United States Patent

Nystuen

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[54] **COMBINATION ASPIRATOR AND SPRAY NOZZLE**

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[52] **U.S. Cl.** **239/318,** 239/354, 239/526

[51] **Int. Cl.** **B05b 7/30**

[58] **Field of Search**.....239/310, 304, 305, 318, 354, 239/537, 526

[56] **References Cited**

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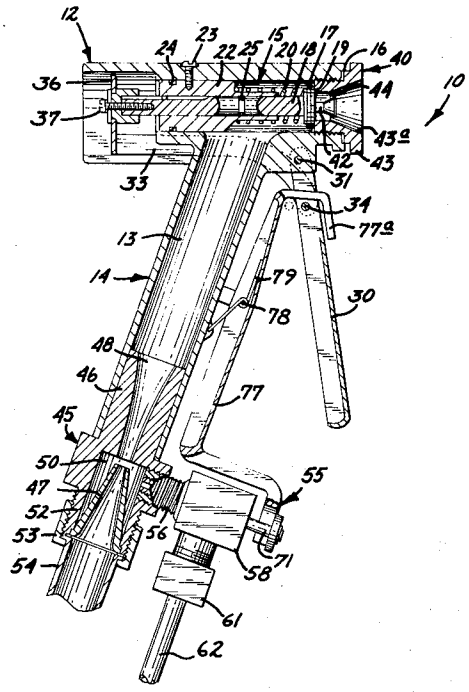
[57] **ABSTRACT**

A portable hand-held spray gun having a hollow handle defining a water passageway therein, a venturi positioned in the water passageway and a product conduit line in communication with the throat of the venturi for injecting product (e.g. a liquid detergent) into the water flow. Two trigger-operated valves separately control the flow of water through the water passageway and the injection of the product into the water flow. A nozzle for forming a variable spray pattern is provided downstream of the venturi, the dimensions of the nozzle orifice and venturi throat being such that the injection rate of the product is essentially constant over a wide range of spray patterns.

6 Claims, 5 Drawing Figures



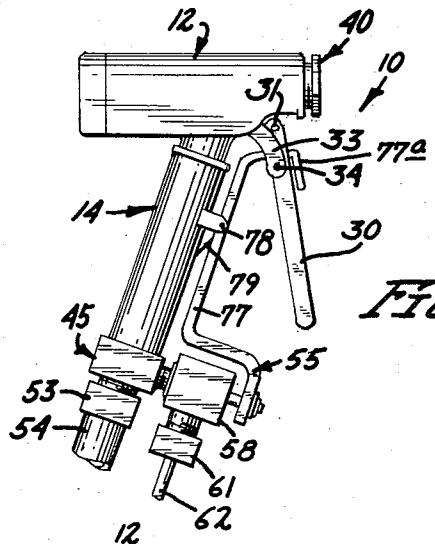


FIG. 1

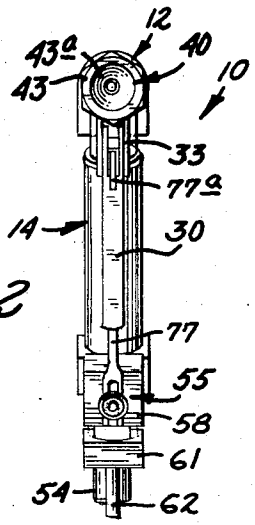


FIG. 2

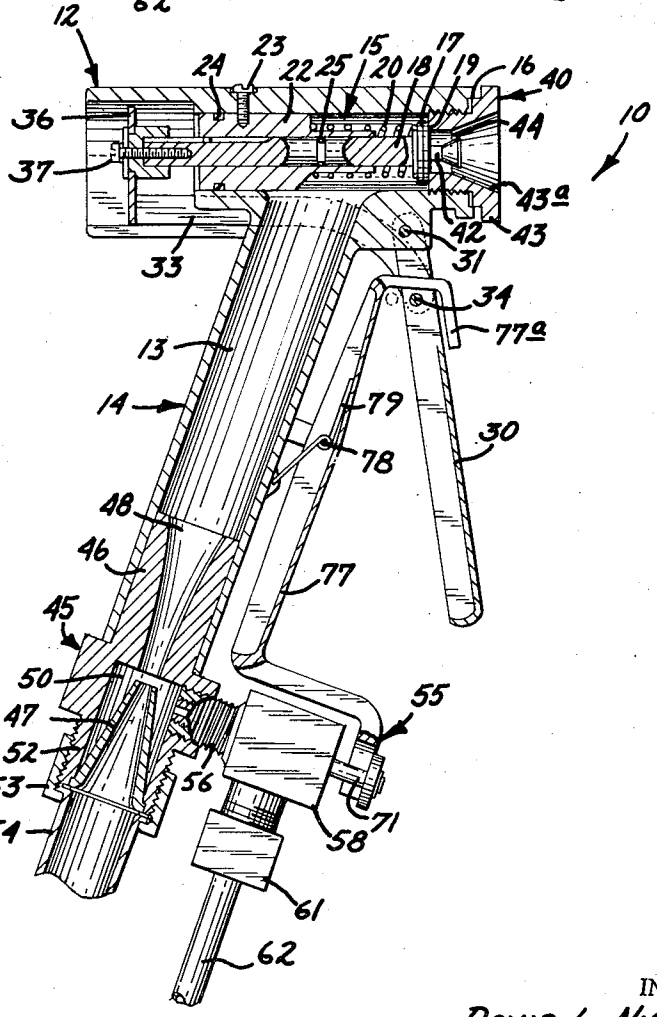


FIG. 3

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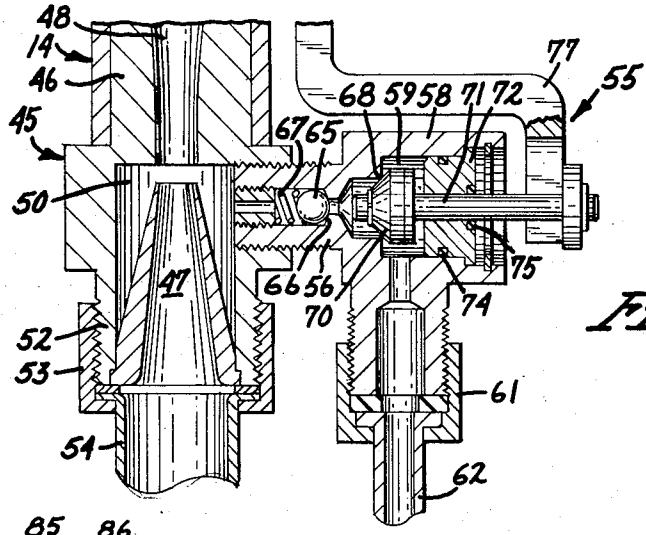

FIG. 4

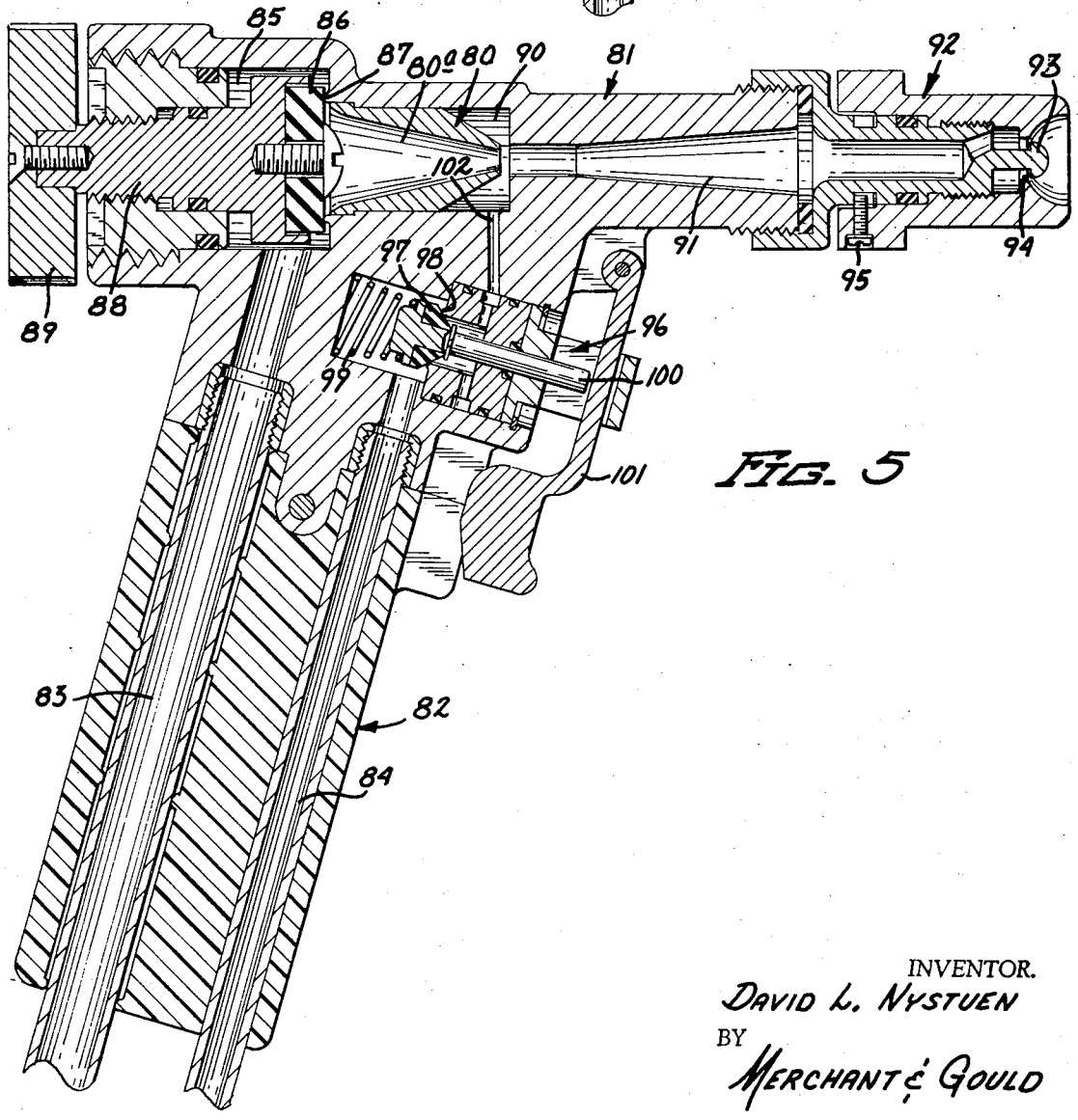

FIG. 5

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COMBINATION ASPIRATOR AND SPRAY NOZZLE

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for injecting a fluid product into a fluid carrier flow and for providing a spray pattern to the combined carrier and product.

The use of aspirator apparatus such as a venturi to inject a fluid product into a flow of a fluid carrier is well known. This is particularly true in the cleansing apparatus art where it is well known that a liquid cleanser can be injected into a flow of water using a venturi of various designs. Commonly, these aspirating devices have included nozzle apparatus for providing a variable spray pattern to the combined flow of water and injected liquid cleanser and have taken the form of a gun-like structure which is portable and hand-held. (See, e.g. U.S. Pat. No. 3,128,949, which issued on Apr. 14, 1964 to S. H. Kaufman.) Such aspirating and spraying devices have found numerous private and commercial applications. For example, they are commonly used to wash the floors and walls in commercial dining institutions and in other similar establishments.

The prior art spray devices are, however, disadvantageous for a number of reasons. First, the rate at which the liquid cleanser is injected into the water flow is dependent on the size of the outlet aperture of limiting orifice in the variable spray nozzle. The same is also true for the total quantity of combined water and aspirated liquid detergent exhausted through the nozzle. This renders the apparatus less effective for certain operating conditions (e.g. different spray patterns) than for others and, consequently, decreases the versatility thereof. Secondly, the prior art aspirating and spraying devices have generally been of a two nozzle type; one nozzle providing a spray pattern to the combined flow of water and liquid cleanser and the second nozzle providing a spray pattern solely to the flow of water for use in the rinsing operation. This has resulted in relatively complex apparatus. Thirdly, it has been common for a liquid cleanser reservoir (e.g. a plastic container) to be mounted on the spray gun. This is necessary since the prior art venturi-aspirators generally are not capable of drawing the liquid cleanser over extended distances so as to allow storage of the cleanser at a remote storage position. Such mounting of the cleanser container has rendered the apparatus rather bulky and clumsy to handle.

SUMMARY OF THE INVENTION

Broadly speaking, the present invention arose out of the discovery that the dimensions of the venturi throat and the outlet aperture in the spray nozzle can be chosen so as to provide a generally constant reduced pressure in the throat of the venturi. The apparatus provided to obtain this feature is preferably in the form of a gun-like structure having two trigger-operated valves for separately controlling the flow of carrier fluid and the injection of product fluid. The combined carrier and product fluids are exhausted through a single spray nozzle.

The present invention has been found to generally eliminate the aforementioned disadvantages of the prior art spraying devices. First, the present invention injects a fluid product (e.g. a liquid cleanser) into a carrier fluid (e.g. water) at a rate which is generally independent of the type of spray pattern formed by the spray-forming nozzle. The total volume of combined carrier and aspirated product exhausted through the nozzle is also essentially constant. Secondly, this invention necessitates only a single nozzle. Moreover, the present invention is of an extremely simple design and is readily portable and hand-held. For example, since the venturi means utilized in the present invention will draw the liquid cleanser over extended distances, it is unnecessary to mount a cleanser storage container on the gun-like structure. This, of course, reduces the bulkiness and clumsiness of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of one preferred embodiment of the aspirating and spraying apparatus provided by the present invention, the apparatus taking the form of a portable hand-held spray gun;

FIG. 2 is a front elevational view of the embodiment illustrated in FIG. 1;

FIG. 3 is a partial cross-sectional view through a vertical plane of the embodiment illustrated in FIG. 1;

FIG. 4 is an enlarged, fragmented cross-sectional view of the valving apparatus shown in FIG. 3 for controlling the amount of product injected into the water flow; and

FIG. 5 is a sectional view through a vertical plane of an alternate embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the embodiment shown in FIGS. 1–4, the numeral **10** generally designates a gun-like structure (i.e. pistol-shaped) comprising the aspirating and spraying apparatus provided by the present invention. As will become apparent from the description hereinbelow, gun-like structure **10** is adapted to eject either (1) a stream of (2) carrier liquid (e.g. water) or a stream of carrier liquid in admixture with a liquid product (e.g. a liquid detergent).

The gun-like structure **10** includes a barrel generally designated **12** having an axial bore which intermediate its ends communicates with a passageway **13** defined by a tubular member or hollow gun handle **14**. The barrel portion **12** includes valving means **15** for controlling the flow of fluid therethrough. The fluid enters the passageway defined by barrel **12** through passageway **13** and is exhausted from the barrel passageway through an outlet opening **16** at the forward end thereof.

Valving means **15** comprises a valve disk **17** attached to an axially extending valve stem **18** and urged toward a valve seat **19** by a compression spring **20**. As illustrated, valve stem **18** extends through an axial bore in a stationary member or plug **22** which is held in its stationary position by a screw **23**. Sealing rings **24** and **25** are positioned within annular grooves in plug **22** and valve stem **18**, respectively, to provide a fluid-tight valving chamber between plug **22** and valve seat **19**. Passageway **13** in gun handle **14** is in communication with this fluid-tight chamber.

Valving means **15** is actuated by a trigger member **30** which is hinged to barrel **12** by a pin **31**. A connecting rod **33** is moveably connected to trigger **30** by pin **34**. Connecting rod **33** extends internally into barrel **12** and

is connected to valve stem 18 by means of a connecting member 36 and a screw 37. By manually depressing trigger member 30 toward handle 14, valve stem 18 and valve disk 17 are urged in an axial direction away from valve seat 19 to allow fluid passage outwardly through the outlet opening 16 in the barrel passageway. On release of the pressure applied to trigger 30, compression spring 20 urges valve disk 17 against valve seat 19 thereby returning valving means 15 to its closed position so as to prevent fluid flow through opening 16.

A nozzle assembly generally designated 40 is associated with outlet opening 16. Nozzle assembly 40 includes an axially extending, generally cylindrical nozzle element 42 connected to an outwardly facing surface of valve disk 17 and having a frusto-conically shaped outer end portion. Nozzle element 42 moves axially in conjunction with the movement of valve disk 17 in response to the depressing of actuating trigger 30. The axial movement of nozzle element 42 occurs within a frusto-conically shaped passageway 43*a* defined by a nozzle element 43 threadedly connected to barrel 12. This axial movement provides a variable spray pattern. For example, when valve disk 17 is only slightly separated from seat 19 so that the nozzle element 42 is in its outermost position, the fluid exhausted through the nozzle assembly will have a generally open cone shape. On the other hand, with nozzle element 42 in its innermost position, the fluid flow exhausted through the nozzle assembly has the shape of a pencil-like jet. An outlet aperture or limiting orifice 44 is defined by the annular separation between the essentially parallel surfaces of the outer end portion of nozzle element 42 and the inner surfaces of the nozzle element 43 defining the frusto-conically shaped passageway 43*a*.

Turning now to the handle portion 14 of gun-like structure 10, passageway 13 has in liquid communication therewith aspirator apparatus generally designated 45 in the form of a tubular member defining a venturi-aspirator. As illustrated, the tubular member 45 has a sleeve portion 46 which is shrink or force fitted into the butt end of handle 14 so as to form an extension of passageway 13. A converging passageway 47 defines the throat of venturi 45 at the apex thereof and an outwardly expanding frusto-conically shaped passageway 48 defines what is commonly referred to as the venturi recovery passageway. A chamber 50 surrounds the throat of the venturi and is in communication therewith. An externally threaded portion 52 opposite the force-fitted sleeve portion 46 receives a female hose coupling 53 and a hose 54 which is connectable to a source of carrier fluid (not shown) such as water.

The venturi-aspirator apparatus has associated therewith valving means generally designated 55. Tubular member 45 has a transverse bore into which is threadedly inserted a conduit 56 having a conventional check valve positioned therein for preventing reverse flow (i.e. left to right flow) of water therethrough. Conduit 56 has one end thereof in communication with chamber 50. The oppositely disposed end of conduit 56 is connected to a valve body 58 having a valving chamber 59 therein. A female coupling member 61 having a conduit 62 attached thereto threadedly engages valve body 58. Conduit 62 is connectable to a source of product fluid (not shown) such as a liquid detergent and, when valving means 55 is in its open position, the liquid detergent flows through conduit 62, valving chamber 59, conduit 56 and into vacuum chamber 50 as subsequently described.

The valving means 55 can be seen particularly well in FIG. 4 and reference should be made thereto in conjunction with the following description. The conventional check valve inserted within conduit 56 comprises a spherical member 65, a valve seat 66 and a compression spring 67 which urges the spherical member 65 against seat 66. Conduit 56 communicates with valving chamber 59 and defines a valve seat 68 at the end thereof communicating with chamber 59. A valve member 70 is connected to a valve stem 71 which extends through an axial bore within a stationary or plug member 72. Valve member 70 and stem 71 are axially moveable toward and away from valve seat 68. Sealing rings 74 and 75 positioned within annular grooves in plug member 72 are provided for sealing valving chamber 59 in which valve member 70 is positioned.

An actuating trigger member 77 is connected to valve stem 71 and is pivotally connected to handle 14 by a pin 78 extending transversely therethrough. Trigger member 77 extends upwardly generally parallel to handle 14 and includes an end portion 77*a* thereof which extends outwardly from handle 14 through an opening in trigger 30 so as to be manually depressible toward handle 14 to unseat valve member 70 from seat 68. A spring element 79 urges the upper portion of trigger 77 outward from handle 14 and, consequently, the valve member 70 is urged against seat 68. Such an arrangement of trigger members 30 and 77 allows the apparatus to be operated by one hand, leaving the other hand of the operator free to assist him in whatever way desirable. Other valving and triggering arrangements can, of course, be utilized.

Although it is believed that the operation of the present invention is apparent from the above description, a brief operative description follows. After gun-like structure 10 is connected to suitable sources of water and liquid detergent, the apparatus is actuated by manually depressing trigger member 30 toward handle 14 to unseat valve disk 17 from seat 19. This allows water flow through hose 54, venturi-aspirator 45, passageway 13, the passageway defined by barrel 12 and past seat 19 outward through the nozzle assembly 40. The extent to which trigger 30 is depressed determines the movement of nozzle element 42 within nozzle passageway 43*a* and, consequently, the spray pattern of the liquid exhausted from nozzle 40. With trigger member 30 alone depressed, only water is exhausted outward through the spray nozzle assembly 40. This provides the wetting or rinse phase of the cleansing operation. When it is desired to add liquid detergent to the water flow, trigger member 77 is depressed toward handle 14 to unseat valve member 70 from seat 68. Thereafter, the reduced pressure at the throat of venturi 45 and within chamber 50 draws the liquid detergent from its remote storage point through hose 62, valving chamber 59 and conduit 56 into chamber 50. There, the liquid detergent is admixed with the water flow. This provides the sudsing phase of the cleansing operation. When it is desired to terminate the sudsing phase, the trigger 77 is released and the spring element 79 urges valve member 70 toward seat 68 to terminate injection of the liquid detergent.

Similarly, when it is desired to terminate the exhaustion of water through nozzle **40**, trigger member **30** is released allowing the valve disk **17** to close against seat **19**.

A particularly advantageous feature of the embodiment illustrated in FIGS. **1–4** is that the rate of injection of liquid detergent into the water flow through the venturi-aspirator is essentially independent of the spray pattern formed by nozzle assembly **40** (i.e. whether the spray pattern is conically-shaped or a straight jet). It (e.g. been found that this advantageous feature is obtainable by choosing the dimensions of the venturi throat and the outlet aperture **44** of the nozzle assembly **40** so as to obtain an essentially constant reduced pressure within vacuum chamber **50**. For example, in the embodiment illustrated in FIGS. **1–4**, the venturi throat has a diameter of about .**147** inches and the outlet aperture **44** has an essentially constant cross-sectional area of about 0.042 square inches. These dimensions provide an essentially constant reduced pressure in chamber **50**.

Such dimensions, and similar relative dimensions for providing the essentially constant reduced pressure at the venturi throat, are obtained, for example, in the following manner. Initially, a venturi throat diameter and a nozzle outlet aperture having approximately the same cross-sectional area as the venturi throat are chosen so as to provide the desired flow rate through the spray gun **10**. The outlet aperture should have an essentially constant cross-sectional area over the entire range of spray patterns provided by the nozzle assembly. Otherwise, the nozzle assembly can be modified to provide this feature as in the embodiment described subsequently. Next, the vacuum within chamber **50** is measured (e.g. by using a standard vacuum gauge) and the size of the outlet aperture is gradually increased (e.g. by conventional machining techniques) until an essentially constant reduced pressure is obtained within chamber **50** over the entire range of spray patterns provided by nozzle assembly **40**. Normally, this constant pressure is obtained at about 21–23 inches of mercury.

As an example, in one run the pressure upstream of the venturi-aspirator was 60 pounds/sq. inch. Here, 5.3 gallons of liquid per minute were exhausted through nozzle assembly **40** in a pencil-like spray pattern and about 0.325 percent of the exhausted liquid was liquid detergent. On adjusting nozzle **40** to provide a conically-shaped spray pattern and using the same upstream pressure, 5.3 gallons of liquid were still exhausted per minute with roughly 0.347 percent of the liquid being liquid detergent.

The alternate embodiment illustrated in FIG. **5** is similar in many respects to the embodiment illustrated in FIGS. **1–4**. Thus, a brief description of this alternate embodiment will suffice.

Again, the aspirating and spraying apparatus is in the form of a gun-like structure having a barrel **81** and a handle **82**. As illustrated, handle **82** defines two fluid passageways; a first passageway **83** which is connectable to a source of water and a second passageway **84** which is connectable to a source of liquid detergent. Passageway **83** extends upwardly to communicate with a valving chamber **85** forming the rearward portion of the axial bore or passageway defined by gun barrel **81**. Positioned within chamber **85** is a moveable valve member **86** which seats against a valve seat **87** when in its closed position. Valve member **86** is moved toward and away from seat **87** by adjustment of a threaded member **88** having one end connected to member **86** and the opposite end connected to a knob **89**. Downstream from valving chamber **85**, the axial bore of the gun barrel defines a venturi-aspirator **80** therein. Venturi **80** has a restricted passageway **80a** which defines the throat of the venturi and which communicates with a chamber **90** surrounding a portion of the restricted passageway **89**. A recovery passageway **91** of venturi **88** communicates with an externally threaded outlet in the barrel and which has a nozzle assembly **92** in threaded engagement therewith.

In the embodiment illustrated in FIG. **5**, nozzle assembly **92** is similar in overall design to the nozzles commonly used in conjunction with ordinary garden hoses. However, the cross-sectional area of the outlet aperture (i.e. the annular spacing between a stationary nozzle element **93** and an axially moveable circular opening **94**) has been adjusted to provide an essentially constant reduced pressure within vacuum chamber **90** and to allow essentially the same amount of liquid to be exhausted therethrough regardless of the spray pattern formed thereby. In the illustrated embodiment, nozzle element **93** has a spherical radius of about 0.154 inches and opening **94** has a radius of about 0.202 inches. These dimensions can be obtained in the same manner as previously described. A screw **95** engages an annular groove in the stationary portion of the nozzle assembly to restrict axial movement (i.e. adjustment) of the moveable portion thereof. This restricted movement provides an outlet aperture having an essentially constant cross-sectional area without significantly reducing the range in spray patterns provided by nozzle assembly **92**.

As in the previously described embodiment, the injection of liquid detergent into vacuum chamber **90** is controlled by a trigger-actuated valve means generally designated **96**. Valving means **96** comprises a valve member **97** which is urged against a valve seat **98** by a compression spring **99**. A valve stem **100** has one end connected to valve member **97** and the opposite end engageable with a pivotal trigger **101** for moving valve **97** away from seat **98** when the trigger is depressed toward handle **82**. With trigger **101** depressed, the liquid detergent is drawn through passageway **94**, past seat **98**, a passageway **102** and into vacuum chamber **90**. There, the liquid detergent admixes with the water flow passing through the venturi. The admixture of water and liquid detergent is then exhausted through nozzle assembly **92** which form the liquid flow into a spray pattern.

As in the first described embodiment, the rate of liquid detergent added to the water is independent of the spray pattern provided by nozzle assembly **92**. Similarly, the total amount of liquid exhausted through the spray nozzle is independent of the spray pattern provided thereby. As mentioned previously, this greatly increases the versatility of the spraying device.

Whereas the present invention has been described in conjunction with two preferred embodiments, it will be apparent to one of ordinary skill in the art that numerous modifications can be made to these embodiments without requiring inventive skill. For example,

the arrangement of the triggering apparatus is not critical to the present invention, but, as mentioned previously, the illustrated arrangement is highly advantageous in that it provides apparatus operable by a single hand. Since numerous other modifications are apparent, it is my intent to be limited only by the scope and spirit of the appended claims.

What is claimed is:

1. Aspirating and spraying apparatus, comprising:
   a. a first passageway means connectable to a pressurized source of carrier fluid;
   b. first valve means associated with said first passageway for controlling the flow of carrier fluid therethrough;
   c. venturi means having a throat thereof in communication with said first passageway, a reduced pressure occurring in said throat upon passage of the carrier fluid through said venturi;
   d. second passageway means in communication with said throat of said venturi means and connectable to a source of product fluid;
   e. second valve means associated with said second passageway means for controlling the flow of product fluid therethrough; said product fluid being injected into said carrier fluid by the reduced pressure in said venturi throat when said first and second valve means are in their open positions; and
   f. nozzle means attached to said first passageway means and having an orifice suitable for providing a range of spray patterns to the fluid exhausted therethrough, the dimensions of said venturi throat and said nozzle orifice being sized to provide a generally constant reduced pressure in said venturi throat when said first and second valve means are in their open positions thereby injecting fluid product into said carrier at an essentially constant rate over said entire range of spray patterns.

2. The aspirating and spraying apparatus of claim 1 in the form of a gun-like structure wherein:
   a. said first passageway means includes first and second portions thereof;
   b. said first portion of said first passageway is defined by the handle of said gun-like structure and the second portion thereof is defined by the barrel of said gun-like structure; and
   c. said second valve means includes trigger-like means for actuating said second valve and means for biasing said second valve in said closed position to prevent injection of the product fluid into said carrier flow until actuation of said second valve.

3. The aspirating and spraying apparatus of claim 2 wherein:
   a. said venturi-means is positioned within said handle portion of said first passageway; and
   b. said first valve means is positioned within said second portion of said first passageway downstream from said venturi throat and includes trigger means for actuating said first valve.

4. The aspirating and spraying apparatus of claim 2 wherein:
   a. said second portion of said first passageway includes a valve seat;
   b. said first valve means includes a threadedly adjustable valve member engageable with said valve seat for controlling fluid flow through said second portion of said first passageway;
   c. said venturi means is positioned within said second portion of said first passageway downstream of said valve seat; and
   d. said handle of said gun-like structure further defines said second passageway.

5. Combination aspirating and spraying apparatus, comprising:
   a. a first passageway connectable to a pressurized source of carrier fluid;
   b. means defining a venturi having a throat thereof in fluid communication with said first passageway;
   c. a second passageway in communication with said throat of said venturi means and connectable to a source of product fluid, said product being injected into said carrier fluid at said venturi throat by the reduced pressure therein; and
   d. means defining a nozzle assembly attached to said first passageway downstream from said venturi means and suitable for providing a range of spray patterns to the fluid exhausted through an outlet aperture therein, the dimensions of said venturi throat and said nozzle outlet aperture being sufficient to provide an essentially constant reduced pressure in said venturi throat over the wide range of spray patterns provided by said nozzle assembly.

6. The combination aspirating and spraying apparatus of claim 5 wherein said nozzle assembly includes a variable spray forming orifice having an essentially constant cross-sectional area over the entire range of spray patterns provided thereby.

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