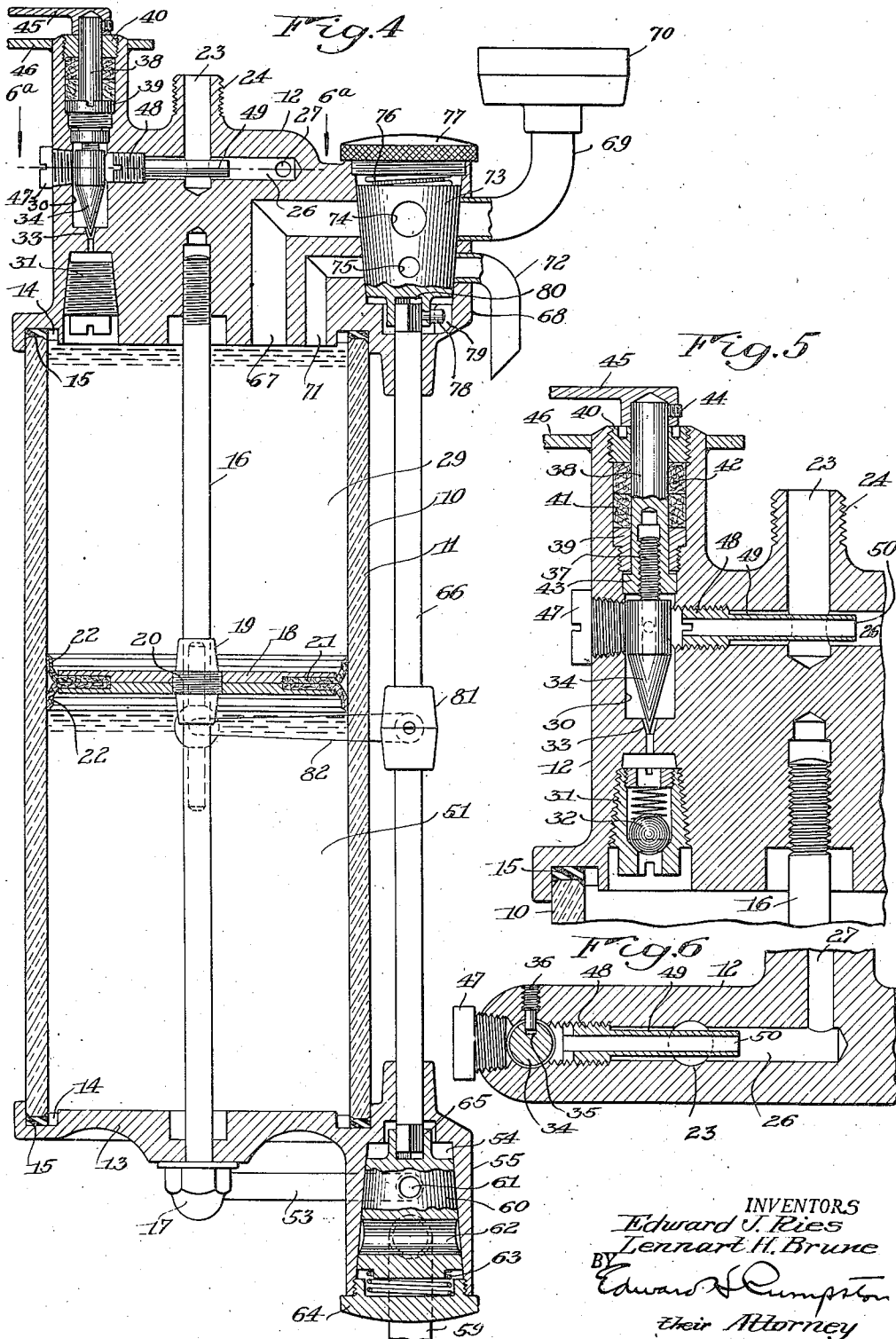
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,415,534

LIQUID MIXING DEVICE

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Application February 18, 1944, Serial No. 522,990

8 Claims. (Cl. 299—85)

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This invention relates to devices for forming liquid mixtures or solutions, such, for example, as mixtures of water and antiseptic solutions used in the operation of water syringes and for other uses in the dental and medical fields, one object of the invention being to provide an improved device of the above character capable of being more easily and quickly manipulated for forming and controlling the strength of desired liquid mixtures.

Another object is to provide such a device having a construction adapted to produce a desired mixture in uniform strength and substantially independently of variations in the pressure of the water service system with which it is employed.

Another object is to provide a device of the character indicated with improved and more convenient means for filling the same with a charge of antiseptic solution.

Another object is to provide a device of the above nature in a more simple, self-contained and efficient type of construction adapted to be manufactured more easily and economically.

To these and other ends the invention resides in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Fig. 1 is a side elevation of a mixing device embodying the present invention and illustrating the manner of filling or charging the same;

Fig. 2 is a top plan view of the device;

Fig. 3 is an enlarged, sectional plan view on the line 3a—3a in Fig. 1;

Fig. 4 is an enlarged, central, sectional elevation on the line 4a—4a in Fig. 2;

Fig. 5 is an enlarged view of parts shown in Fig. 4, with additional portions shown in section, and

Fig. 6 is a sectional plan view on the line 6a—6a in Fig. 4.

The embodiment of the invention herein disclosed, by way of illustration, comprises, preferably, a vertically arranged and generally cylindrical liquid container 10, Figs. 1 and 4, having cylindrical side walls 11 of uniform diameter, which may be conveniently made of transparent glass or plastic material for inspection of the condition of the contents. The ends of the container are closed by top and bottom closures, or heads, 12 and 13, respectively, which may be conveniently manufactured as metal castings, each formed with an annular recess, or channel, as 14, 55

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fitting over the corresponding end of the side walls, with interposed sealing gaskets, as 15, of rubber or the like. A tie rod 16 having a head 17 is passed through a central opening in the bottom closure 13 and threadedly engaged at its upper end in an opening in the top closure 12, as shown, for drawing the heads together and against the side walls, to tightly close and seal the container.

Container 10 is divided into two compartments by a piston 18, Fig. 4, having a central hub 19 slidably surrounding tie rod 16 and serving as a guide bearing thereon. The piston is preferably formed by two plates having threaded central openings engaged with a threaded central portion 20 of hub 19 for securing the plates thereon. The peripheral portions of the plates are reduced in thickness to provide a peripheral recess 21 for the reception of hydraulic packing sheets 22, of the double lip type, spreading outwardly in opposite directions against the inner surface of the side walls 11, so as to be automatically maintained in sealing contact therewith under pressure, as well understood in the art. The piston 25 is thus free to slide longitudinally from end to end of the container in response to differences in pressure on the opposite sides thereof.

The top closure 12 is preferably cored to contain several liquid passages. One of these is a conduit 23, Figs. 4, 5, and 6, comprising a threaded nipple 24 for connection by any suitable means with a service water system or other source of suitable water pressure, as indicated by the pipe connection 25 in Fig. 1. From such connection conduit 23 extends downwardly in the closure 12 into communication with a transverse branch 26 which opens at one end through a side of the closure and has at its other end an angular branch 27 terminating in a threaded outlet nipple 28 for connection, by any suitable means, with a thermo-water heater and spray nozzle, or other apparatus to be supplied with the mixture. The antiseptic solution is mixed with the water in the branch 26 of conduit 23, which serves as the mixing chamber, as hereafter described.

The antiseptic solution is supplied, by means hereafter described, to the upper compartment 29 of the container above piston 18, to which pressure is applied, and the means for delivering the solution therefrom to the mixing chamber in conduit 23 comprises, preferably, a passageway, or conductor, 30, formed in the top closure 12. Conductor 30 opens downwardly through the top closure into compartment 29 through a check valve comprising a housing 31 formed with a

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seat controlled by a spring actuated ball valve 32, as shown, which may have any known or suitable construction, permitting the flow of the solution upwardly through conductor 30 but obstructing flow in the opposite direction, to prevent entry of water to compartment 29.

Conductor 30 is preferably formed with a tapered seat 33, Fig. 5, cooperating with a needle-like valve body 34 having in one side wall thereof a longitudinal slot 35 slidably embracing a pin 36 fixed on the closure, so as to hold valve 34 against rotation. The valve carries a stem 37 threadedly engaged in a bore in the lower end of an operating rod 38. Rod 38 is rotatably supported in bearings in a pair of plugs 39 and 40, threadedly engaged in the opposite ends of a packing chamber 41 in the closure. Suitable packing 42 is compressed about rod 38 between the plugs 39 and 40 to seal in the liquid. Rod 38 has an enlarged lower end 43 abutting against plug 39, and its upper end has fixed thereon, as by means of a set screw 44, a handle 45 for turning the rod to move the valve toward and from its seat. Rod 38 is thus held against longitudinal movement, and a plate 46, fixed on the closure below the handle, is suitably marked with graduations, to indicate the different positions of the handle corresponding to the different positions of adjustment of the valve.

Conductor 30 intersects and communicates with the transverse branch 26 of conduit 23 near its outer end which is closed by a screw plug 47. Inwardly of the intersection with conductor 30, conduit branch 26 is threaded, as at 48, and engaged by the enlarged threaded end of a tube 49, the opposite end of which is positioned in the branch 26 of the conduit. This end of tube 49 has an external diameter which is somewhat smaller than the diameter of the passage 26, so as to form an annular constricted portion in branch 26 through which the water flowing from the conduit acquires increased velocity and a correspondingly reduced pressure, whereby liquid is aspirated from the tube 49. The antiseptic solution is supplied through tube 49 under pressure created in chamber 29 by means hereafter described and its discharge from the tube into the water is further induced by said reduced water pressure, the end of the tube thus serving as a nozzle 50 for discharging the solution into the water in the mixing chamber.

The means for applying pressure to the antiseptic solution comprises a connection between the lower chamber 51 of the container and the same source of water pressure to which the conduit 23 is connected. To this end, bottom closure 13 has an opening 52 therein, Fig. 3, connected by a pipe 53 with a port in the tapered interior 54 of a valve housing 55 offset laterally from the bottom closure beyond the cylindrical side wall 11, as shown. The valve housing is formed with an opposite port with which is connected a pipe 56, Figs. 1 and 3, for connection with said source of water pressure. The bottom closure is provided also with an outlet opening 57, Fig. 3, connected by a pipe 58 with a port in one side of housing 55, the opposite side of which is formed with a similar port and with a pipe 59 leading therefrom to a discharge outlet. Rotatably contained in housing 55 is a tapered valve body 60 having a port 61 opening therethrough for connecting the inlet pipes 53 and 56 and also a port 62, for connecting the outlet pipes 58 and 59. Valve body 60 is kept seated by a coiled spring 63 maintained under compression by a cap 64 screwed into the housing. The upper end of the valve body has a

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squared socket 65, engaged by the squared lower end of a spindle 66, operated by means hereafter described. It will be noted that the inlet and outlet ports of the valve housing are alined with one another vertically, while the ports 61 and 62 of the valve body are at right angles with each other, so that when the valve is moved to position to connect compartment 51 with the source of water pressure, its outlet is closed and vice versa.

The means for supplying antiseptic solution to the upper compartment 29 of the container comprises, preferably, a passageway 67 leading to a port in the interior of a valve housing 68 which is offset laterally beyond the side wall 11 of the container in vertical alinement with the lower valve housing 55. Housing 68 is provided with an opposite port with which is connected an upwardly extending pipe 69 terminating in a filling spout 70. Chamber 29 is likewise provided with means for venting the same, comprising a passage 71 formed in the top closure and leading to a port in the side of valve housing 68, the opposite side of which has a similar port connected with a pipe 72 opening to atmosphere, these housing ports being vertically alined. The tapered interior of valve housing 68 receives a tapered valve 73 formed with vertically alined port openings 74 and 75, adapted to be registered with the ports of the filling passage 67 and the venting passage 71, respectively. Valve body 73 is held seated by a coiled spring 76, maintained under pressure by a cap 77, screwed into the open end of the housing, as shown.

It will be seen from this construction that valve body 73 may be turned to register its port openings with the passages 67 and 71, in which position the antiseptic solution may be supplied to chamber 29 through the filling spout 70, the chamber being simultaneously vented to release the air. After filling the compartment, valve body 73 is rotated through 90°, thereby simultaneously closing the filling and vent passages 67 and 71. Such positions of the valve body are determined by a stop pin 78 fixed thereon and engaging opposite lugs, as 79, on the closure.

For connecting and operating the valves, the lower end of the valve body 73 has a square socket 80 in which is engaged the squared upper end of the spindle 66 which is similarly engaged at its lower end with the valve 60. Surrounding and pinned to the intermediate portion of the spindle is a hub 81 carrying a curved handle 82 for rocking the same. The valve bodies 60 and 73 are assembled in such relation on the spindle that when valve 73 is turned to close the filling and vent openings, as shown in Fig. 4, valve 60 is turned to connect the lower chamber 51 with the source of water pressure and close its outlet, this being the operating position in which handle 82 lies close to the wall of the container. By swinging handle 82 outwardly, the spindle is rocked to rotate the valves simultaneously, so that lower chamber 51 is disconnected from the source of pressure and connected to discharge, while the filling and vent openings of the upper chamber 29 are opened for recharging it with antiseptic solution.

Filling spout 70 preferably has its inner side walls threaded, as at 83, Fig. 1, and is provided with a detachable funnel 84, for cooperation with a supply bottle 85 having a correspondingly threaded neck, so that the bottle may be opened and inverted and threadedly engaged with the filling spout while the solution flows into the

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upper chamber, the threads of the spout being preferably provided with a notch (not shown) to permit the entrance of relief air into the bottle.

In operation, with handle 82 pulled outwardly, a supply bottle is inverted and applied to the filling spout and the antiseptic solution flows into the upper compartment 29, driving the piston 18 to the lower end of the container. When filling is completed, handle 82 is turned to lie substantially against the container, thereby simultaneously closing the filling and vent openings and connecting the lower compartment with the source of water pressure and closing its outlet, the water pressure being transmitted by the piston to the antiseptic solution above it. The same water pressure being applied to conduit 23, valve handle 45 is turned to open the regulating needle valve 34 to supply the desired proportion of antiseptic solution. On a demand for the mixture created by operation of the syringe, or other equipment to be supplied with the mixture, the antiseptic solution is discharged into the branch conduit 26 from the nozzle 59 under pressure from the same source which supplies conduit 23, so that any fluctuations in such pressure are transmitted equally to both the water and the antiseptic solution. The described reduction in the pressure of the water at the tip of the nozzle 50 through which the antiseptic solution is supplied, serves to maintain a pressure in the nozzle higher than that of the water in which the nozzle discharges, so as to insure a positive discharge of the solution during all periods of demand for the mixture. The relative proportions of the ingredients are readily controlled by the setting of the handle 45 of the regulating valve 34, and when set to correspond with a predetermined strength of mixture, the proportions are uniformly maintained, by the means described, substantially independently of any fluctuations in the pressure of the water supply.

As will be apparent from the above description, the invention provides a device by means of which the proportions of the ingredient liquids may be easily and conveniently controlled, and by which a selected strength of mixture is automatically and efficiently maintained. By supplying the device with warm or cold water, or by using it to operate a thermo-water syringe, for example, the mixture may be supplied in either warm or cold condition, and, if desired at any time, the antiseptic solution may be entirely cut off by means of valve handle 45, so that water alone is supplied. The construction is also of such a character as to be quickly and easily filled with the liquid to be mixed with the water supply, the connections for that purpose being simultaneously adjusted by means of the single handle 82. The construction, furthermore, is compact and self-contained and adapted to be readily and economically manufactured.

It will thus be seen that the invention accomplishes its objects, and while it has been herein disclosed in connection with the details of a preferred embodiment, it is to be understood that such disclosure is intended in an illustrative, rather than a limiting sense, as it is contemplated that various modifications and changes in the construction and arrangement of the parts will readily occur to those skilled in the art within the spirit of the invention and the scope of the appended claims.

We claim:

1. A solution forming device comprising a

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container having a piston movable therein and dividing said container into separate compartments, a pipe for connecting one of said compartments with a source of water under pressure, a pipe for connecting said one of the compartments with a discharge outlet, a single valve means for simultaneously opening one of said pipes and closing the other thereof, a conduit in said device for connection with said source and having an outlet and a constricted portion for producing therein a region of increased velocity and reduced pressure, means provided with a valve for filling the other of said compartments with an ingredient for said solution, and for connecting it with the atmosphere, a conductor communicating with said other compartment and with said region of reduced water pressure for delivering said ingredient thereto, and a valve in said conductor to regulate the flow of said ingredient therethrough, for forming said solution uniformly in a strength regulated by said conductor valve.

2. A solution forming device comprising a container having a piston movable therein and dividing said container into separate compartments, means including a valve for connecting one of said compartments with a source of water under pressure and with a discharge outlet, a conduit in said device for connection with said source and having an outlet, means provided with a valve for filling the other of said compartments with an ingredient for said solution and for connecting said other compartment with the atmosphere, a single means for simultaneously opening and closing said valves, a conductor communicating with said other compartment and having a nozzle located in and constricting said conduit for forming therein a region of increased velocity and reduced pressure for inducing the flow of said ingredient from said nozzle, and a valve in said conductor to regulate the flow of said ingredient therethrough, for forming said solution uniformly with a strength predetermined by the adjustment of said conductor valve, substantially independently of variation in the pressure of said source of water.

3. A solution forming container comprising cylindrical side walls of uniform inner diameter having end closures applied thereto, said side walls being formed of transparent material to visibly expose the contents thereof, a tie rod within said container connecting said closures and provided with means for drawing the same against the ends of said side walls to close and seal the container ends, a piston having a guide bearing on said rod, said piston being movable longitudinally of said container and dividing the same into separate compartments, means for connecting one of said compartments with a source of water under pressure, a conduit in one of said end closures for connection with said source and with an outlet, means for filling the other of said compartments with an ingredient for said solution, a conductor communicating with said other compartment and with said conduit for delivering said ingredient thereto, and a valve in said conductor to regulate the flow of said ingredient therethrough, for forming said solution uniformly in predetermined strength.

4. A solution forming container comprising cylindrical side walls having top and bottom closures applied thereto, a piston movable therein and dividing said container into separate compartments, a pipe provided with a valve extending through said bottom closure for connecting

one of said compartments with a source of water under pressure, a pipe provided with a valve extending through said bottom closure for connecting said one of the compartments with a discharge outlet, a single means for simultaneously opening one of said pipe valves and closing the other thereof, a conduit formed in said top closure for connection with said source and having an outlet and a constricted portion for producing therein a region of increased velocity and reduced pressure, means formed in said top closure and provided with a valve for filling the other of said compartments with an ingredient for said solution, means formed in said top closure and provided with a valve for venting said other compartment to atmosphere, a single means for simultaneously opening and closing said valves, a conductor formed in said top closure to communicate with said other compartment and with said region of reduced water pressure for delivering said ingredient thereto, and a valve cooperating with a seat in said conductor to regulate the flow of said ingredient therethrough, for forming said solution uniformly in predetermined strength.

5. A solution forming container comprising cylindrical side walls having top and bottom closures applied thereto, said side walls being formed of transparent material to visibly expose the contents thereof, a tie rod within said container connecting said closures to hold the same on said side walls, a piston having a guide bearing on said rod, said piston being movable longitudinally of said container and dividing the same into separate compartments, means communicating through said bottom closure for connecting one of said compartments with a source of water under pressure and with a discharge outlet, a conduit extending through said top closure for connection with said source and having an outlet and a constricted portion for producing therein a region of increased velocity and reduced pressure, a passageway formed in said top closure and provided with a valve and a filling spout for filling the other of said compartments with an ingredient for said solution, a passageway formed in said top closure and provided with a valve for venting the same to atmosphere, a single means for simultaneously opening and closing said passageway valves, a conductor extending through said top closure and communicating with said other compartment and with said region of reduced water pressure for delivering said ingredient thereto, and a valve cooperating with a seat in said conductor to regulate the flow of said ingredient therethrough, for uniformly producing said solution in predetermined strength substantially independently of variation in the pressure of said source of water.

6. A solution forming container having a piston movable therein and dividing said container into separate compartments, conducting means provided with valve means for connecting one of said compartments with a source of water under pressure and with a discharge outlet, a conduit in said container for connection with said source and having an outlet, a conductor communicating with the other of said compartments and with said conduit for delivering an ingredient into said conduit, means for regulating the flow

of said ingredient, openings for filling said other compartment with said ingredient for said solution and for venting the same to atmosphere, valve means for controlling said openings, and a single means for simultaneously operating all of said valves.

7. A solution forming container comprising cylindrical side walls having top and bottom closures applied thereto, a piston movable in said container and dividing the same into separate compartments, said closures being formed with valve housings offset laterally beyond said side walls, means extending through the valve housing of said bottom closure for connecting one of said compartments with a source of water under pressure and with a discharge outlet, valve means in said bottom closure housing for controlling said connecting means, a conduit in one of said closures for connection with said source and having an outlet, means extending through the valve housing of said top closure for filling the other of said compartments with an ingredient for said solution and for venting the same to atmosphere, valve means in said top closure housing for controlling said filling and venting means, a conductor communicating with said other compartment and with said conduit for delivering said ingredient thereto, means for regulating the flow of said ingredient, and a single means for simultaneously operating all of said valve means.

8. A solution forming container comprising cylindrical side walls having top and bottom closures applied thereto, a piston movable in said container and dividing the same into separate compartments, said closures being formed with valve housings offset laterally beyond said side walls, means extending through the valve housing of said bottom closure for connecting one of said compartments with a source of water under pressure and with a discharge outlet, a valve body in said bottom closure housing provided with ports for controlling said means, a conduit in one of said closures for connection with said source and having an outlet, means extending through the valve housing of said top closure for filling the other of said compartments with an ingredient for said solution and for venting the same to atmosphere, a valve body in said top closure housing provided with ports for controlling said filling and venting means, a conductor communicating with said other compartment and with said conduit for delivering said ingredient thereto, means for regulating the flow of said ingredient, a spindle connecting the valve bodies of said valve housings, and a handle for rotating said spindle and simultaneously operating said valve bodies.

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