Aug. 7, 1945. S. A. HAYES 2,381,589

SYSTEM AND APPARATUS FOR DISTRIBUTING LIQUID SOLUTIONS

Filed Sept. 24, 1940

Fig. 1.

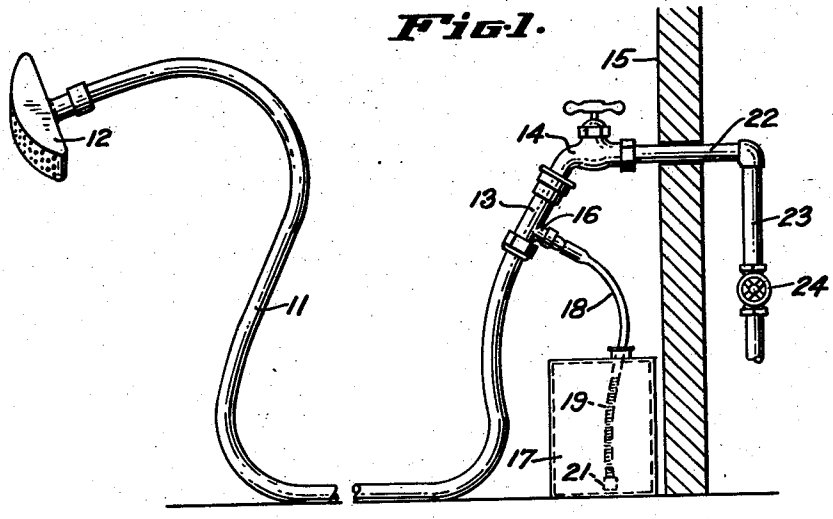


Fig. 2 a.

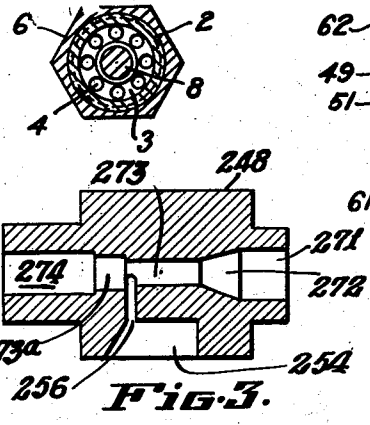
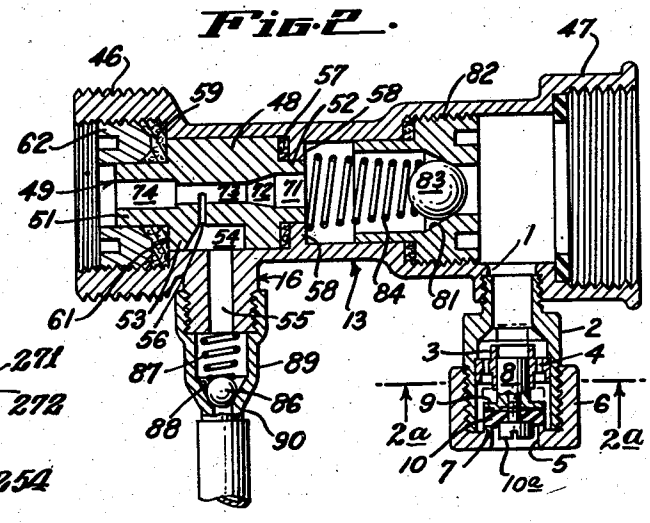


Fig. 3.

Fig. 2.



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SYSTEM AND APPARATUS FOR DISTRIBUTING LIQUID SOLUTIONS

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5 Claims. (Cl. 103—262)

The invention, in general, relates to the entrainment of materials by a liquid. More particularly, the invention relates to apparatus utilizing the motive force of a flowing liquid for affording the production of mixtures of liquid material in uniform, predetermined proportions.

Embodiments of my invention are entirely suitable for adaptation to a variety of industrial uses wherever a definite proportionate mixture is desired and normally is obtained through the employment of somewhat complex metering devices. An important application of my invention is in the treatment of plants, flowers, trees, lawns and the like with insecticidal, germicidal and fungicidal means or materials as well as with soluble fertilizers. For purposes of illustration and description, solely, this application will be directed to the invention as exemplified in the last mentioned environment.

A primary object of my invention is to provide improvements in one of the elements of a liquid mixing system of the character utilizing the motive power of a moving liquid to lift material thereinto which affords the production of liquid mixtures of predetermined proportions under both constant and variable pressures of the moving liquid.

More specifically, the object of the invention is to provide an improved proportioner for a liquid mixing system of the indicated nature which is capable of effecting the automatic entrainment of desired, predetermined amounts of a material per given volume of liquid passing therethrough and which has means incorporated therein for positively preventing dilution of the material at its source by back flow of liquid thereinto.

The foregoing and other objects are attained in a preferred embodiment and a modified embodiment of my invention which are illustrated in the accompanying drawing. It is to be understood that I am not to be limited to the precise embodiments shown, nor to the precise arrangement of the various elements thereof, as my invention, as defined in the appended claims, can be embodied in a plurality and variety of forms.

Referring to the drawing:

Figure 1 is a reduced elevational view of a preferred embodiment of the invention, as exemplified in garden equipment; the garden hose being broken for purpose of illustration only.

Figure 2 is a longitudinal, sectional view of a preferred embodiment of a proportion employed in my preferred liquid mixing system.

Figure 2*a* is a view taken on the line 2*a*—2*a* of Figure 2.

Figure 3 is a longitudinal sectional view of one element of a modified proportioner of my invention.

One proportioner, as depicted in Figure 2 of the drawing, is particularly designed for accurately applying chemicals at the rate of one gallon of concentrated solution to fifty gallons of water under pressure variations as above stated while a slightly modified embodiment thereof, as illustrated in Figure 3 of the drawing, is especially designed for accurately applying chemicals at the rate of one gallon of concentrated solution to twenty-five gallons of water under pressure variations as stated and in both instances with fifty feet of one-half inch, or five-eighth inch, or three-quarter inch garden hose. Thus, it is to be understood that for given lengths of hose or pipe one proportioner or another may be employed for applying a desired, definite proportionate mixture of chemical and liquid.

As particularly illustrated in Figures 1, 2, 2*a* and 3 of the drawing, the liquid system of my invention, as exemplified in equipment for applying suitable treating chemicals to plants, trees, lawns and the like, preferably includes a conventional ½ inch, ⅝ inch, or ¾ inch garden hose **11** having a full flowing type nozzle **12** on the outlet end thereof. The drawing is intended to depict a standard garden hose of fifty feet in length, although greater lengths of hose may be employed, if desired, with the proportioner of the system interposed in the line as above explained. The system also includes a proportioner **13** which, for a fifty foot length of hose, is attached to the inlet end thereof and also is fastened to a standard faucet **14** extending, as is customary, from an exterior wall **15** of a home, or other building or, for example, extending from a standpipe in the garden or anywhere in the vicinity of the plants, lawn or trees to be treated. In addition, the system includes a suitable container **17** which may be fabricated of any desired material, such as glass, wood, clay or metal, or from plastic material or of porcelain; the container serving to hold a supply of a desired and proper chemical for application. A suitable conduit **18**, which may be and preferably is a flexible rubber tube having a spring or other suitable strainer **19** at one end thereof, depends into the container **17** and is preferably weighted with any suitable form **21** to hold the tube and strainer adjacent to the bottom of the container; the tube being fastened at its other end to the suction inlet **16** of the proportioner **13**. As is well understood, faucet **14** is on the outlet end of a water supply line including a plurality of pipes, such as the

pipes 22 and 23; the water supply line, of course, including numerous taps therein of which one is shown at 24 in pipe 23.

The combination depicted in Figure 1 of the drawing is especially suitable for sprinkling desired amounts of either a soluble chemical or other materials, such as lead arsenate, "Rotetone," pyrethrum, dichlor-ethyl ether, or the like, upon lawns for moth control, or for applying suitable weed killing chemicals to desired areas. It also is to be observed that by cutting the water volume very low, this combination can be and has been used effectively with soluble insecticides on potted plants, flats, etc., etc., in the greenhouse without waste of material. It is not necessary to water the lawn after applying the chemicals with the proportioner installed in the system, as the proper amount of water is used when applying the chemicals.

In accordance with my invention, the liquid mixing system in every instance is provided with a proportioner 13 which preferably comprises a hollow body having a hose connection 46 and 47 at each end thereof, the connections having standard threads so that the proportioner can be fitted either to a conventional garden hose or to a faucet having standard threads, such as the faucet 14. Removably disposed within the hollow body of the proportioner 13 is a multi-step, balanced metering element 48 having an axial bore 49 of variable cross-section by virtue of the interior step formation of the element. In its preferred form, the metering element 48 of my improved proportioner 13 includes annular flanges 51 and 52 on opposite ends thereof, as well as an annular flange 53 on one side thereof which defines, in conjunction with the inner surface of the proportioner body on which it seats, a chamber 54 communicating with an axial bore 55 of proportioner inlet 16. The metering element 48 also is transversely slitted to provide a relatively narrow material inlet port 56 establishing communication between bore 55 of the inlet 16 and the bore 49 of the metering element through the chamber 54. In fitting the metering element 48 within the proportioner body, I first seat a washer 57, preferably fabricated of rubber to insure a water-tight joint, on an inturned, annular shoulder provided by an inner flange 58 of the proportioner body, and then slide the metering element into operative position in engagement with the rubber washer 57; the flange 52 of the metering element seating against the inner surface of flange 58 of the hollow body. I also dispose a mass of malleable material 59, such as soft lead, around flange 51 of the metering element on an exterior shoulder 61 of the element formed by the flange 51; the lead filling the space between the metering element and the inner surface of the hose connection 46 of the body 13. To lock the metering element tightly in this operative position, I provide a lock-nut 62 having external threads thereon for threaded engagement with internal threads on the hose connection 46, and screw this nut tightly against the mass of sort lead 59; the nut conveniently being provided with a pair of slots for the reception of a spanner wrench to tighten the nut or to remove the same when it is desired to replace a damaged metering element 48. If it be necessary to replace a metering element in the proportioner for any reason, the nut 62 is removed and the soft lead tooled out with a suitable instrument, whereupon the metering element can be readily withdrawn.

The metering element 48 of the proportioner 13 which is depicted in the enlarged showing of Figure 2 of the drawing is a four step metering element for accurately applying chemicals at the rate of one gallon of concentrated solution to fifty gallons of water under varying water pressures with fifty feet of ½ inch, ⅝ inch, or ¾ inch garden hose. The "stepping" of the metering element is critical in order that pressure balances be maintained on both sides of material inlet port 56. As shown, the metering element 48 is so stepped as to provide a bore section 71 at the inlet end thereof which is of uniform diameter and larger in diameter than any of the other bore sections of the metering element. Bore section 71 merges with a tapered or inwardly converging bore section 72 which, in turn, merges with a relatively long bore section 73 of relatively small but uniform diameter throughout; the center of bore section 73 being on the longitudinal axis of the metering element. Bore section 73, in turn, merges with a last bore section 74 at the outlet end of the metering element, such outlet bore section 74 being of uniform diameter but slightly larger in diameter than the diameter of the central bore section 73. As depicted, the material inlet port 56 of the metering element communicates with the central, long bore section 73 at which point the material is entrained by the motivating power of the water caused to flow through the bore of the metering element which creates a vacuum at the expanding bore section 74. It is to be particularly observed that, in forming the material inlet port 56 of the proportioner metering element 48, the slit is extended to the transverse center of the central bore section 73, the port 56 thus partially interrupting fluid flow through such bore. This formation of the material inlet port 56 enhances the interior sealing of the metering element against the admission of air and thus eliminates all possibility of disturbing the lifting power or value of the flowing fluid and of disturbing the ratio between the amount of fluid and of the entrained material in the resultant mixture emitted.

In accordance with my invention, the proportioner 13 of my improved liquid mixing system is provided with means for positively preventing the pollution of the water supply line with treating chemicals, which might otherwise occur, and frequently has heretofore occurred in systems heretofore employed, as a result of the creation of a back pressure of sufficient value to overcome the head pressure of the line, or the creation of a vacuum anywhere along the line. As is well known, a kinking of the garden hose 11 is one cause of setting up a back pressure of such value, and this frequently occurs. The creation of a vacuum in the line may occur in a number of ways such as, for example, when a fire plug is broken off or if the main water line is plugged off at the bottom of a hill for repairs, and air is allowed to enter the line when draining from the top to the bottom of the hill. This last mentioned event has resulted in the creation of a vacuum as high as 30 inches of mercury. Moreover, a vacuum may be created should fire fighting equipment pump the main line dry. The means that I preferably provide in my improved proportioner include not only an air control unit, hereinafter termed the "vacuum breaker," but also a fluid control unit at the inlet end of the proportioner. As illustrated in Figure 2 of the drawing, the fluid control unit preferably comprises a spring-controlled check valve including a

valve seat 81 having external threads thereon for threadedly fitting the seat within the proportioner body which is provided with internal threads 82 for this purpose, together with a valve 83 which is urged against the seat 81 by a spring 84 bearing against the valve 83 at its one end and against the internal flange 58 of the proportioner body at its other end. While I have depicted the valve 83 as of the ball type, any other suitable valve may be employed, as desired. Whenever sufficient back pressure is set up in the line to overcome the pressure of the water supply line, the valve 83 is urged against its seat 81 and held there, thus preventing the mixture of fluid and chemical from passing back into the pipes 23 and 24, as well as into other pipes of the supply circuit of the home or other building so that likelihood of illness or possible death of persons from drinking or cooking water containing toxic material is effectively avoided. The air control unit, or vacuum breaker preferably comprises an integral part of the proportioner 13 and includes an air inlet 1 formed in the proportioner body between the check valve 83 and the connection 47 at the inlet end of the proportioner, together with a hollow body 2 housing a valve guide 3. If desired, the proportioner body may be threaded at the air inlet 1 for threadedly receiving the hollow body 2, as shown. The valve guide 3 of the vacuum breaker is surrounded by passages 4, which may be a series of holes as illustrated especially in Figure 2a of the drawing, or may be enlarged slots, for admitting air to the inlet 1 after it has been admitted through an orifice 5 formed in a valve cap 6 which is interiorly formed to provide a valve seat 7. Any suitable valve may be employed in the vacuum breaker unit for controlling orifice 5. In the embodiment shown, I provide a flat head type of valve including an integral stem 8 which freely slides in valve guide 3, and a head 9. A rubber washer 10 is preferably fitted to head 9 of the valve, the washer being conveniently held in position by a small screw 10a. In operation, when the water or liquid supply is turned on the pressure effects a closing of the vacuum breaker valve to prevent air from entering through orifice 5. Upon the creation of a vacuum in the line, the vacuum breaker valve opens to allow an inrush of air past orifice 5, the passages 4 and thru inlet 1 into the line on the inlet side of the check valve 83. The orifice 5 is of such size as to admit sufficient air to overcome any vacuum created and thus prevent drawing of material into the line by the suction. It may be observed that the vacuum breaker of my improved proportioner has successfully been tested by the Los Angeles Water and Plumbing Department definitely establishing that no material can enter the supply line upon the creation of a vacuum therein with my improved proportioner containing such vacuum breaker as a part of the liquid mixing system.

In addition to the provision of means for preventing back flow of water and material to the water supply line, I also provide means associated with the proportioner 13 and forming part thereof for preventing flow of the mixture of water and entrained material back into the container 17 when back pressure is created. These means preferably comprise a spring-controlled valve 86 which is urged by a spring 87 against a seat 88 formed in a pipe connection 89 which is internally threaded for detachable engagement with external threads provided on proportioner inlet 16; the connection 89 having a reduced portion 90 thereon for fitting tube 18 thereto, all as clearly shown in Figure 2 of the drawing. While a ball valve 86 is shown, any other suitable type of valve may be employed as desired. As is well known, the flow of fluid or liquid through the metering element 48, upon opening of the faucet 14, will unseat valve 83 to permit the liquid to flow through the multi-section bore 49 of the metering element, thus creating sufficient suction to lift material from the container 17 for entrainment in the liquid stream. The step formation of the metering element affords the entrainment of definite amounts of chemical per volume of water passing through a hose 11 of fifty foot length and of a diameter of either ½ inch, ⅝ inch, or ¾ inch; the metering element depicted in Figure 2 of the drawing functioning to entrain one part, by volume, of chemical, to fifty parts of water.

While I have depicted a four step metering element in the enlarged showing of Figure 2, it is to be understood that my invention also contemplates the use of additional steps in the metering element in order that the proportion of chemical to water in the resultant mixture can be varied to suit desired ends, and it is to be observed that the additional steps are preferably added at the outlet end of the metering element. I have successfully used a five step metering element, i. e., one having five bore sections, for applying one gallon of a soluble chemical, or a chemical in suspension in water, to twenty-five gallons of water under pressure through the metering element, using fifty feet of either ½ inch, or ⅝ inch, or ¾ inch garden hose, with the proportioner attached to the water faucet, as shown, or with the proportioner interposed between two fifty feet lengths of hose, or pipe. Moreover, I have successfully used a proportioner of my invention having more than five bore sections, in conjunction with a spray type nozzle at the output end of a hose of the stated dimensions, for also applying one gallon of such chemical to twenty-five gallons of water, even though the last mentioned metering element having more than five bore sections will apply only one gallon of chemical to one gallon of water when used with a full flowing nozzle of the type depicted in Figure 1 of the drawing. In other words, this last mentioned metering element, with a spray nozzle on the hose, converts the resultant mixture from one in which the proportion of chemical to water is one to one to a mixture in which the proportion is one part, by volume, of chemical to twenty-five parts of water, as a result of the back pressure set up by the use of the restrictive type of nozzle. In Figure 3 of the drawing, I have illustrated a modified embodiment of metering element 248 for the proportioner of the improved liquid mixing system, such modification being alluded to hereinabove. In this modification, as in the embodiment shown in Figure 2, the metering element is recessed to provide an enlarged chamber 254 for receiving material to be distributed, and also is slitted to provide a material inlet port 256 which communicates with chamber 254; the slit preferably being extended to the common axis of the various bore sections of the element and preferably being relatively narrow, or approximately one-half the diameter, more or less, of the diameter of the central bore section of the metering element. The multi-section bore of metering element 248 comprises a relatively short inlet bore section 271 formed

to a right cylinder, as shown; a short, tapering bore section converging toward the center of the element; a relatively long central bore section **273** of circular cross-section but of smaller diameter than bore section **271**; together with a short bore section **273***a* of slightly larger diameter than bore section **273**; and an outlet bore section **274** preferably formed to a right cylinder and of larger diameter than the bore section **273***a*. These bore sections are preferably formed by "stepping" the metering element internally, although the multi-section bore can be formed in a separate tube or other element and removably inserted in the element **248**, if desired. As shown, the five bore sections define a continuous bore having a common axis and it is to be noted that the added bore section **273***a*, as compared to the four step metering element depicted in Figure 2, preferably is formed in the metering element on the outlet side and next to the central bore section **273**. In the event that a reduced ratio between the liquid caused to flow through the proportioner and the entrained material is desired, an addition or additional steps, and defined bore sections, can be provided in the metering element of the proportioner, all such additions being formed on the outlet side of the central bore section **273**.

I claim:

1. A proportioner for effecting the distribution of a substantially constant, predetermined proportionate mixture of a pest control material and a carrier liquid under all variations of pressure of the carrier liquid, said proportioner being adapted to be interposed in a line through which a carrier liquid is caused to flow under variable pressures and comprising a hollow body having an inlet and an outlet for receiving and emitting the carrier liquid, a side inlet formed in said body through which a pest control material may pass for entrainment in the carrier liquid, and a metering element in said body; said metering element comprising a multi-section jet therethrough communicating with the inlet and outlet of said body, said jet including an inlet section of right cylinder cross-section and predetermined diameter for receiving the carrier liquid from the inlet of said body and for transmitting the same in a full, solid stream, a tapering section merging with said inlet section and serving to increase the speed of flow of the carrier liquid, a relatively long central section of right cylinder cross-section and of less diameter than the diameter of said inlet section merging with said tapering section and communicating with said side inlet of said hollow body; said central section serving to seal the jet against admission of air and to maintain the transmission of the carrier liquid in a straight, solid stream for effecting the entrainment of a pest control material in the carrier liquid through said side inlet, and an outlet section of right cylinder cross-section and of greater diameter than the diameter of said central section and merging therewith; said outlet section serving to control the ratio of pest control material to carrier liquid that is emitted from the outlet of said body.

2. A proportioner for effecting the distribution of a substantially constant, predetermined proportionate mixture of a pest control material and a carrier liquid under all variations of pressure of the carrier liquid, said proportioner being adapted to be interposed in a line through which a carrier liquid is caused to flow under variable pressures and comprising a hollow body having an inlet and an outlet for receiving and emitting the carrier liquid, a side inlet formed in said body through which a pest control material may pass for entrainment in the carrier liquid, and a metering element in said body; said metering element comprising a multi-section jet therethrough communicating with the inlet and outlet of said body, said jet including an inlet section of right cylinder cross-section and predetermined diameter for receiving the carrier liquid from the inlet of said body and for transmitting the same in a full, solid stream, a tapering section merging with said inlet section and serving to increase the speed of flow of the carrier liquid, a relatively long central section of right cylinder cross-section and of less diameter than the diameter of said inlet section merging with said tapering section and communicating with said side inelt of said hollow body; said central section serving to seal the jet against admission of air and to maintain the transmission of the carrier liquid in a straght, solid stream for effecting the entrainment of a pest control material through said side inlet into the carrier liquid, and a multi-step outlet section communicating with said central section as well as with the outlet of said body; said multi-step outlet section serving to control the ratio between the entrained pest control material and the carrier liquid and including a first step of right cylinder cross-section and of greater diameter than said central section, and a last step of greater diameter than the diameter of any other step of said multi-step outlet section.

3. A proportioner as defined in claim 1 wherein said metering element is removably mounted in said body and is replaceable with a metering element in which the outlet section of said multi-section jet of said metering element is of a different diameter than the diameter of the outlet section of the replaced metering element thus enabling the distribution of a mixture of pest control material and carrier liquid of any desired predetermined proportions between the pest control material and the carrier liquid.

4. A system for distributing substantially constant predetermined proportionate mixtures of a pest control material and a carrier liquid under all variations of pressure of the carrier liquid; said system comprising a source of supply of carrier liquid, a hose through which a mixture of pest control material and the carrier liquid is caused to flow under variable pressure on the carrier liquid, a container for holding a supply of pest control material, a proportioner interposed between said source of supply of carrier liquid and said hose; said proportioner having a main inlet and a main outlet for establishing communication between said source of supply of carrier liquid and said hose and also having a side inlet through which pest control material may pass from said container into the carrier liquid as it moves under variable pressure through said proportioner, said proportioner also having an atmospheric vent therein between said main inlet and said source of supply of carrier liquid, a first valve for controlling the main inlet of said proportioner; said first valve normally being maintained open by the pressure on the carrier liquid to permit flow of the carrier liquid under pressure through said proportioner and said hose from the source of supply of carrier liquid, said first valve automatically closing whenever a back pressure is set up in said hose of greater value than the pressure of the carrier liquid thereby

preventing pollution of the source of supply with pest control material mixed with the carrier liquid, a second valve controlling the side inlet of said proportioner; said second valve normally being maintained open by the suction created by the carrier liquid moving under variable pressure through said proportioner, said second valve being adapted automatically to close whenever a back pressure is set up in said hose of greater value than the pressure of the carrier liquid thereby preventing dilution of the pest control material in said container with the carrier liquid, and a third valve controlling the atmospheric vent in said proportioner; said third valve normally being maintained closed and being adapted automatically to open and permit an inrush of air whenever a vacuum is placed on the source of supply of carrier liquid thus preventing pollution of the source of supply of carrier liquid by pest control material from said container and said hose tending to flow back through the main inlet of said proportioner upon the placing of a vacuum on the source of supply of carrier liquid.

5. A system for distributing liquid solutions of which one liquid is a carrier liquid and the other is a pest control material or the like, said system being adapted to prevent pollution of the source of carrier liquid as well as to prevent dilution of the supply of pest control material; said system comprising a source of supply of carrier liquid, a hose through which solutions of carrier liquid and pest control material is distributed, a container for holding a supply of pest control material, an ejector body connected between said source of supply of carrier liquid and said hose; said body having a main inlet and a main outlet establishing communication between said source of supply of carrier liquid and said hose as well as a side inlet establishing communication between said container and the carrier liquid passing through said body, means in said body for effecting the ejection of material from said container for entrainment in said carrier liquid, a first valve controlling said main inlet, a second valve controlling said side inlet; said first and second valves being adapted automatically to close whenever the back pressure in said hose exceeds the pressure on said carrier liquid and thus to prevent flow of the solution back through said body to said source of supply of said carrier liquid or back into said container; said body having an atmospheric vent therein, and a third valve controlling said atmospheric vent to check any return flow of the solution to the source of supply of carrier liquid whenever a vacuum is placed on the source of supply of carrier liquid.

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