United States Patent [19]

Lilja

[11] **3,841,555**

[45] **Oct. 15, 1974**

[54] **SPRAY APPARATUS AND METHOD**

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[22] Filed: **Nov. 8, 1973**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 280,476, Aug. 14, 1972, Pat. No. 3,780,943.

[52] **U.S. Cl.** **239/8,** 239/269, 239/308, 239/373, 239/417.5, 239/528, 137/625.18

[51] **Int. Cl.** **A01g 25/02**

[58] **Field of Search** 239/8, 266, 269, 308, 373, 239/415, 416.1, 372, 528, 417.5, 423, 526; 137/625.12, 625.18, 625.48

[56] **References Cited**

UNITED STATES PATENTS

1,321,014	11/1919	Day	239/8
1,488,125	3/1924	Kline	239/372 X
3,055,596	9/1962	Pope	239/415 X
3,122,324	2/1964	Lee	239/415 X
3,580,284	5/1971	Bini et al.	137/625.18
3,658,255	4/1972	Beall, Jr.	239/415
3,752,404	8/1973	Forsberg	239/308

FOREIGN PATENTS OR APPLICATIONS

712,299	8/1966	Italy	137/625.18

Primary Examiner—Lloyd L. King
Assistant Examiner—Andres Kashnikow

[57] **ABSTRACT**

A spray apparatus and method operable to concurrently discharge a spray product and air under relatively low pressure. The air progressively atomizes the spray product upon discharge from the applicator to convert it to a fine, particulate spray at low pressure. Air supply means provides air under pressure to a spray applicator as well as a spray product reservoir. The spray applicator has sequential valve means operable to initiate air flow through the applicator prior to the spray product flow, and to halt spray product flow through the applicator before the air flow is stopped. The spray is maintained fine and particulate, and large irregular masses of spray product at commencement and termination of spraying are eliminated. The apparatus includes an economical spray product reservoir which minimizes pressure fluctuations in the system and is quickly and easily replaced upon depletion of the spray product contained therein. The reservoir includes a container wherein the usual dip tube is eliminated while yet providing a leak-proof reservoir for the spray product.

24 Claims, 10 Drawing Figures

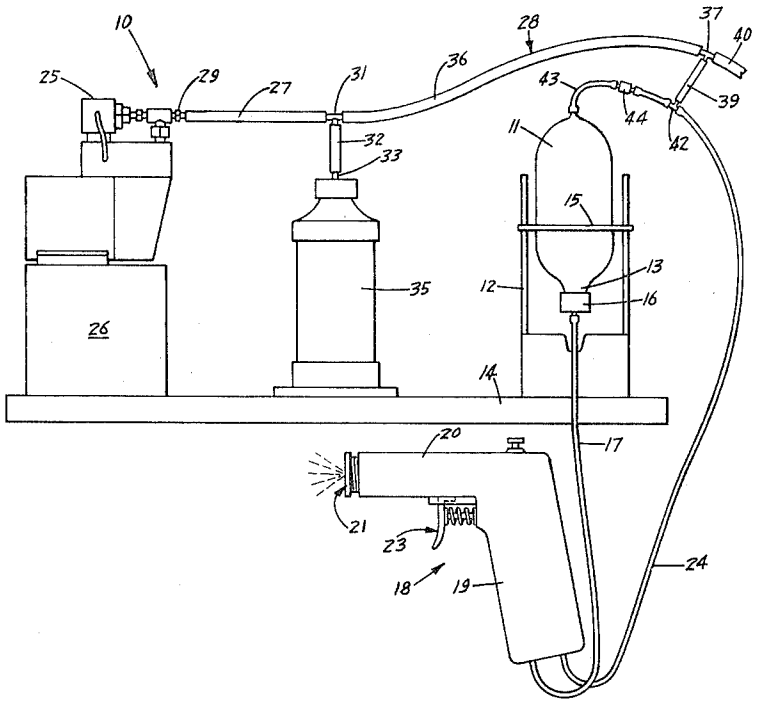
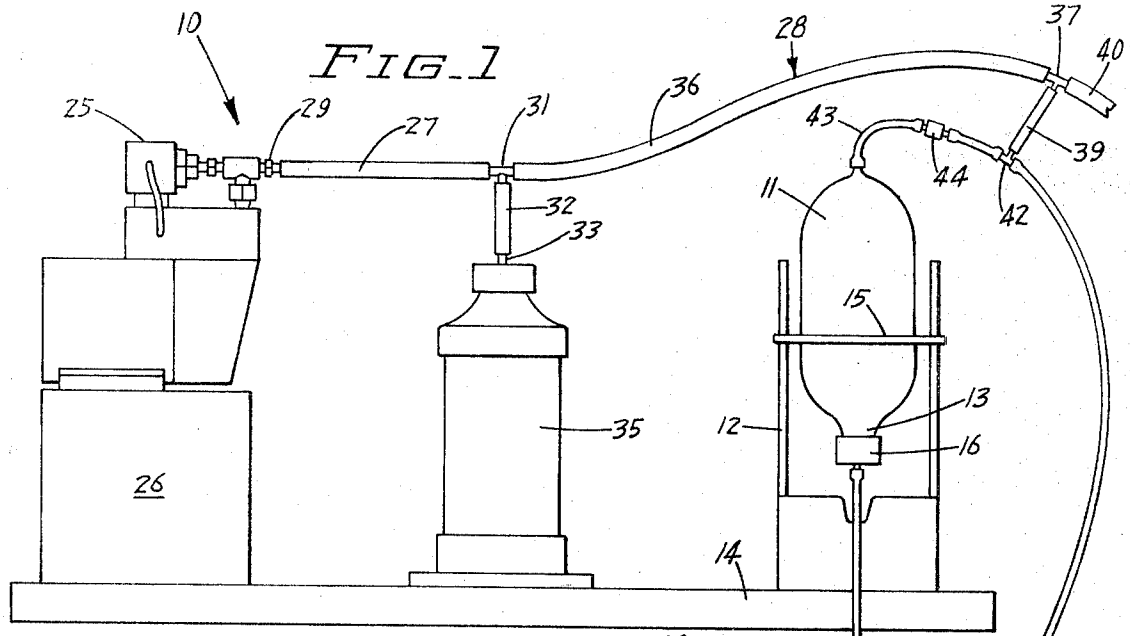


FIG. 1



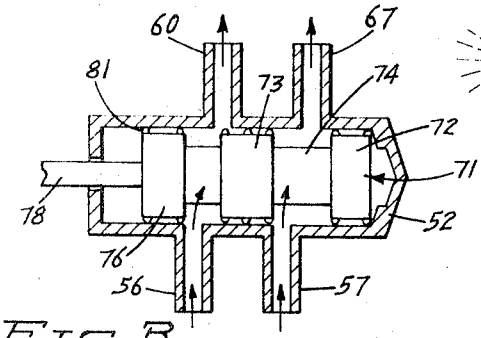


FIG. 3

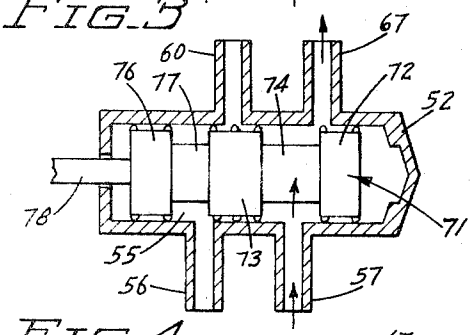


FIG. 4

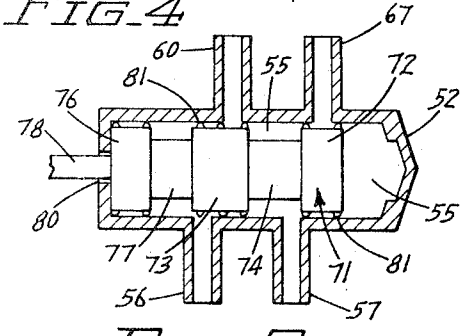


FIG. 5

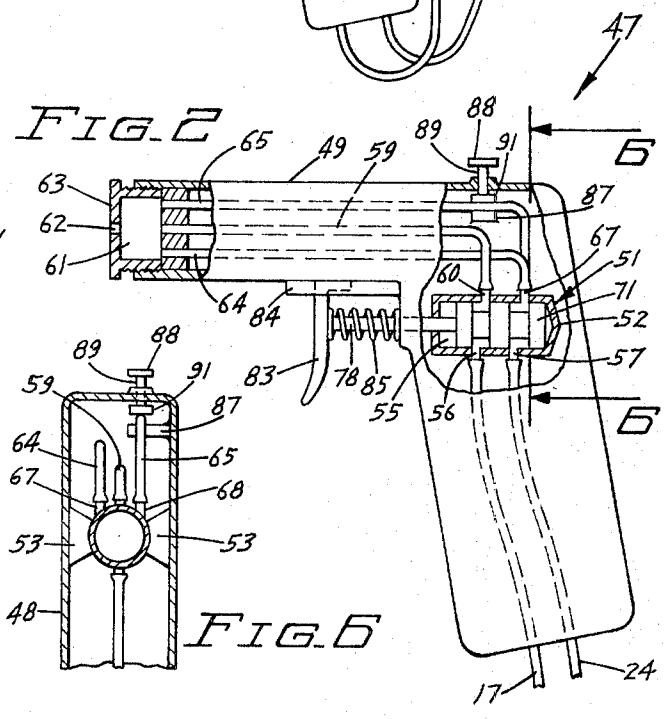


FIG. 2

FIG. 6

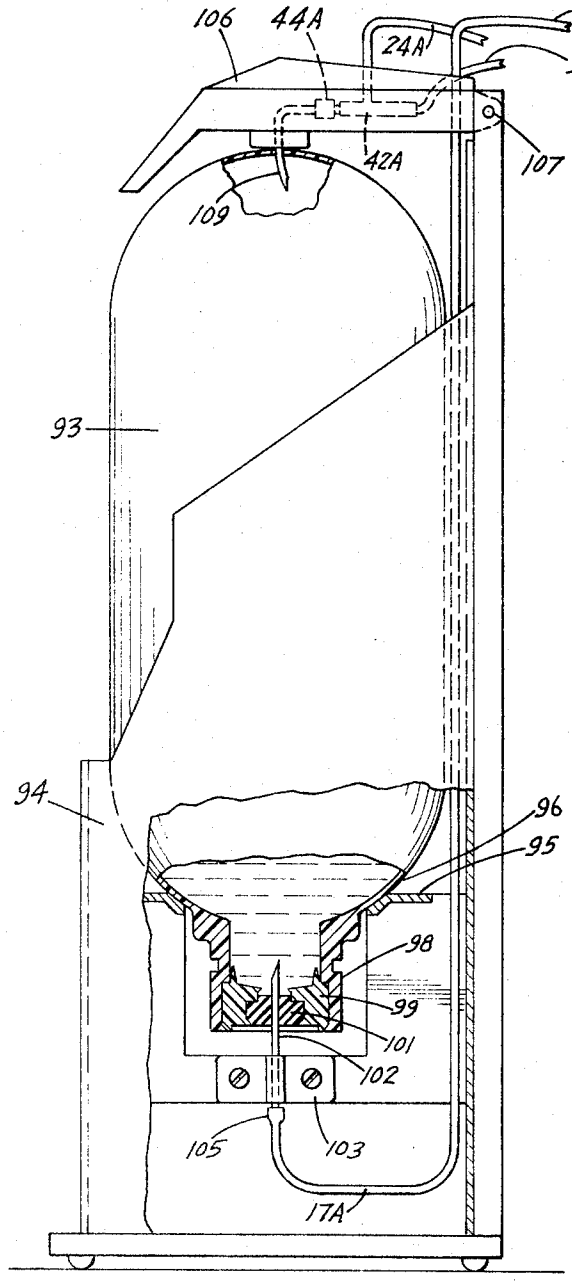


FIG_7

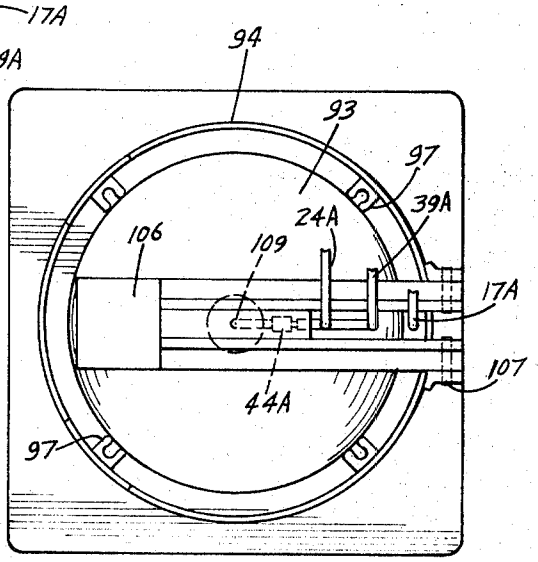


FIG_8

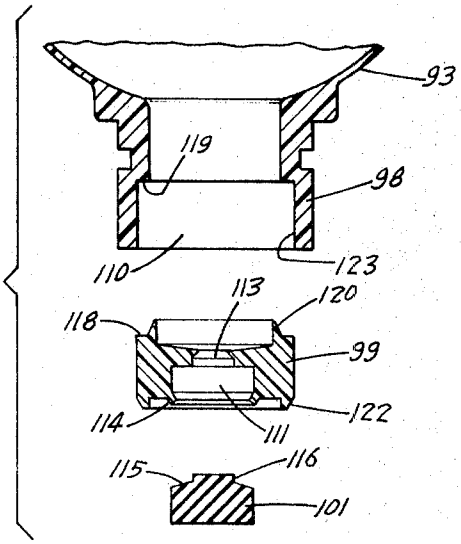


FIG_9

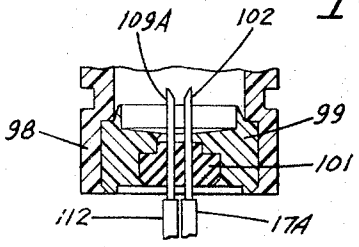


FIG_10

SPRAY APPARATUS AND METHOD

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of U.S. application Ser. No. 280,476, filed Aug. 14, 1972, now U.S. Pat. No. 3,780,943.

BACKGROUND OF THE INVENTION

The invention relates to the field of liquid spray systems, and in particular to those systems meant to provide a fine, particulate spray of a liquid and a gas, usually air under pressure. Such a system finds application, for example, in beauty salons where hair setting liquids and hair holding liquids, and the like, are in general use. While many of such liquids are available in aerosol cans, large scale use of aerosol cans is not economically feasible, and the use of such spray systems is preferred. Such spraying systems for use in beauty salons are described in U.S. Pat. No. 3,122,324 to Lee and U.S. Pat. No. 3,752,404 to Forsberg.

These spray systems usually include a liquid or spray product reservoir for storing the spray product, and an applicator such as a spray gun, associated with the reservoir to concurrently discharge air and the spray product on the surface to be sprayed. Air is supplied by a compressor or other suitable source to both the spray gun and the reservoir. Typically pressurized air for the spray gun is drawn from the reservoir, whereby the reservoir actually constitutes a link in the passage of air from the air supply to the spray gun.

In such spray systems, the air supply means provides air under pressure simultaneously to the spray product reservoir and the spray gun. When the air supply line is opened, as by opening the spray nozzle, pressure in the air line drops. Air under pressure in the product reservoir flows back into the now-lower pressure air line. When the system is again pressurized, air flows back into the product reservoir. The spray product in the reservoir experiences erratic pressure fluctuation. The amount and the pressure of spray product thereby delivered to the spray means necessarily fluctuates also. In order to maintain an acceptably uniform, particulate spray at the spray nozzle, it is necessary to use a relatively high pressure to minimize the ratio of the pressure fluctuation to the total pressure of the system. It is desirable to eliminate this pressure fluctuation and thereby enable the spray system to be operated at a relatively low pressure.

Spray applicators of the aforementioned systems commonly employ staging of the air spray and fluid spray. Upon actuation of the applicator, the flow of air is initiated before the flow of spray product. Upon termination of spraying, the flow of spray product is cut off before the flow of air. This serves to prevent large, irregular masses of spray product being introduced into the spray stream at the commencement and termination of spraying. It also prevents clogging of the applicator by cleaning the spray product out of the applicator. It also prevents a residual drip at the termination of spraying. One apparatus used to accomplish such staging includes the sequential pinching of the flexible, tubular air delivery and spray product delivery lines. This results in wear on the delivery lines especially since the lines are usually in the pinched or closed position. In addition, the tubes may not be completely

pinched off or closed in the closed configuration and thus leak.

Spray product containers or reservoirs of the prior art systems employ dip tubes to draw spray product from the container. Dip tubes add to the expense of the container and are susceptible of malfunctioning and breakage.

SUMMARY OF THE INVENTION

The present invention provides a spray apparatus of the type described which provides a relatively fine, uniform, particulate spray at a relatively low air pressure. Gas, as air, is supplied under pressure through a main air line to a spray applicator of the invention. A branch of the air line supplies air under pressure to a spray product reservoir of the invention. Disposed in the air branch to the reservoir is a one-way air valve orientated to permit the flow of air through the branch from the main air line to the reservoir, but operable to prevent the flow of air from the reservoir back into the main air line. Erratic pressure fluctuation due to rapid air movement is not experienced by the spray product in the reservoir. A spray product line extends from the reservoir to the spray gun.

The spray applicator of the invention incorporates sequential valving means to stage the flow of air and spray product. Valve means includes a valve casing defining a chamber, and a valving element movably located in the chamber. Air and spray product inlets and outlets communicate with the chamber. The valving element is sequentially movable between a position blocking fluid communication of both the air and spray inlets and outlets, to a position providing fluid communication between the air inlet and outlet but blocking fluid communication between the spray product inlet and outlet, and to a position allowing fluid communication between the air inlet and outlet as well as the spray product inlet and outlet. Dual air outlet passages, in a preferred embodiment, allow a measure of regulation of the amount of air mixing with the spray product to form either a relatively coarse or a fine spray. Positive sequential valving is provided by the applicator. There is no wear and tear on the product and air delivery tubes, yet the applicator has a minimum of moving parts. Positive shut-off of both the air and spray product supply is provided.

In terms of a method, the invention includes directing air under pressure through a main air line to a spray applicator; directing a portion of the air from the main air line through an air branch having a one-way air valve to a spray product reservoir; directing the spray product from the reservoir through a product line to the spray applicator; commencing the spray of air; commencing the spray of product following the commencement of the air spray; and terminating the spray of spray product prior to termination of the spray of air upon completion of the spraying operation. The method further comprises directing the spray product and the air through a sequential valving means in a spray applicator.

The spray reservoir of the present invention comprises a container usable in an inverted position to provide spray product to the applicator. The container has an open neck closed by a plug. A ledge in the open neck mates with a ledge on the plug. A tapered lip extending from the plug is biased against and makes sealing contact with the corner of the ledge in the open

neck. A central insert in the plug is formed of an elastically penetrable material, as a latex rubber. The insert is adapted to be penetrated by a needle forming a part of a spray product delivery line. A needle forming a part of the branch from the main air line may also penetrate the insert.

An object of the invention is to provide a spray apparatus providing a fine, uniform, particulate spray of spray product at a relatively low pressure. A further object of the invention is to provide a spray applicator for such an apparatus having sequential valving means to stage the spray of air and spray product. A further object is to provide a spray product reservoir for such a spray apparatus being economical to manufacture and usable in an inverted position and easily removed and replaced in the spray apparatus. Further objects of the invention will become apparent upon the following description.

IN THE DRAWINGS

FIG. 1 is a schematic view of the spray apparatus of the invention;

FIG. 2 is a side elevational view of a preferred embodiment of a spray applicator of the present invention, partly sectioned for illustration;

FIG. 3 is a schematic view of the valving means of the spray applicator of FIG. 2 in a fully open position;

FIG. 4 is a schematic view of the valving means of FIG. 3 in an intermediate position;

FIG. 5 is a schematic view of the valving means of FIG. 3 in a fully closed position;

FIG. 6 is a sectional view taken along the line 6—6 in FIG. 2;

FIG. 7 is a side elevational view of a spray product reservoir according to the present invention located in a holder with portions sectioned for illustration;

FIG. 8 is a top plan view of the reservoir and holder of FIG. 7;

FIG. 9 is an exploded sectional view of the closure portion of the spray product reservoir of the invention; and

FIG. 10 is an enlarged sectional view of a portion of the spray product reservoir illustrating an alternative embodiment.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIG. 1, there is shown schematically the various components of the spray apparatus of the invention, indicated generally at 10, in assembled relationship relative to one another. A product reservoir including a container 11 is supported by a stand or holder 12 on a surface 14, and is secured in place by appropriate strap 15. Container 11 stores or contains a liquid spray product, for example, a hair spray for use as a hair fixative in a beauty salon. Container 11 has a lower necked-in portion 13 closed and sealed by a cap 16. One end of a flexible, hollow, tubular spray product line 17 connects with an outlet of container 11 at cap 16 as by engaging a hollow needle (not shown) inserted through cap 16.

A spray applicator or spray gun 18 is adapted to concurrently discharge first and second fluids such as a spray product and air under pressure upon the surface to be sprayed. Spray gun 18 includes the usual base or handle 19 and a forwardly projected barrel 20 terminating in an appropriate spray nozzle 21. A trigger 23 is movably mounted to the handle 19 of the gun. The product supply line 17 and the end of an applicator air supply line 24 extends through the bottom of handle 19 upwardly to barrel section 20. The gun 18 is preferably of the type that provides staged spraying of the air and spray product. That is, at the commencement of spraying, the air flow begins first, followed by the spray product flow. Upon termination of the spraying, the spray product shuts off first, followed by the shutoff of the air. While several versions of such an applicator are available, a preferred embodiment will be described presently.

Gas or air supply means includes an air compressor 25 shown supported on a suitable stand 26. Air compressor 25 is of a conventional, commercially available type having low power requirements and adapted to supply air under relatively low pressure. A first section 27 of a main air line 28 extends from the air discharge 29 of compressor 25 to a first T-connector 31. The perpendicular leg of the T-connector 31 connects through a tubular branch 32 to an inlet 33 of an air pressure accumulator 35. The pressure accumulator 35 comprises a closed, empty container or vessel providing a sealed volume where air under pressure is accumulated for use when the air compressor 25 is shut off. The compressor 25 is of the variety equipped with a standard pressure switching mechanism whereby the compressor 25 is energized when the line pressure drops to a predetermined level or low limit, and shuts off when the line pressure has been raised to a second predetermined level or high limit. In the present apparatus, a low limit of 8 pounds per square inch and a high limit of 12 pounds per square inch is satisfactory. Compressor 25 provides pressurized air to applicator 18 and at the same time pressurizes accumulator 35. When the line pressure reaches 12 pounds per square inch, the compressor shuts off, and the applicator 18 receives air under pressure from that stored in the accumulator 35.

A second section 36 of the main air supply line 28 extends from the first T-connector to a second T-connector 37. A connecting tube 39 extends from the perpendicular leg of the second T-connector 37 to provide air under pressure from main air supply line 28 to the container 11 and spray gun 18 of the spray apparatus. The main air supply line 28 continues from the second T-connector 37, as at 40, where it may be extended to additional spray systems connected in series, as, for example, in a beauty salon where there may be a plurality of stations, each having a separate spray product reservoir and spray applicator.

Connecting tube 39 extends from the second T-connector 37 to the perpendicular leg of a third T-connector 42. A reservoir air pressure supply branch 43 extends from one of the aligned legs of a third T-connector 42 to the product container 11. The end of supply branch 43 opposite the third T-connector 42 communicates with the interior of the container 11 as by engaging a tubular pin or needle (not shown) disposed generally in the upper portion of the container 11 and opening into the interior thereof. Connected to the opposite aligned leg of the third T-connector 42 is the applicator air supply line 24 which extends through the handle of the spray gun 18, as previously described. The third T-connector 42 as shown provides a reducing coupling allowing the use of smaller diameter tubing for the branch 43 and supply line 24. The use of a tubing of a smaller diameter than that of the main air line

is preferable when a series of spray systems are in use to minimize pressure drop along the main air line.

Intermediately disposed in the reservoir pressure supply branch 43 is a one-way air valve 44. The valve 44 disposed in branch 43 may be any one of several commercially available, the criteria being that the valve allow free air movement in one direction while restricting air movement in the opposite direction. A suitable valve for this purpose is described in U.S. Pat. No. 3,780,943. As disposed in the reservoir air supply branch 43, valve 44 is orientated to allow flow of air under pressure into the container 11 from the main air line 28, but operable to prevent air from flowing back through the branch 43 from the container 11.

In the use of the spray apparatus of the invention, spray product is stored in the container 11, as, for example, a hair holding liquid. Compressor 25 pressurizes the spray system to the predetermined high limit. Accumulator 35 and the upper or empty portion of container 11 are likewise pressurized. Upon engagement of the trigger 23 of spray gun 18 by the operator, air and spray product are concurrently discharged from the nozzle, preferably in staged sequence as previously described. The air mixes with and atomizes the spray product to form a fine, particulate, uniform spray. Air in the container 11 does not back up through the branch 43, whereby an erratic pressure fluctuation is not experienced by the spray product in the container. The spray is therefore fine and uniform at low pressure.

A preferred embodiment of a spray applicator for use in conjunction with the spray apparatus of the invention is shown in FIG. 2 and is fashioned for convenience as a spray gun 47 having an outer housing with a handle portion 48 and a barrel portion 49. Spray gun 47 includes sequential valving means 51 for staging of the air spray and the liquid spray at initiation and termination of spraying. A valve casing or housing 52 of valving means 51 is cylindrical and is centrally located in handle 48 and is secured in position by suitable struts 53, as shown in FIG. 3, extending from the interior walls of handle 48. Valve casing 52 defines an interior valve chamber 55 having separate inlet means and outlet means for a first and second fluid or, specifically, for air and a liquid spray product. Spray product line 17, entering the bottom of handle 48, engages a fluid or liquid inlet port 56 on casing 52 opening into chamber 55, as by snugly engaging an open nipple associated with a port 56. Likewise, air line 24 enters the bottom of handle 48 and engages an open nipple associated with fluid or air inlet port 57 spaced from liquid inlet port 56. A liquid line 59 leads from a liquid spray product outlet port 60 from valve chamber 55 to a mixing chamber 61 afforded by a suitable spray nozzle 63 having spray orifice 62 and threaded into the end of barrel portion 49 of applicator 47 to establish fluid communication between the fluid outlet means and spray nozzle 63. A pair of flexible, tubular air lines 64, 65 extend from a pair of open nipples integral with a pair of circumferentially aligned air outlet ports 67, 68 in communication with chamber 55 of valve casing 52. Air lines 64, 65 extend to and open into mixing chamber 61 to establish fluid communication between the air outlet means and the spray nozzle. Movably located in valving chamber 55 is a valving element 71 having first and second fluid passages or conduits for establishing communication between the air inlet and outlet ports and the liquid spray product inlet and outlet ports, respectively. Valving element 71 located in valve chamber 55 is sequentially movable between a first position in blocking relationship to the spray product inlet and outlets, and in blocking relationship to the air inlet and outlets shown in FIG. 5; a second position in blocking relationship to the spray product inlet and outlet, but with the first fluid conduit allowing fluid communication between the air inlet and air outlets, shown in FIG. 4; and a third position with the second fluid conduit allowing fluid communication between the spray product inlet and outlet and with the first fluid conduit allowing fluid communication between the air inlet and outlets, shown in FIG. 3.

Referring to FIGS. 3 through 5, valving element 71 is comprised as a plunger having a plurality of spaced apart, aligned, cylindrical heads 72, 73 and 76 having outer walls with portions in sealing relationship of the interior walls of the valve chamber 55. The heads are relatively spaced apart to provide passages to accomplish, in conjunction with the spacing of the various ports, the aforementioned staging or sequential valving action. A first head 72 is located at the interior end of valving plunger 71 relative to chamber 55, and is movable into and out of blocking relationship relative to the air inlet port 57 and air outlet ports 67, 68. A second head 73 is connected in aligned relationship to the first head 72 by a first neck 74, and is movable into and out of blocking relationship between the spray product inlet port 56 and the spray product outlet port 60. A neck 74 connected to heads 72 and 73 has a reduced diameter and outer walls spaced from the interior walls of the chamber 55, thus providing a first fluid conduit or passage through the chamber 55. A third head 76 is spaced from the second head 73 and connected to it by a second neck 77. Second neck 77 is likewise reduced in diameter and provides a second fluid conduit or passage through the chamber 55. A valve shaft 78 extends from the third head 76 outward of chamber 55 through a suitable aperture 80 wherein there is provided usual and preferred sealing means to prevent leakage. The various head 72, 73, 76 have outwardly projected circumferential ridges 81 which contact the interior walls of the chamber 55 and provide the necessary sealing relationship.

Plunger 71 is movable between three operative positions in valve chamber 55. In a first or closed position, as shown in FIG. 5, first head 72 blocks fluid communication between the air inlet port 57 and air outlet port 67 as by blocking air outlet port 67. Second head 73 prevents fluid communication between the spray product inlet port 56 and the spray product outlet port 60 by blocking both ports as shown, although, it is apparent that it is necessary only to block one of the ports. Plunger 71 is linearly movable from a position shown in FIG. 5 to that of FIG. 4 wherein the first head 72 is moved out of blocking relationship to the air outlet port 67. A passage or conduit of fluid communication is established between the air inlet port 57 and air outlet port 67 around the first neck 74. Air flow is initiated. Second head 73 remains in blocking relationship to spray product outlet port 60. On further linear movement of plunger 71 in chamber 55, the position of FIG. 3 is achieved. A fluid conduit or passage remains established between air inlet port 57 and air outlet port 67 around the first neck 74. A second fluid conduit or passage is established between the spray product inlet

port 56 and spray product outlet port 60 around the second neck 77 as second head 73 is moved out of blocking relationship to the spray product outlet port 60. Spray product flow is initiated. As shown in FIG. 3, second head 73 is in a position to prevent mixture of the air and spray product in the chamber 55. With the valving plunger 71 in the position of FIG. 3, air and spray product are concurrently being discharged, the air progressively mixing with and atomizing the spray product to provide a fine, particulate spray. Upon termination of spraying, movement of plunger 71 in valve chamber 55 is reversed, going respectively through the sequence of FIGS. 3, 4 and 5. The flow of spray product is first shut off when the second head 73 blocks the spray product outlet port 60 in the position of FIG. 4. Finally the air flow is also shut off when the plunger 71 reaches the position of FIG. 5, as previously explained. The staging of the air and spray product flow is accomplished by the relative sizing and spacing of the first and second heads 72, 73, as well as the relative spacing of the various ports. It is apparent that these parameters may be varied to vary the degree of staging. It is further apparent that additional fluid conduits could be introduced into the valve and staged as desired.

As shown in FIGS. 3 through 5, the inlet ports 56, 57 are not located on casing 52 diametrically opposite the respective outlet ports 60, 67, 68, but are staggered. In the closed position of FIG. 5 the liquid inlet port 56 is partially open to chamber 55 to permit liquid lubrication about the second neck 77. Air port 57 is open to the chamber 55 to permit even distribution of air pressure around first head 72.

Referring again to FIG. 2, linear movement of plunger 71 in valving chamber 55 is controlled by linear movement of plunger shaft 78 linearly extending from the third head 78 and second neck 77. Plunger shaft 78 extends outward from the valve chamber 55 and outward of the gun handle 48 and is attached at one end to a trigger 83. The upper end of trigger 83 is guided for linear movement in a suitable channel 84. A helical compression spring 85 surrounds the outboard portion of shaft 78 between trigger 83 and gun handle 48 to bias valve plunger 71 in the outermost or closed position. Digital pressure on trigger 83 is operative to actuate valving means 51 to provide the previously described staged spray of spray product and air.

The coarseness or fineness of a spray is determined in part by the amount of air mixed with the spray product, a lesser amount of air resulting in a coarser spray. It is occasionally desirable to change from a fine spray to a more coarse spray. For example, a beautician in shaping and styling the hair of a customer wants to use a fine, particulate spray. However, upon completion, the beautician wants to use a coarse spray for purposes of holding the hair style. The spray applicator 47 provides for the spray operator to alternate between a fine and a more coarse spray. Air outlet means on the valve casing 52, as previously noted, includes a pair of outlet ports 67, 68 which are joined respectively to a pair of air lines 64, 65, of which at least one is comprised of a flexible tubing. The flexible tubular air line 65 extends upward from valve casing 52 and then extends forwardly to the mixing chamber 61. A portion of the air line 65 passes over a ledge 87 extending inward from a vertical wall of applicator 47 near the top of barrel portion 49. A button 88 located exteriorly of barrel 49 has a shaft 89 passing through an aperture provided in barrel 49, and terminates in a plate 91. A portion of the air line 65 is sandwiched between the plate 91 and the ledge 87. Application of digital pressure downward on the button 88 results in the pinching off of the air line 65 cutting the flow of air to the mixing chamber 61 by approximately one-half. The resultant spray is more coarse.

In the use of the applicator 47, the operator simply engages the trigger 83. As the shaft 78 moves the plunger 71 interiorly of the valve chamber 55, the air and liquid product sprays are automatically staged. Likewise, upon termination of spraying, simply by release of the trigger 83 the termination of the air and liquid sprays is staged. The spring 85 returns the plunger 71 to the closed position. Pneumatic pressure developed in the interior end of the chamber 55 upon inward movement of plunger 71 also biases the plunger toward a closed position.

The method of spraying a spray product includes providing a supply of air under pressure and directing it through a main air line to a spray applicator. A portion of the air is directed through an auxiliary branch having a one-way air valve to a spray product reservoir. Spray product from the reservoir is directed to the spray applicator. The spray product and air are directed to a sequential valving means located in the spray applicator. The air spray is first commenced, and then the spray product spray. The spray product spray is first terminated, and then the air spray.

Shown and illustrated in FIGS. 7 through 9 is a preferred embodiment of a spray product reservoir or container assembly, according to the present invention. A generally cylindrical spray product container 93 is mounted in a holder 94 in an inverted position and contains the spray product. Container 93 is preferably plastic formed by a conventional blow molding process. Container 93 has a rounded shoulder 96 at the lower portion thereof, in the orientation shown in FIG. 7, which rests on a radially inward projected shelf 95 integral with holder 94. A plurality of vertical guides 97, shown in FIG. 8, correctly position the container 93. At the lower-most portion of container 93 is an open neck 98 defining an open throat closed by a plug 99. An open central portion of the plug 99 is closed by an insert 101 formed of an elastically penetrable material such as latex rubber. A pointed hollow needle 102 is securely, vertically positioned by suitable brace means 103 at the bottom of holder 94. The upper pointed portion of the needle 102 penetrates the insert 101 and communicates with the interior of che container 93. The lower end of the needle 102 is engaged by one end of the spray product delivery line 17A as at 105. Spray product delivery line 17A is trained upwardly along holder 94, emerging therefrom to extend to the spray applicator, as previously described.

An arm 106 is pivotally assembled to the top of holder 94 at the back thereof as at 107. Interiorly mounted in arm 106 and extending downward therefrom is a hollow, pointed, slightly curved needle 109. The pointed end of needle 109 penetrates the upper portion of container 93 and communicates with the interior thereof. The opposite end of needle 109 is connected to a oneway air valve 44A of the type previously described. The one-way valve 44A is connected to one leg of a T-connector 42A mounted interiorly of the arm 106. The other two legs of the T-connector 42A are connected respectively to a branch 39A leading from

a main air supply line, and an air supply line 24A leading to the applicator, as previously described. It may be seen that the air delivery line 24A and spray product delivery line 17A correspond to the air supply line 24 and product delivery line 17 of FIG. 1, while the branch line 39A corresponds to the branch 39 of FIG. 1.

In use, a full bottle of spray product 93 is placed in the holder with the arm 106 pvioted out of the way. The guides 97 properly position the container in the holder with the insert 101 of plug 99 in neck 98 positioned over the fluid needle. A gentle push downward on the jar causes the fluid needle 102 to pierce the insert 101 which seals around the needle 102 to prevent leakage, thereby establishing the liquid communication between the spray product in container 93 and the spray application. Arm 106 is pivoted downward to a position whereby the air needle 109 punctures the container 93 and enters it. The air needle 109 is slightly curved so as not to rip or tear the surface of container 93, but enter in a smooth continuous motion. When the air needle 109 is seated in the container 93, the air pressure connection is established between the main air line and the interior of the container 93. When the container 93 is emptied, it is simply removed from the holder 94 and discarded. Upon removal of liquid needle 101 from insert 101, insert 101 reseals to prevent loss of liquid in the event that container 93 is not yet empty.

As shown in FIG. 10, the air needle could optionally be situated adjacent the liquid product needle 102. An air needle 109A is suitably secured in brace 103 adjacent liquid needle 102 and penetrates insert 101. A suitable connecting tube 112 connects air needle 109A to the air pressure supply branch. Air under pressure is delivered to the container 93 through air needle 109A as spray product is delivered through the liquid needle 102 to the applicator. The one-way air valve 44A prevents the backing up of the spray product into the main air line 24A or air delivery line 39A.

The closure assembly of container 93 is shown in greater detail in FIG. 9. Container 93 terminates in neck 98 having an open throat 110 adapted to snugly receive plug 99. Plug 99 is generally cylindrical having outside walls to closely conform to the interior walls of neck 98, and has a central cylindrical opening 111 having a reduced, tapered portion 113 facing the interior of container 93. Peripherally surrounding the opposite end of opening 111 on plug 99 is, in the unassembled form of FIG. 9, an outwardly directed, upstanding annular ridge 114.

Insert 101 is generally cylindrical adapted to snugly fit in the central opening 111 of plug 99, and has a conical shoulder 115 facing the plug 99, terminating in a reduced cylindrical section 116.

In assembly, insert 101 is first positioned in the central opening 111 of plug 99 whereby the conical shoulder 115 and reduced cylindrical portion 116 of insert 101 make sealing contact with the interior walls defining reduced tapered opening 113 in plug 99. Ridge 114 is fused by heat or other suitable means over the outer end of insert 101, as seen in FIG. 7, whereby the insert is tightly sealed in plug 99.

The container 93 having been filled with the proper spray product, plug 99 is positioned in throat 110 of neck 98. An exterior outer peripheral ledge 118 on plug 99 abuts a mating, interior annular ledge 119 at the interior end of throat 110. A tapered, interiorly directed lip 120 adjacent ledge 118 on plug 99 is forced radially inward by the corner of ledge 119 in throat 110 to effect a seal. An annular ridge 122 located at the exterior end of plug 99 and coextensive with the perimeter thereof, is fused to the end portion 23 of the interior walls of neck 98 as by spin welding. A leak-proof seal is formed between the plug 99 and the neck 98.

The assembly of the insert 101, plug 99 and container 93 is such that the container 93 is not reusable upon depletion of the spray product. The mixing of volatile or toxic substances and residues is avoided.

In terms of bottling or containing a liquid, the method includes providing a plug 99 with a central opening 111. An elastically penetrable insert 101 is located in the central opening 111 of the plug 99 and fused therein with portions in sealing contact with edges of the central opening 111. A container having an open neck is filled with a spray product. The plug is located in closing relationship to the open neck with portions of the plug 99 in sealing relationship to inside surfaces of the neck 98. The plug and the neck are fused together, as by spin welding. The method further includes providing an annular ridge 114 on the plug 99 to fuse over the elastically penetrable insert 101 to hold it in place. The method further includes the use of a one-way air valve in association with said container to allow air freely to enter said container but to restrict the exit of air from said container.

Thos skilled in the art will recognize that the present invention will find use in many applications other than beauty salons, where it is desirable to have a fine, particulate, low pressure spray. For example, the spraying of finishes, paints, cleaning fluids, insecticides, and the like. The spray apparatus of the invention is particularly useful for the spraying of volatile products which would normally be quick to evaporate when exposed to rapid air movement and erratic pressure fluctuation. For example, the invention finds application in the medical field where it is common to spray ether on slight wounds for use as a local anesthetic. It is further apparent that the apparatus is useful for the concurrent spray of any two fluids whether in a gaseous or liquid state. As previously mentioned, the valving means 51 is easily adapted for the discharge of more than two fluids in staged sequence as desired.

While there have been shown and described a novel container for use in the spray apparatus of the invention, it is apparent that such a container has other beneficial uses. For example, containers of fluid for intravenous feeding of hospital patients are used in an inverted position and employ dip tubes extending from the bottom of the container to the top in order to allow air into the container as the fluid is dispensed to a patient. The use of the present container in association with a one-way air valve allows elimination of the dip tube in such containers containing an intravenous feeding solution. Those skilled in the art will recognize further uses for the container of the present invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An apparatus for the spraying of a spray product to obtain a fine particulate spray at low pressure comprising:

a closed reservoir to contain the spray product;

a main air line adapted to receive a supply of air under low pressure from an air supply means;

spray applicator means operable to concurrently discharge air and a spray product in a fine particulate spray;

said main air line connected directly to the spray applicator means to supply air under low pressure to the spray applicator means;

an air pressure supply branch disposed between the main air line and the reservoir to supply air under pressure to the reservoir;

a one-way air valve disposed in said air passage supply branch orientated to allow the free passage of air from the main air line into the reservoir and restrict passage of air from the reservoir to the main air line;

a product line disposed between the reservoir and the spray applicator means to deliver spray product to the spray applicator means;

said spray applicator means having sequential valving means and actuator means to actuate the sequential valving means;

said sequential valving means operable to initiate flow of air before flow of spray product upon commencement of spraying, and terminate the flow of spray product before termination of the flow of air upon completion of spraying.

2. The spray apparatus of claim **1** including: a pressure accumulator associated with said main air line.

3. The spray apparatus of claim **1** wherein: said spray applicator means comprises a spray gun.

4. The spray apparatus of claim **1** including:

a plurality of said spray reservoirs associated with an equal plurality of spray applicator means;

said main air line connected to each of said spray applicator means;

an air pressure supply branch disposed between said main air line in each of said reservoirs; and

a one-way valve disposed in each said air pressure supply branch.

5. The spray apparatus of claim **1** wherein said sequential valving means includes:

a valve casing defining a valve chamber;

air inlet means to the valve chamber and connected to the main air line;

spray product inlet means to the valve chamber and connected to the product line;

air outlet means from the valve chamber;

spray product outlet means from the valve chamber;

a valving element movably located in said valve chamber;

said valving element having a first fluid passage and a second fluid passage;

said valving element sequentially movable between a first position blocking fluid communication between the air inlet means and the air outlet means and blocking fluid communication between the spray product inlet means and spray product outlet means;

a second position with the first fluid passage in position to allow fluid communication between the air inlet means and the air outlet means and in blocking relationship between the spray product inlet means and the spray product outlet means;

a third position with the first fluid passage in position to allow fluid communication between the air inlet means and the air outlet means, and the second fluid passage in position to allow fluid communication between the spray product inlet means and the spray product outlet means;

said actuator means being adapted to sequentially move said valving element.

6. The spray apparatus of claim **5** wherein: said air outlet means includes a pair of air outlet ports communicating with the valve chamber; and including means to selectively restrict the flow of air through one of said air outlet ports.

7. The spray apparatus of claim **5** including: bias means associated with the actuator means to bias said valving element in the first position.

8. The spray apparatus of claim **5** wherein:

said air inlet means is comprised of at least one air inlet port;

said air outlet means is comprised of at least one air outlet port;

said spray product inlet means is comprised of at least one spray product inlet port;

said spray product outlet means is comprised of at least one spray product outlet port;

said valving element is constituted as a plunger linearly movable in said valve chamber;

said plunger having a first head movable into and out of blocking relationship between said air inlet port and said air outlet port, a first neck in linear alignment with said first head and providing said first fluid passage, a second head in linear alignment with said first neck and movable into and out of blocking relationship between the spray product inlet port and spray product outlet port, and a second neck linearly aligned with said second head and providing said second fluid passage.

9. A spray applicator for the concurrent discharge of a first fluid and a second fluid with staged initiation and termination of spraying of the first fluid and second fluid, said applicator comprising:

an applicator housing;

sequential valve means located in said applicator housing;

said sequential valve means including a valve casing defining a valve chamber;

first fluid inlet means to the valve chamber adapted to receive a first fluid under pressure from a first fluid delivery line;

second fluid inlet means to the valve chamber adapted to receive a second fluid under pressure from a second fluid delivery line;

first fluid outlet means from the valve chamber;

second fluid outlet means from the valve chamber;

a valving element movably located in said valve chamber;

said valving element having a first fluid passage and a second fluid passage;

said valving element sequentially movable between a first position blocking fluid communication between the first fluid inlet means and the first fluid outlet means, and blocking fluid communication between the second fluid inlet means and the second fluid outlet means;

a second position with the first fluid passage allowing fluid communication between the first fluid inlet means and the first fluid outlet means, and blocking fluid communication between the second fluid inlet means and the second fluid outlet means; and

a third position with the first fluid passage allowing fluid communication between the first fluid inlet means and the first fluid outlet means, and the second fluid passage allowing fluid communication between the second fluid inlet means and the second fluid outlet means;

actuator means adapted to sequentially move said valving element;

a spray nozzle associated with said spray applicator housing; and

means establishing fluid communication between the first outlet means and the second outlet means, and the spray nozzle.

10. The spray applicator of claim **9** wherein: said first fluid outlet means includes a pair of fluid outlet ports communicating with the valve chamber; and including means to selectively restrict the flow of the first fluid through one of said first fluid outlet ports.

11. The spray applicator of claim **9** including: bias means associated with the actuator means to bias said valving element in the first position.

12. The spray applicator of claim **9** wherein:

said first fluid inlet means is comprised of at least one first fluid inlet port;

said first fluid outlet means is comprised of at least one first fluid outlet port;

said second fluid inlet means is comprised of at least one second fluid inlet port;

said second fluid outlet means is comprised of at least one second fluid outlet port;

said valving element is constituted as a plunger linearly movable in said valve chamber;

said plunger having a first head movable into and out of blocking relationship between said first inlet port and said first outlet port, a first neck in linear alignment with said first head and providing said first fluid passage, a second head in linear alignment with said first neck and movable into and out of blocking relationship between the second fluid inlet port and said fluid outlet port, and a second neck in linear alignment with said second head and providingly said second fluid passage.

13. The spray applicator of claim **12** wherein: said first fluid outlet means is comprised of a pair of first fluid outlet ports; and including means to selectively restrict the flow of first fluid through one of said first fluid outlet ports.

14. The spray applicator of claim **13** wherein: means establishing fluid communication between the first fluid outlet means and the spray nozzle includes a flexible, tubular fluid line extending from one of said first fluid outlet ports to said spray nozzle; and wherein the means to selectively restrict the flow of first fluid through one of said fluid outlet ports includes a ledge secured to said spray applicator housing, a plate located adjacent said ledge and attached to a shaft extending out of said applicator housing, a button attached to the opposite end of said shaft outside of said applicator housing, said flexible tubular fluid line having a portion passing over said ledge between said ledge and said plate whereby upon application of digital pressure to said button said flexible tubular fluid line is pinched off.

15. The spray applicator of claim **12** wherein said actuator means to actuate the sequential valving means includes: a plunger shaft extending from said plunger linearly outward of said valve chamber and said applicator housing, and a trigger connected to the outward end of said plunger whereby digital pressure upon said trigger is operable to move said valve plunger between said first, second and third positions.

16. A method of spraying a spray product in a fine particulate spray including the steps of:

directing air under relatively low pressure through a main air line directly to a spray applicator;

directing a portion of the air from the main air line through an air branch having a one-way air valve to a spray product reservoir;

directing the spray product from the reservoir through a product line to the spray applicator; and

sequentially discharging first the air and then the spray product upon the initiation of spraying, and sequentially terminating first the spray product and then the air upon the completion of spraying.

17. The method of claim **16** wherein the step of sequentially discharging first the air and then the spray product upon the initiation of spraying, and sequentially terminating first the spray product and then the air upon the completion of spraying includes:

directing the spray product to the spray product inlet of a sequential valve means having a movable valving element and spray product inlet means, spray product outlet means, air inlet means and air outlet means;

directing the air to the air inlet means of the valving means;

sequentially moving the valving element to initiate spraying, from a first position blocking fluid communication between the spray product inlet means and spray product outlet means, and between the air inlet means and air outlet means; to a second position blocking fluid communication between the spray product inlet means and spray product outlet means, and allowing fluid communication between the air inlet means and air outlet means; to a third position allowing fluid communication between the spray product inlet means and spray product outlet means, and allowing fluid communication between the air inlet means and air outlet means;

providing fluid communication between the air outlet means and a spray nozzle, and between the spray product outlet means and the spray nozzle; and

moving the valving element from the third to the second then the first position upon completion of spraying.

18. An apparatus for the spraying of a spray product to obtain a fine, particulate spray at low pressure comprising:

a closed spray product reservoir to contain the spray product;

a main air line adapted to receive a supply of air under low pressure from an air supply means;

spray applicator means operable to concurrently discharge air and a spray product in a fine, particulate spray;

said main air line connected directly to the spray applicator means to supply air under low pressure to the spray applicator means;

an air pressure supply branch disposed between the main air line and the reservoir to supply air under pressure to the reservoir;

a one-way air valve disposed in said air passage supply branch orientated to allow the free passage of air from the main air line into the reservoir and restrict passage of air from the reservoir to the main air line;

a product line disposed between the reservoir and the spray applicator means to deliver spray product to the spray applicator means, said product line terminating at a hollow, pointed needle;

said spray product reservoir having a closed container with an open neck portion, closure means cooperating with the neck portion to close the open neck portion, said closure means having a central opening, an elastically penetrable insert located in sealing relationship to and closing said central opening of the closure means, said container being positioned in an inverted position with said neck portion at the bottom thereof, said pointed needle of said product line penetrating said elastically penetrable insert and communicating with the interior of the container.

19. The spray apparatus of claim **18** wherein: said air pressure supply branch terminates in a hollow, pointed needle, said air pressure supply branch needle penetrating said elastically penetrable insert and communicating with the interior of the container.

20. The spray apparatus of claim **18** wherein: the closure means includes a plug located in said open neck having outer wall portions in sealing engagement with interior portions of said open neck to seal the open neck.

21. In a spray apparatus of the type having a spray product reservoir, a main air line adapted to receive a supply of air under low pressure from an air supply means, spray applicator means operable to concurrently discharge air and a spray product in a fine, particulate spray, said main air line connected directly to the spray applicator means to supply air under low pressure to the spray applicator means, an air pressure supply branch disposed between the main air line and the reservoir to supply air under pressure to the reservoir, a one-way air valve disposed in said pressure supply branch orientated to allow free passage of air from the main air line into the reservoir and restrict passage of air from the reservoir to the main air line, and a product line disposed between the reservoir and the spray applicator means to deliver spray product to the spray applicator means, an improved spray reservoir including:

a closed container having an open neck, closure means sealably closing the open neck of the container, said closure means having a central opening, an elastically penetrable insert located in sealing relationship to said central opening and adapted to be penetrated by a portion of the product line whereby spray product is carried from the interior of the container through the product line to the spray applicator.

22. The spray apparatus of claim **21** wherein: the closure means includes a plug located in said open neck having outer wall portions in sealing engagement with interior portions of said open neck to seal the open neck.

23. The spray apparatus of claim **22** wherein: the open neck portion of the container has an interior, outwardly facing ledge; said plug having a peripheral, inwardly facing ledge in mating contact with the outwardly facing ledge of the open neck.

24. A liquid product reservoir comprising:

a closed container having an open neck portion with interior walls defining an open throat;

an interior, outwardly facing ledge integral with said interior walls of said throat;

a plug located in said throat having outer walls closely conforming to the interior walls of said neck portion to close the neck portion;

said plug having a peripheral, inwardly facing ledge in mating contact with the outwardly facing ledge in said throat;

the end portion of said neck being fused to the end of said plug to secure said plug in said throat;

said plug having a central opening;

an elastically penetrable insert sealably located in said central opening of said plug.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,841,555 Dated October 15, 1974

Inventor(s) Duane F. Lilja

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 8, line 50, "che" (second occurrence) should be --the--.

Column 9, line 16, "application" should be --applicator--.

Column 9, line 26, "101" (first occurrence) should be --102--.

Column 10, line 29, "Thos" should be --Those--.

Column 13, line 40, following "said" insert --second--.

Column 16, delete Claim 24.

On the cover sheet under the Abstract, "24 Claims" should read -- 23 Claims --.

Signed and sealed this 31st day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents