United States Patent

Sachnik

[15] **3,701,482**

[45] **Oct. 31, 1972**

[54] **FOAM GENERATING NOZZLE**

[72] Inventor: **Norman H. Sachnik,** 1035 Columbia, Houston, Tex. 77008

[22] Filed: **March 17, 1971**

[21] Appl. No.: **125,172**

[52] **U.S. Cl.** ....**239/590.3,** 169/1 R, 169/15

[51] **Int. Cl.** **B05b 1/14**

[58] **Field of Search**.....239/419.5, 428.5, 590, 590.3, 239/590.5, 429, 433; 169/15, 14

[56] **References Cited**

UNITED STATES PATENTS

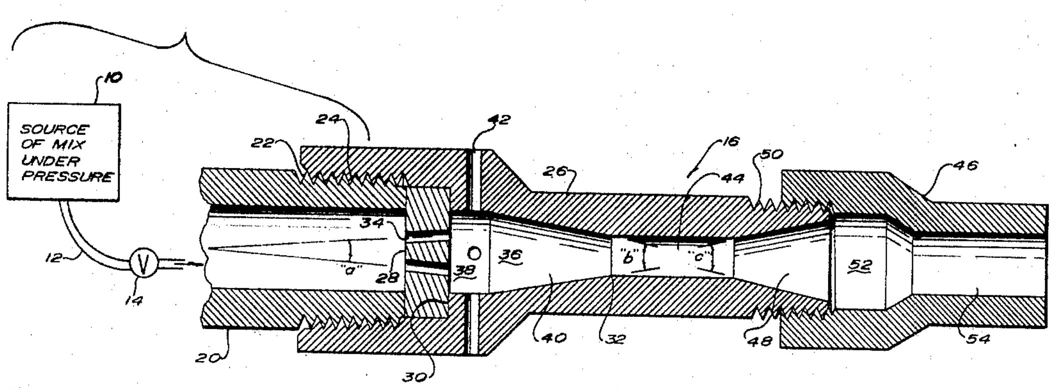
2,361,980	11/1944	Tirrell	169/15
2,990,885	7/1961	Brazier	169/1 R
2,556,239	6/1951	Tuve et al.	169/4
2,388,508	11/1945	Timpson	239/428.5
2,737,413	3/1956	Mitchison	169/15 X
2,774,583	12/1956	Haftke	239/428.5 X
3,388,868	6/1968	Watson et al.	239/590.3 X
3,512,912	5/1970	Linch	239/590.3 X

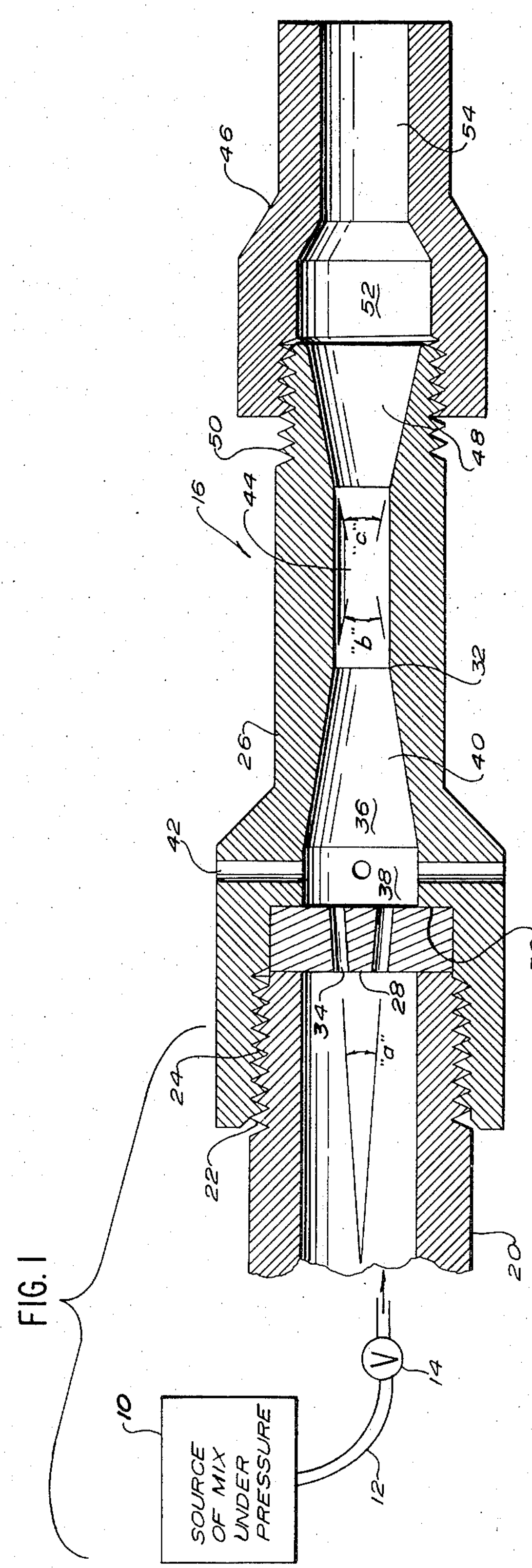
Primary Examiner—Lloyd L. King
Assistant Examiner—Thomas C. Culp, Jr.
Attorney—Joe E. Edwards, M. H. Gay, Alfred H. Evans, Jack R. Springgate, W. Ronald Robins and Julian Clark Martin

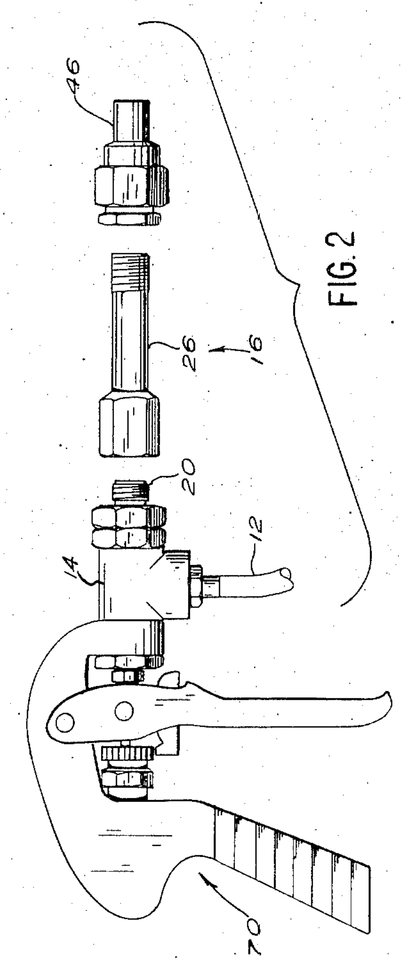
[57] **ABSTRACT**

A foam generating nozzle is to be used for applying treating material entrained into foam to plants. A mix of water, foam agent and treatment material is fed through a valve to the generating nozzle. The generating nozzle jets the liquid into a low pressure chamber where it draws air into it and from there, the low pressure chamber is isolated from the high pressure chamber by a throat section. Effort is made to conserve as much energy as possible so the high pressure section will have a pressure of at least one-fifth the pressure of the source of the liquid. The foam is dispersed from the high pressure section by interchangeable spray-pattern nozzles to obtain the desired pattern for dispersing the foam.

2 Claims, 12 Drawing Figures







NORMAN H. SACHNIK
INVENTOR.

BY C. W. Coffee
Atty.

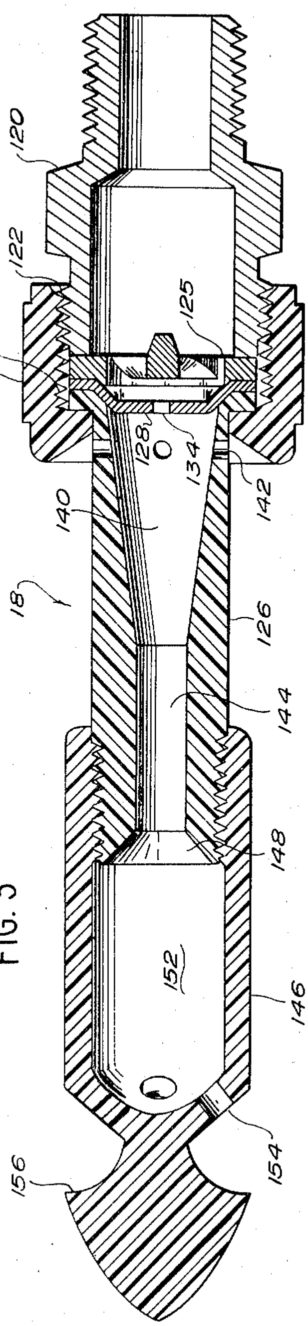


FIG. 3

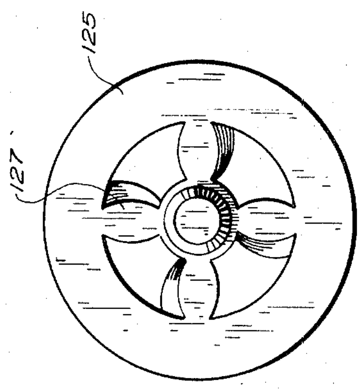


FIG. 4

NORMAN H. SACHNIK

INVENTOR.

BY C. A. Koffee
Atty.

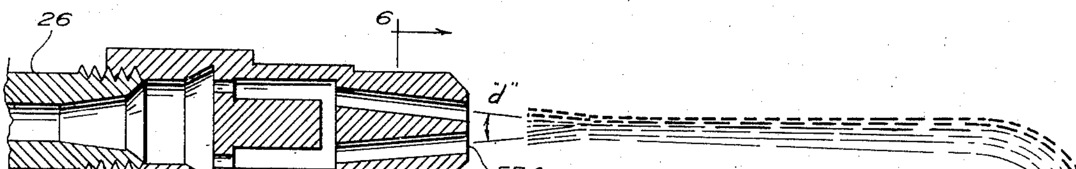


FIG. 5

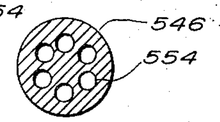


FIG. 6

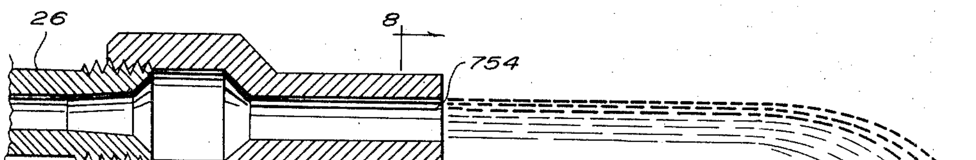


FIG. 7

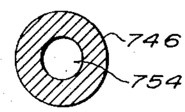


FIG. 8

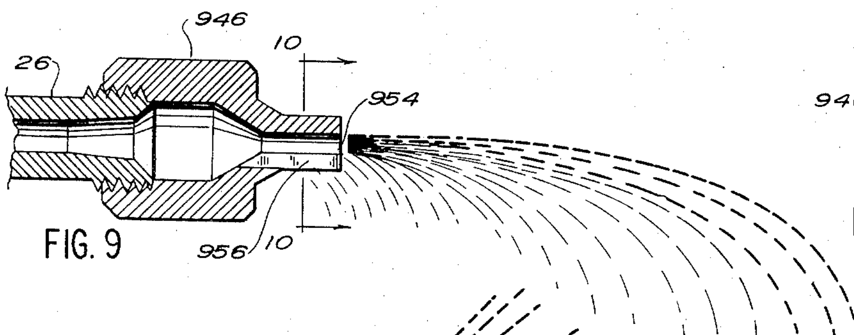


FIG. 9

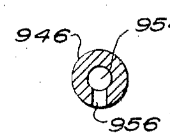


FIG. 10

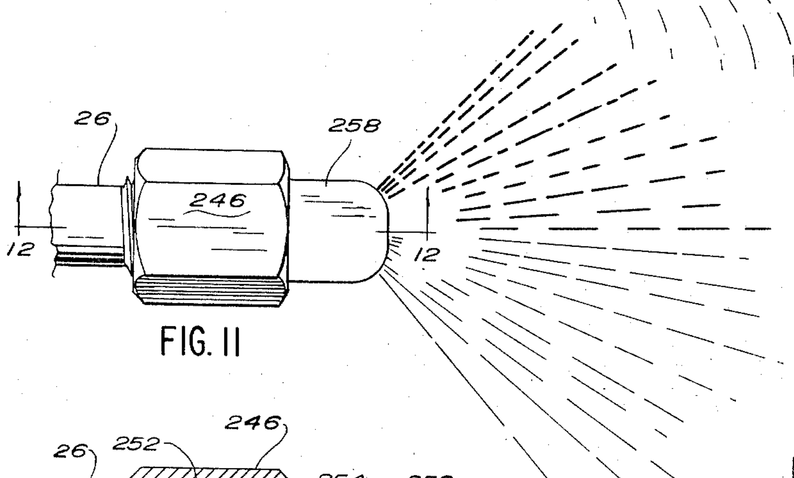


FIG. 11

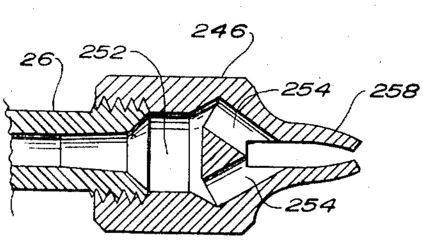


FIG. 12

NORMAN H. SACHNIK
INVENTOR.

BY C. M. Loffler
Atty.

FOAM GENERATING NOZZLE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is related to applicant's prior filed patent applications which include

830,088	6-3-69
824,868	5-15-69
634,551	4-28-67
561,740	6-30-66 (now abandoned)

However, at the time of filing, the claims of this application do not read on any of the prior applications.

BACKGROUND OF THE INVENTION

1. Field of the invention

This invention relates to horticulture and more particularly to applying treating material such as herbicides, pesticides, fungicides and the like, entrained in foam, to plants. More specifically, it is concerned with the generation of the foam with the treating material entrained therein.

2. Description of the Prior Art

Treating materials for plants, traditionally, have been dusted upon the plants dry or applied to the plants in a liquid. Sometime the treating material is applied to the plants in an oil or hydrocarbon base. More generally, the treating material is applied to the plant in a water spray.

LOWENSTEIN, British Pat. No. 486,113, suggests that the treating material could be entrained in a foam.

My prior patent applications, set out above, all involve applying treating materials to plants, the treating material being entrained in foam.

The Department of Agriculture has made some investigation of this, although I am unaware of any publication of their work, but there have been some news releases of their work as reported in the November 1968 issue of the Farm Journal.

Whereas there is almost no prior art before my entry into the field concerning the entrainment of treating material into foam to be applied to plants, the art has been highly developed for foam generating nozzles for fire fighting purposes.

TUVE ET AL, U.S. Pat. No. 2,556,239, **discloses a nozzle and goes into considerable detail. He discloses a nozzle which has the low pressure chamber with the i.e., TUVE liquid spray jetted into it, the low pressure chamber having a converging section to a cylindrical throat followed by diverging section wherein it then extends to a dispersing nozzle. TUVE**'s high velocity nozzle converges at the same angle as the low pressure chamber. Also, TUVE recognizes in his particular field of fire fighting the desirability of generating a low expansion foam. I.e., a foam having about three parts air to one part liquid. He recognizes it is desirable to have a throat area of about two and one-half times the velocity nozzle area. However, TUBE considers it important for his application to have a very large volume in the high pressure chamber. He states that the length of the high pressure chamber should be 20 to 30 times the diameter of the throat section. Of course, TUVE contemplates an operation wherein once the generator was activated, it would remain generating until its task was completed and does not contemplate an intermittent operation.

BRAZIER, U.S. Pat. No. 2,990,885, discloses a nozzle to produce foam for fire fighting wherein the high velocity nozzle jets the initial stream of liquid outward against a converging ring. BRAZIER states that one of his objects is to provide a foam nozzle to obtain a very high volume of expansion. Also, he contemplates that the ambient atmosphere is in direct communication with the turbulent area, which is in direct conflict to my teaching herein.

TIMPSON, U.S. Pat. No. 2,388,508, discloses a nozzle for a generating foam which has a selector valve wherein it can either produce foam or a solid stream. TIMPSON is not believed to disclose his valve as being a cutoff valve.

[Other U.S. patents found in a search before filing this patent application, but were not considered pertinent, include:

RE. 25,037	3,040,758
1,816,417	3,117,629]
2,936,835	

SUMMARY OF THE INVENTION

1. New and Different Function

Generating foam for applying treating material to plants is basically different than generating foam for fire fighting purposes. Although, TUVE discloses a low expansion ratio for fire fighting purposes, most fire fighting foam is a high expansion ratio, sometimes as high as 50 to 1. However, probably the most important difference between the generation of foam for application to plants and for fire fighting is that the generation for plants must be an intermittent or an on and off proposition. i.e., normally the application will be by a hand-held gun sprayer wherein a valve is opened to produce spray for a short period of time to apply the spray to a particular plant or a group of plants and the valve is closed to shut off the generation of foam until the operator moves on to the place of next application. This is even the pattern of operation for aerial spraying, I.e., the foam will be generated for spraying one pass over a field and then the valve is closed to shut off generation while the plane turns to be in position to generate foam for the next pass. On the other hand, for fire fighting purposes, once the foam is generated, it is not discontinued until the fire is extinguished. When foam generation is discontinued in the use of a fire fighting nozzle of known design, the nozzle has compressed air therein which will cause the foam within the nozzle to expand and since there is no flow through the nozzle, the foam will back up and clog the air inlet holes. As stated before for fire fighting, this is no problem whatsoever because when the nozzle is shut down, the equipment is cleaned up in preparation for the next fire. However, if this type nozzle were used for applying treating material, it gives an undesirable effect because it not only produces a foam of undesirable quality, but the nozzle often must be cleaned each time the generation of foam is interrupted.

Therefore, I have found that the volume of the high pressure chamber must be reduced to a minimum. The high pressure chamber must be present because it is necessary that there be an agitation or a mixing of the liquid and the air to generate foam. Therefore, when the flow is shut off, the generated foam in the high pressure section, as it expands, will not expand sufficiently to clog the low pressure chamber nor the air ports into the low pressure chamber.

Also, the dispersing nozzles for fire fighting purposes have been almost identical to water nozzles. I have found that to spray the foam for agricultural purposes, it is usually necessary to break the foam up into globulets. For different types of application, there are various, distinct spray patterns desirable; therefore, I have found it desirable to be able to interchange the spray pattern dispersing nozzle without having to completely redesign the entire generating nozzle.

2. Objects of the Invention

An object of this invention is to apply treating material entrained in foam to plants.

Further objects are to achieve the above with a device that is sturdy, compact, durable, lightweight, simple, safe, efficient, versatile, and reliable, yet inexpensive and easy to manufacture, operate, and maintain.

The specific nature of the invention, as well as other objects, uses, and advantages thereof, will clearly appear from the following description and from the accompanying drawing, the different views of which are not necessarily to the same scale.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a axial sectional view, partially schematic, of a foam generating nozzle according to this invention.

FIG. **2** is a side elevational view of the generating nozzle attached to a hand gun for hand operation.

FIG. **3** is an illustration of a modified form of the nozzle particularly adapted for use on an airplane.

FIG. **4** is an elevational view of a part of the airplane modification taken on line **4—4** of FIG. **3**.

FIG. **5** is a sectional representation of a spray pattern nozzle for projecting the foam an extremely long distance.

FIG. **6** is a cross-sectional view taken substantially on line **6—6** of FIG. **5**.

FIG. **7** is an axial sectional view of another spray pattern nozzle projecting another foam pattern.

FIG. **8** is a sectional view taken on line **8—8** of FIG. **7**.

FIG. **9** is an axial sectional view of a spray pattern nozzle designed to produce a scattered foam pattern.

FIG. **10** is a cross-sectional view taken on line **10—10** of FIG. **9**.

FIG. **11** is an elevational view of yet another spray pattern nozzle producing a fan-shaped pattern.

FIG. **12** is an axial sectional view taken substantially on line **12—12** of FIG. **11**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, there is shown schematically in FIG. **1** a source **10** of mix under pressure. The mix would include water, foam agent, and treating material. Foam agents are well known to the art as demonstrated by the patents identified above. The treating material is also well known, as set out above. The treating material may be any of several materials used for treating plants. These materials may be herbicides, insecticides, fungicides, or other pesticides. These materials also may include fertilizer to be applied to the leaves of the plants.

From the source **10** under pressure, the material is transmitted in suitable conduit such as hose **12** to valve **14**. As illustrated in FIG. **2**, this valve in the form of a hand gun **70** with the generating nozzle **16** attached thereto, or in the case of the particular modification for airplanes, the valve (not shown) is controlled by the pilot and it would not be immediately adjacent to the plurality of airplane foam generating nozzles **18**. (FIG. **3**, also see FIG. **3** of application Ser. No. 824,868).

Referring to FIG. **1**, it may be seen that inlet nipple **20** has external threads **22** thereupon. These threads mate with internal threads **24** of nozzle body **26**. Velocity nozzle disc **28** is within the inlet of the body **26** and one edge seats against shoulder **30** formed between the internal bore **32** of the body and the end of the nipple **20**. The disc **28** has drilled therethrough a plurality (such as three to six) of inlet velocity nozzles **34**. The cylindrical nozzles divert outward, having an apex angle of *a*, which I have found to be desirable at 4° to 6°. Other than the apex divergent angle, the nozzles **34** are straight, i.e., they are not helixed.

The bore **32** has a first low pressure chamber **36**. This includes a short cylindrical section **38** and a frusto-conical converging outlet section **40**. The frusto-conical outlet section **40** has an apex angle *b* of from 10° to 14°. Ports **42** extend through the body **26** into the cylindrical section **38**. The ports **42** admit ambient air into the low pressure chamber **36**. The low pressure chamber **36** terminates with throat **44**. The throat is a cylindrical portion of the bore **32**. The length of the throat **44** is no less than twice its diameter. The cross-sectional area of the throat **44** bears a specific relationship to the combined cross-sectional area of the velocity nozzles **34**. I.e., the cross-sectional area of the throat **44** is between 2.2 and 2.75 times the cross-sectional area of all of the velocity nozzles **34**. Because there is some leeway with this area, it is possible to change discs **28** for a grater or lesser foam generation. The rate the foam is generated will depend solely upon the area of the velocity nozzles **34** and the pressure of the source **10** within the nipple **20** just before the mix enters the velocity nozzles **34**. Therefore, although the optimum size of the area of the velocity nozzles will be 1/2.5 of the cross-sectional area of the throat **44**, it may be seen that this may be increased by 10 percent to 2.75 or decreased by about 10 percent to 2.2 for the production of greater or lesser foam. Also, the pressure can be increased or decreased so the nozzle produces a greater or lesser amount of foam.

As will be discussed later, spray pattern nozzle **46** may be changed to produce different spray patterns, but the changing of the spray pattern nozzle **46** does not affect the quality or the quantity of the foam produced. When I use the term "it does not affect the quality", it is meant that the size of the air bubbles or the ratio of air to liquid in the foam is not affected. It does affect the quality of the foam if the size of globulets is considered to be a factor of foam quality.

From the throat section **44**, the bore **32** has a diverging frusto-conical section **48**. This diverging section will have an apex angle *c* between 14° and 30°. The body **26** at the diverging section **48** has external threads

50 thereon to mate with internal threads of the spray pattern nozzle 46. The spray pattern nozzle 46 has a chamber 52 equal in diameter to the root diameter of the threads 50. This chamber is called the high pressure chamber 52. The high pressure is defined to include the entire volume up to the beginning of the spray pattern nozzle bore 54. The spray pattern nozzle bore itself has a diameter which is greater than the diameter of the throat section 44.

With this design, the mix jetting through the velocity nozzles 34 will create a low pressure area within the low pressure chamber 36. This low pressure area will be below ambient pressure and therefore, there will be an inward flow of air through the inlet ports 42. The jets impinge against the converging walls of conical outlet 40 and proceed on into the throat section 44. The throat section 44 will have low pressure. The flow through the majority of the throat section will be straight forward without turbulence. Therefore, up until this point there will be little or no foam generated, although there will be a carrying of the air forward into the throat area. At the outlet of the throat area begins turbulence and therefore, the beginning of foam generation. There will be additional foam generation and turbulence through the diverging section 48. The generation is completed and the foam refined in the high pressure chamber 52.

As the area 48 diverges, the pressure will increase. There has been a very small loss of energy to this point. I.e., all of the energy contained in the entering fluid within the nipple 20, because of its pressure, has been retained in the high pressure chamber 52. This pressure energy in the nipple 20 was changed to velocity energy as it went through the nozzles 34 and through the throat section 44. In the high pressure chamber 52, the energy is again converted to pressure energy. Specifically, after the foam has been discharged from the spray pattern nozzle bore 54, the volume will be three or four times as great as the entering liquid volume in the nipple 20. Therefore, if from an energy standpoint the nozzle were one hundred percent efficient, the pressure in the high pressure chamber 52 would be less because of the greater volume. I have been able to maintain the gauge pressure within the high pressure chamber 52 in ratio to the gauge pressure within the nipple 20 of 5 to 1 maximum to a low of 2.7 to 1. The energy of the material within the high pressure chamber 52 is again transformed into velocity energy as it is discharged from the spray pattern nozzle bore 54.

The design criteria set forth above are specifically designed to obtain a well mixed, fine bubble-size foam, a short nozzle 16, a high velocity discharge, a wet foam having about four times the volume of the inlet liquid. In addition to these factors, it is also essential that when the valve 14 is snapped shut and the flow of the liquid ceases, the foam from the high pressure chamber 52 does not back up through the throat 44 into the low pressure chamber 36 and clog the air ports 42. It is essential in ordinary operation that the turbulence within the latter part of the throat area 44 and the generation of the foam does not permit any of the foam to back up so as to clog the low pressure area.

One of the functions of the high pressure chamber 52 is the refinement of the foam so there are fine air bubbles through the foam; particularly when a wet foam is being generated, (such as 3 ½ to 1 or less expansion), difficulty is experienced with some of the liquid exits in the liquid phase rather than in a foam phase. If there is not good mixing with a small air bubble or a fine air bubble structure, this is likely to happen. However, with the design set forth as I have described it, I have been able to achieve my desired objective. One of the points in the design is that the volume of the high pressure chamber is no greater than ten times the volume of the throat 44. E.g., if the volume of the throat is one cubic centimeter, the volume of the high pressure chamber must be no greater than ten cubic centimeters.

Referring to FIG. 3, there may be seen a slightly different modified form of the nozzle as would be used on aircraft. In this figure, the source of mix under pressure has not been shown nor has the valve to cause intermittent flow to the generator 18 been shown. It will be understood that there would be a manifold and a plurality of generators 18 on the manifold and the valve would be located between the source of the mix under pressure and the manifold. There is an inlet nipple 120 having external threads 122 which mate with internal threads on 124 upon a cuff 123 which holds the body 126 in place. The body has a plurality of air inlets or air ports 142 in the low pressure chamber which includes the frusto-conical outlet 140 which leads into the throat 144 which then is dispersed from the diverging frusto-conical portion 148 into the high pressure chamber 152. The twirling disc 125 has a plurality of veins 127 which import a circular motion to the fluid. Then when the fluid passes through the orifice 134 within the disc 128, the liquid will spray from the orifice from about 4° to 6° conical angle. Also, the apex angle upon the diverging frusto-conical section 148 is much greater than 30°. The spray pattern nozzles formed by the bores 154 through the outlet of the spray pattern nozzle 146 have a very high diameter to the length. Therefore, the foam would pass through them with a great deal of turbulence rather than high velocity jet and they impinge against the exterior flange 156.

Because of the particular design of the airplane generator 18 shown in FIG. 3, the pressure in the high pressure chamber 152 will not be extremely high because there is a loss of energy through inefficiency of the passage through the orifice 134 and the other inefficiencies of the design. However, with the airplane nozzle, the only pressure needed in the high pressure chamber 152 is to force the foam out through the nozzles 154 and against the splatter flange 156. As soon as the foam is forced out and against the splatter flange, the air stream created by the movement of the aircraft through the air will cause the spray to break up into globulets and then it is necessary only that they be carried by the air stream and gravity to their desired location.

However, it will be understood that the nozzle shown in FIG. 3 is a special purpose nozzle and it is adapted to be used only for dispersing the foam into an air stream and therefore, because of this special consideration, it is designed as it is.

One of the advantages of my design is that the same generator with the same body 26 may be used with several different dispersing nozzles. The dispersing nozzle **46** shown in FIG. **1** has a length of about twice its diameter; therefore, this will result in a pattern wherein the foam stays reasonably well together and there is only medium turbulence at the time foam is discharged, resulting in a rather close together stream which projects a reasonable distance.

Referring to FIG. 7, there is illustrated a spray pattern nozzle **746**, having spray pattern nozzle bore **754** illustrated where the length of the bore is several times greater than the diameter of the bore. However, there is one single bore. Because of the longer bore, there will be less turbulence in the spray and therefore, the spray will be projected a longer distance and there will be less scattering of the foam.

FIG. **5** illustrates a spray pattern nozzle **546** wherein there is illustrated a plurality of bores **554**, each of which is extremely long with respect to the diameter. Also, the bores have a slight angle of convergence with a conical apex angle *d* of only one or two degrees. Therefore, foam will be thrown an extremely long distance without particularly breaking up. With pressures of 100 pounds at the inlet to the velocity nozzle, this dispersing nozzle will throw foam for over 50 feet. With pressures up to 300 pounds, the nozzle will throw foam about 70 feet.

The dispersing nozzle **946** shown in FIG. **9** is designed so it produces an F-shaped pattern which has a width of over half its maximum projected distance. Therefore, it is desirable for certain applications. To obtain this, slot **956** is cut along the bottom of bore **954** of the spray pattern nozzle **946**. Thus, the pattern is "-spoiled" in this particular area so it produces this particular design and breaks the foam into globulets.

FIG. **12** shows a design of dispersing nozzle **246** for producing a fan-shaped pattern. In it two nozzles **254** project a jet of fluid which converge at a sharp angle and therefore splatter, breaking the foam into small globulets on either side. The two bores **254** project from the high-pressure chamber **252**. Wings **258** help to shape and control the spray pattern.

The embodiments shown and described above are only exemplary. I do not claim to have invented all the parts, elements or steps described. Various modifications can be made in the construction, material, arrangement, and operation, and still be within the scope of my invention. The limits of the invention and the bounds of the patent protection are measured by and defined in the following claims. The restrictive description and drawing of the specific example above do not point out what an infringement of this patent would be, but are to enable the reader to make and use the invention.

I claim as my invention:

1. A foam generating nozzle comprising

an inlet nipple adapted to receive fluid under pressure,

a disc disposed in the downstream end of said nipple, said disc having at least one passage extending therethrough,

a body joined to said nipple, said body having a low pressure chamber in communication with said disc and receiving fluid passing therethrough and said body having a throat smaller in diameter than said low pressure chamber and connected to and receiving fluid from the low pressure chamber and said body having at least one radially disposed air port therein communicating between said low pressure chamber and the exterior of said body and said body having a diverging frusto-conical section communicating at its smaller end with the downstream end of said throat,

a spray pattern member joined to the larger end of said frusto-conical section, said spray pattern member having at its upstream end a high pressure chamber and at its downstream end one or more bores conveying fluid from said high pressure chamber to the exterior of said nozzle,

said high pressure chamber having a volume no greater than ten times the volume of said throat, so that a back pressure is held on foam being released from the nozzle but upon stoppage of flow of fluid to said nipple foam will not back up and discharge into said air port.

2. The nozzle of claim **1** wherein said spray pattern member has a plurality of bores and wherein a pair of spaced wings are provided on the outlet end of the spray pattern member and wherein the said bores converge toward their outlet ends to mix fluid from the bores in the space between said wings.

* * * * *