Jan. 18, 1938. R. M. URQUHART ET AL 2,106,043

METHOD AND APPARATUS FOR FOAM GENERATING AND DISTRIBUTING

Original Filed Oct. 18, 1932 2 Sheets-Sheet 1

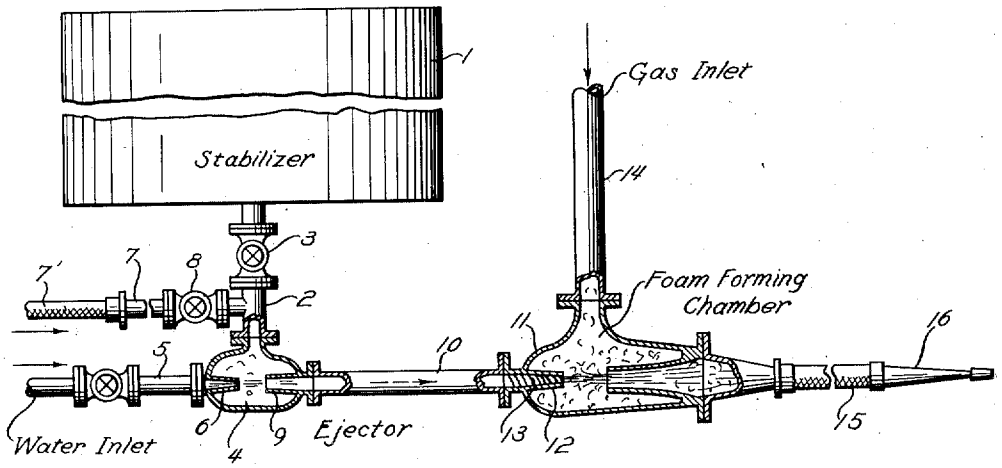

Fig. 1

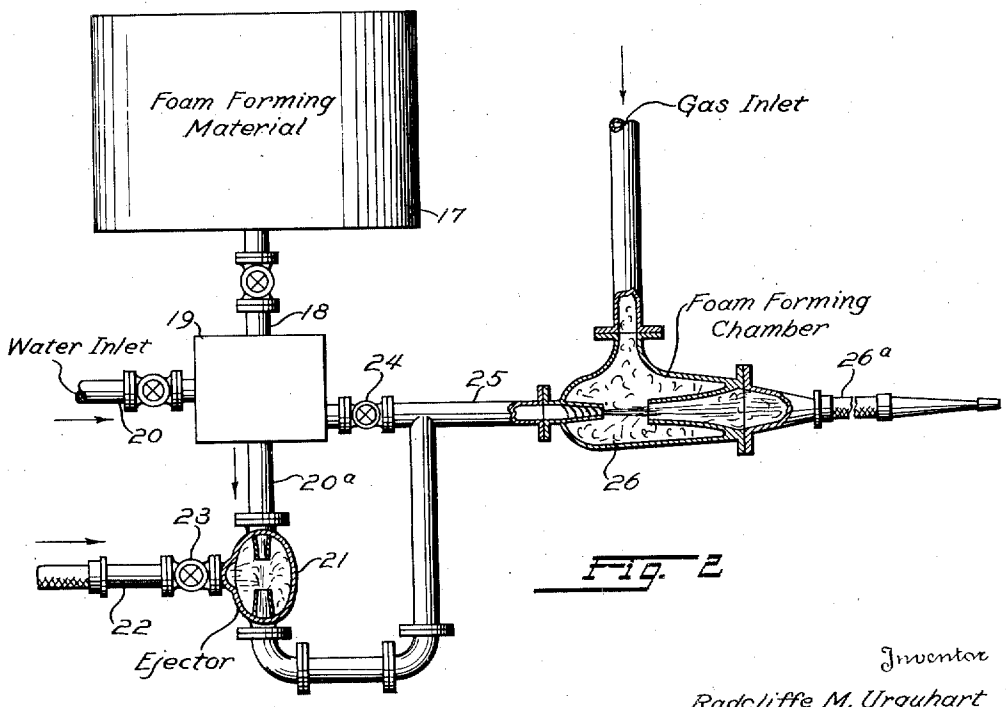

Fig. 2

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Fig. 3

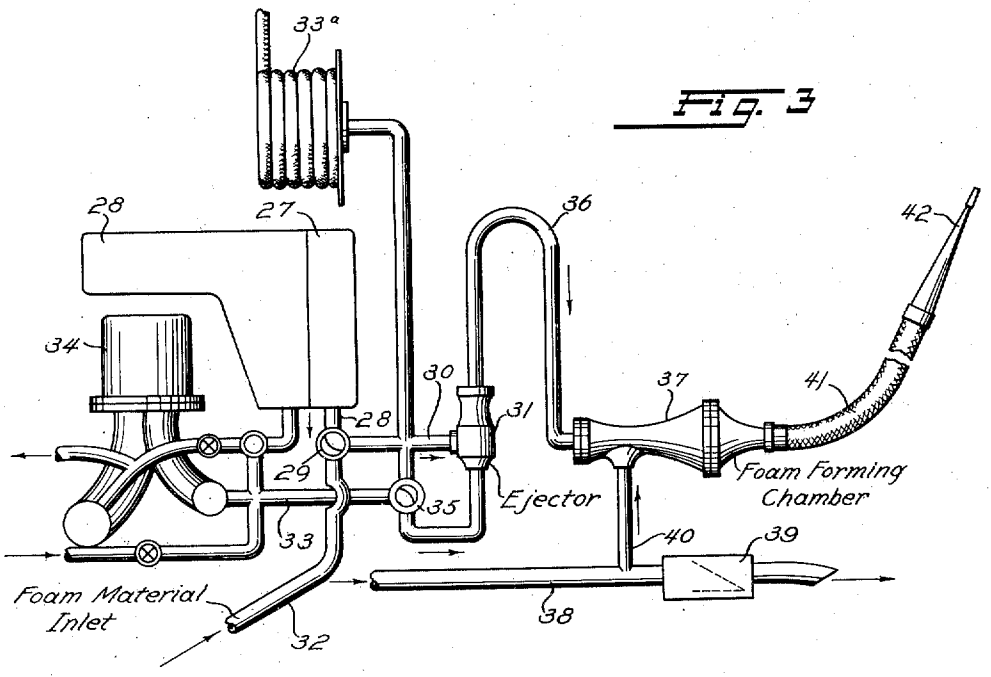
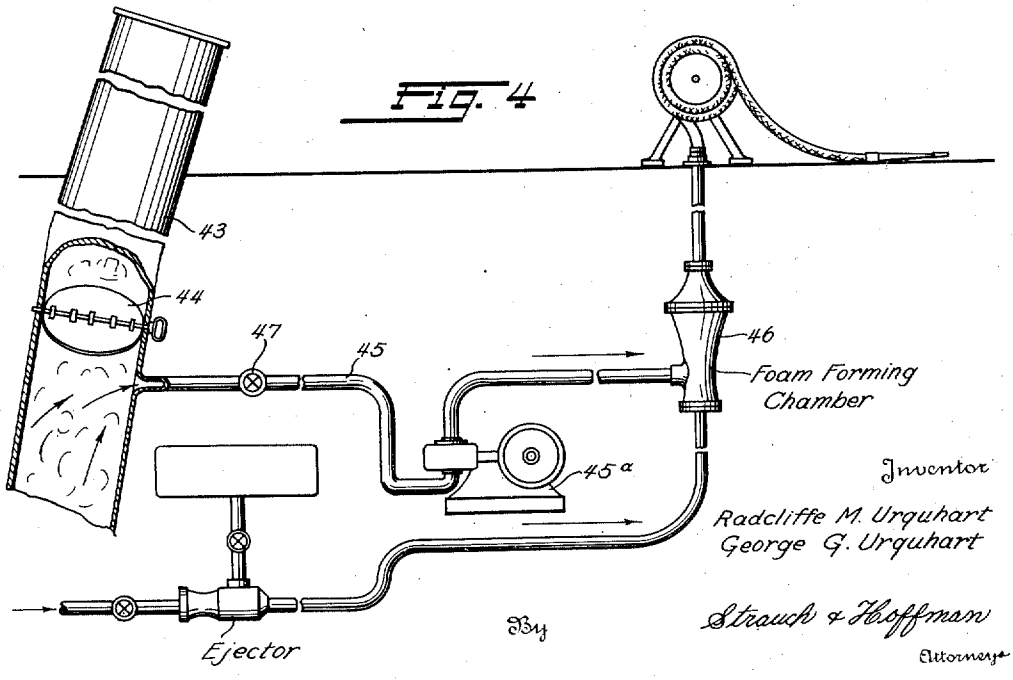


Fig. 4



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UNITED STATES PATENT OFFICE

2,106,043

METHOD AND APPARATUS FOR FOAM GENERATING AND DISTRIBUTING

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Original application October 18, 1932, Serial No. 638,272. Divided and this application November 8, 1937, Serial No. 173,514

15 Claims. (Cl. 261—76)

This invention relates to improvements in methods and apparatus for generating and distributing foam for extinguishing fires or for other purposes where a foam blanket may be required, for example, in checking evaporation from volatile liquids. In accordance with the invention a stream of gas is utilized as a foam inducing agent, as distinguished from the conventional type of foam-forming method in which chemicals produce a gas within a solution containing a foam-forming material.

The present application is a division of application Serial No. 638,272, filed October 18, 1932.

A principal object of the invention is to provide compact, readily portable foam generating equipment, especially adapted for mounting on an automobile truck to be operated by the exhaust gases therefrom or otherwise, and on ships where the foam-forming equipment is to be operated by the stack gases or otherwise, as will be more fully described later.

Another object of the invention is to provide foam generating equipment which can be used in the protection of oil tanks and the like. Another object of the invention is to reduce the expense of foam generation by avoiding the use of gas-producing chemicals while maintaining the quality of the foam.

Various other objects and advantages of the invention will be apparent from the following description, read in connection with the accompanying drawings, in which;

Figure 1 is a vertical section through a preferred type of equipment;

Figure 2 is a vertical section through an alternative form of the apparatus;

Figure 3 is a side elevation showing the installation of the equipment on a motor truck; and

Figure 4 is a side elevation, partly in section, showing the equipment on a steam boat.

Referring first to Figure 1, reference numeral 1 indicates a tank adapted to contain an adequate supply of a foam-forming material. This will usually be an aqueous solution of a secondary extract of licorice, extract of tank bark, saponin, or other suitable substance. These are known in the trade as "stabilizers". The invention is not limited to the use of any particular type of foam-forming material. It is sufficient if the material has the capacity of being foamed by injecting a gas into its solution or suspension. When reference is made herein to foam-forming material it is understood that this will usually be an aqueous solution, but suspensions or other suitable materials may be used.

The tank 1 is connected through a pipe 2, in which there is a valve 3, with an ejector chamber 4. Into this chamber there is introduced, through a pipe 5, a stream of water which emerges from a nozzle 6 inside the chamber. The water is forced in under suitable pressure which is supplied by the city mains or by the pump of a fire engine. As the water rushes out of nozzle 6, it causes the foam-forming material to be drawn in more or less regularly from the tank 1 for admixture with the water stream.

In order to provide a larger capacity the pipe 2 may be connected to a branch 7 in which there is a valve 8 and this branch is connected in turn to an auxiliary source of the foam-forming material. The mixture of water and foam-forming material passes from the ejector chamber 4, preferably through a conical passageway 9, into a pipe 10 which is connected to a foam-forming chamber 11. It is desirable to pass the foam-forming mixture into this chamber through a conical passageway 12 in which there is a spiral 13 or other suitable baffle means which will cause turbulent flow of the mixture and insure good contact with the gas, which is injected through pipe 14. The gas is preferably non-combustible, for example, carbon dioxide, nitrogen, exhaust gas, flue gas, vapors of carbon tetrachloride, or other non-inflammable organic compound or the like. However, for some purposes it is permissible to use a gas having some oxygen content, or even air itself. Application Serial No. 638,272 above referred to is concerned with the latter aspect of this invention. It is obviously better, however, to use a non-combustible gas for fire extinguishing purposes, as there will inevitably be some decomposition of the foam with release of gas.

The action taking place in the passageway 12 may be described as mechanical subdivision of the foam-forming mixture. This action is not absolutely necessary for the present invention but it is advantageous. The entering gas is distributed in the chamber 11 under pressure which may be from 15 to 30 pounds per square inch, or any desired pressure, depending upon the throw which is desired from the foam nozzle. It is possible to introduce the gas at relatively low pressures (not lower than the nozzle outlet pressure) but better results are obtained by forcing the gas in at higher pressures. The gas causes the formation of a copious foam which we have found to be satisfactorily stable and fire resistant.

The pressure of the gas is sufficient in general to carry the foam from chamber 11 through

hose 15 and nozzle 16 to the desired distance. However, it is within the scope of the invention to utilize a pump or other means to increase the pressure of the foam. The action taking place in the discharge end of the mixing chamber 11 and in the hose 15 may be described as a secondary mechanical subdivision of the foam. It will be produced in relatively coarse form in the inlet end of chamber 11 but before it is discharged from nozzle 16 it will have assumed the necessary fine state of subdivision.

Referring to Figure 2, the foam-forming material is supplied from a tank 17 through a valved line 18 into the inlet chamber of a pump 19. In the pump the foam-forming material, which is preferably a dilute aqueous solution, is mixed with water entering the pump through a line 20. The mixed water and foam-forming solution pass from the discharge chamber of the pump through a pipe 20a into the ejector chamber 21. This, as in Figure 1, is connected with a hose or pipe 22 which supplies an auxiliary amount of foam-forming solution if required. Unless the auxiliary supply is needed, a valve 23 in line 22 will be closed and valve 24 in line 25, connected to the discharge chamber of the pump, will be opened. In this case the pump will deliver the aqueous foam-forming material directly to the foam-forming chamber 26 for discharge through a hose 26a. It will be unnecessary to describe this chamber as it, and its connections, are identical with those shown in Figure 1.

Referring now to Figure 3, the device of the invention is shown as mounted on a motor truck for actuation by the exhaust gases from the truck engine. While this mode of actuation is most convenient, it is feasible to supply a gas by mounting cylinders of compressed gas on the truck. A tank 27 is arranged on the truck to carry a solution of the foam-forming material. This tank may, for example, have a capacity of about twenty gallons. In another compartment 28 there is stored a larger volume of liquid which may be water without foam-forming substance in it. This compartment may hold about one hundred gallons. The figures are given with reference to an installation on a three to five ton fire truck. Tank 27 is arranged to discharge through a line 28 in which there is a two-way valve 29. This valve communicates respectively with a pipe 30 which leads to the ejector chamber 31 and with a pipe 32 arranged for connection to an auxiliary supply of foam-forming material. Water is supplied to the ejector chamber 31 through a line 33 which can be put in communication with any suitable source of water supply as the pump 34 which takes suction from tank 28. A two-way valve 35 is installed in line 33 for putting it into communication with the ejector chamber 31 or for shutting it off therefrom and connecting the line to hose 33a. The water and foam-forming material pass from the ejector through line 36 to foam-forming chamber 37. Exhaust gases for forming the foam are obtained from the exhaust manifold 38. There is arranged in this a valve 39 which can be operated from the dashboard or other suitable location. When the valve is closed, the exhaust gases will be diverted through branch pipe 40 into the inlet end of the mixing chamber 37. The foam produced in the mixing chamber passes out, under pressure of the exhaust gas, through hose 41 and nozzle 42.

Referring to Figure 4, the installation is similar to that shown in Figure 3 but is shown as applied on a steam vessel. Flue gases from the stack 43 are diverted at least in part by closing a valve 44, through branch pipe 45 and pump 45a, into the foam-forming chamber 46. The valve 47 in line 45 is closed when the device is not in operation. It will not be necessary to describe the remaining parts of the equipment since they are identical with those shown in Figures 1 and 3.

The following specific example will illustrate the operation of the device:

A solution of secondary extract of licorice is supplied in tank 1, Figure 1. When a fire is to be extinguished or other use made of the foam-forming equipment, water is passed through line 5 under a pressure of, for example, 30 to 100 pounds per square inch. After having opened valve 3 in line 2 the mixture of water and licorice extract is mechanically subdivided in chamber 13 and is subjected to the action of carbon dioxide passed into foam-forming chamber 11 under a pressure of about 25 pounds per square inch. These conditions will permit the use of a hose of at least 150 feet in length and will, in most cases, give a throw of foam from the nozzle of about 75 feet.

It will be understood that these conditions are given merely for illustration. Various changes and alternative arrangements may be made within the scope of the appended claims in which it is our intention to claim all novelty inherent in the invention as broadly as the prior art permits.

We claim:

1. Method of producing foam, comprising subjecting a foam-forming material to mechanical subdivision induced by turbulent flow; injecting a stream of gas under pressure from an exterior source into the material while so subdivided, further mechanically subdividing the foam, and then withdrawing it at least partially by pressure of the gas.

2. Apparatus for producing foam, comprising means for holding a foam-forming material, means for withdrawing the same therefrom, means for mixing the material with water, means for imparting turbulence to the resultant mixture and means for injecting a stream of gas under pressure into the turbulent mixture.

3. Apparatus for producing foam, comprising means for holding foam-forming material, means for withdrawing the material therefrom by the ejection effect of a stream of water, means for commingling the withdrawn material with water, and means for injecting gas under pressure into the resulting mixture.

4. Apparatus for producing foam, comprising means for supplying a foam-forming material, means for passing a stream of water through a constricted opening, a channel receiving such stream of water and connected to the means for supplying the foam-forming solution, whereby the water withdraws the solution therefrom, means for exposing the resultant mixture to gas in a manner to cause commingling of said gas with said mixture, and means for increasing the surface of said mixture exposed to said gas.

5. Apparatus for producing foam, comprising a tank for holding a foam-forming solution, an ejector chamber connected to the tank, a water line entering said ejector chamber and adapted to discharge water at high velocity into said chamber, a foam-forming chamber into which the mixture from the ejector chamber passes, a

gas line entering said foam-forming chamber, and a hose connected to receive and discharge the foam produced in said chamber.

6. Method of producing foam, comprising injecting water into a mixing zone, supplying foam-forming material to the mixing zone, through the suction of the water stream, injecting the resulting mixture of water and foam-forming material into a foam-forming zone, supplying a gas under pressure to said foam-forming zone, discharging the foam formed therein by the pressure of the gas, and conveying the foam to the point at which it is to be used.

7. Method according to claim 6 in which an additional amount of foam-forming material is supplied from an exterior source.

8. In combination with a conveyance driven by an engine producing inert gas, a container on the conveyance adapted to hold foam-forming material, means for taking off portions of such material in a stream of water, means for interconnecting the stream of water carrying foam-forming material with the inert gas from the engine, means for delivering the inert gas under pressure into said stream to produce foam therefrom, and means for conveying the foam to the point of utilization.

9. In combination with a motor truck, a container thereon for foam-forming material, a water pump, an ejector, means connecting the water pump with the ejector and the container, a second ejector, means for passing the mixture of water and foam-forming material to said second ejector, means for introducing a gas under pressure into said second ejector, and means for conveying the foam to the point of utilization.

10. Method of producing foam comprising introducing into a continuous stream of water under pressure, a suitable quantity of a foam-forming substance, subjecting the combined materials to mechanical subdivision induced by turbulent flow, passing the subdivided materials to a foam-forming zone, maintaining the subdivided condition of the materials while injecting thereinto a stream of gas under pressure from an outside source and withdrawing the resultant foam.

11. Apparatus for producing foam, comprising means for supplying a foam-forming material, means for passing a stream of water through a constricted opening, a chamber receiving such stream of water and connected to the means for supplying the foam-forming solution, whereby the water withdraws the solution therefrom, means for ejecting the resulting liquid at high velocity from a nozzle in such manner as to impart a high degree of turbulence to the body of said stream of liquid, thereby finely subdividing the same, and means for entraining a gas into and by means of the resulting stream of subdivided liquid.

12. Method of producing a fire-extinguishing foam which comprises ejecting one or more high velocity streams of liquid from a corresponding number of nozzles in such manner as to impart a high degree of turbulence to the body of said stream of liquid, thereby finely subdividing the same, and entraining gas into and by means of the resulting stream of subdivided liquid in the presence of a foam-promoting agent.

13. Method of producing a fire-extinguishing foam which comprises producing a dispersed stream of liquid and aspirating a gas into said dispersed stream, in the presence of a foam promoting agent, and increasing the pressure of the resultant mixture by means of a pump.

14. Method of producing a fire-extinguishing foam which comprises flowing a liquid from a source of supply toward a point of discharge, introducing into said liquid a foam-promoting agent, shaping said flowing liquid into an ejecting stream of dispersed foam in the presence of a gas whereby said stream acts to aspirate the gas and to cause a mingling of said liquid and gas as they move toward the point of discharge.

15. Apparatus for producing foam, comprising a channel, means for supplying a foam-promoting material to said channel, means for passing a stream of liquid through said channel in such manner that the liquid withdraws said material therethrough, means for ejecting the resulting liquid at high velocity from one or more nozzles, in such manner as to impart a high degree of turbulence to the body of said stream of liquid, thereby finely subdividing the same, and means for aspirating a gas into and by means of the resulting stream of subdivided liquid.

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CERTIFICATE OF CORRECTION.

Patent No. 2,106,043. January 18, 1938.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 32, claim 14, for the word "foam" read form; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of September, A. D. 1938.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.

gas line entering said foam-forming chamber, and a hose connected to receive and discharge the foam produced in said chamber.

6. Method of producing foam, comprising injecting water into a mixing zone, supplying foam-forming material to the mixing zone, through the suction of the water stream, injecting the resulting mixture of water and foam-forming material into a foam-forming zone, supplying a gas under pressure to said foam-forming zone, discharging the foam formed therein by the pressure of the gas, and conveying the foam to the point at which it is to be used.

7. Method according to claim 6 in which an additional amount of foam-forming material is supplied from an exterior source.

8. In combination with a conveyance driven by an engine producing inert gas, a container on the conveyance adapted to hold foam-forming material, means for taking off portions of such material in a stream of water, means for interconnecting the stream of water carrying foam-forming material with the inert gas from the engine, means for delivering the inert gas under pressure into said stream to produce foam therefrom, and means for conveying the foam to the point of utilization.

9. In combination with a motor truck, a container thereon for foam-forming material, a water pump, an ejector, means connecting the water pump with the ejector and the container, a second ejector, means for passing the mixture of water and foam-forming material to said second ejector, means for introducing a gas under pressure into said second ejector, and means for conveying the foam to the point of utilization.

10. Method of producing foam comprising introducing into a continuous stream of water under pressure, a suitable quantity of a foam-forming substance, subjecting the combined materials to mechanical subdivision induced by turbulent flow, passing the subdivided materials to a foam-forming zone, maintaining the subdivided condition of the materials while injecting thereinto a stream of gas under pressure from an outside source and withdrawing the resultant foam.

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12. Method of producing a fire-extinguishing foam which comprises ejecting one or more high velocity streams of liquid from a corresponding number of nozzles in such manner as to impart a high degree of turbulence to the body of said stream of liquid, thereby finely subdividing the same, and entraining gas into and by means of the resulting stream of subdivided liquid in the presence of a foam-promoting agent.

13. Method of producing a fire-extinguishing foam which comprises producing a dispersed stream of liquid and aspirating a gas into said dispersed stream, in the presence of a foam promoting agent, and increasing the pressure of the resultant mixture by means of a pump.

14. Method of producing a fire-extinguishing foam which comprises flowing a liquid from a source of supply toward a point of discharge, introducing into said liquid a foam-promoting agent, shaping said flowing liquid into an ejecting stream of dispersed foam in the presence of a gas whereby said stream acts to aspirate the gas and to cause a mingling of said liquid and gas as they move toward the point of discharge.

15. Apparatus for producing foam, comprising a channel, means for supplying a foam-promoting material to said channel, means for passing a stream of liquid through said channel in such manner that the liquid withdraws said material therethrough, means for ejecting the resulting liquid at high velocity from one or more nozzles, in such manner as to impart a high degree of turbulence to the body of said stream of liquid, thereby finely subdividing the same, and means for aspirating a gas into and by means of the resulting stream of subdivided liquid.

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