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Lambert

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[54] **METHOD AND APPARATUS FOR GENERATING FIRE-FIGHTING FOAM**

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[52] **U.S. Cl.** **169/15,** 239/9

[51] **Int. Cl.** **A62c 5/02**

[58] **Field of Search** 169/14, 15; 239/8, 239/9

[56] **References Cited**

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[57] **ABSTRACT**

A fire protection method and apparatus for generating a high expansion foam. The method includes fluidizing the foams by wetting. The apparatus includes a housing having a source of foam solution under pressure and a source of water under pressure. The housing includes a fan and a perforated member. The fan is positioned in the housing to provide air flow across the perforated member which is wetted by the foam solution to produce high expansion foam bubbles. The fan is driven by a plurality of nozzles mounted both for discharging the water under pressure and for wetting the foam bubbles.

7 Claims, 9 Drawing Figures

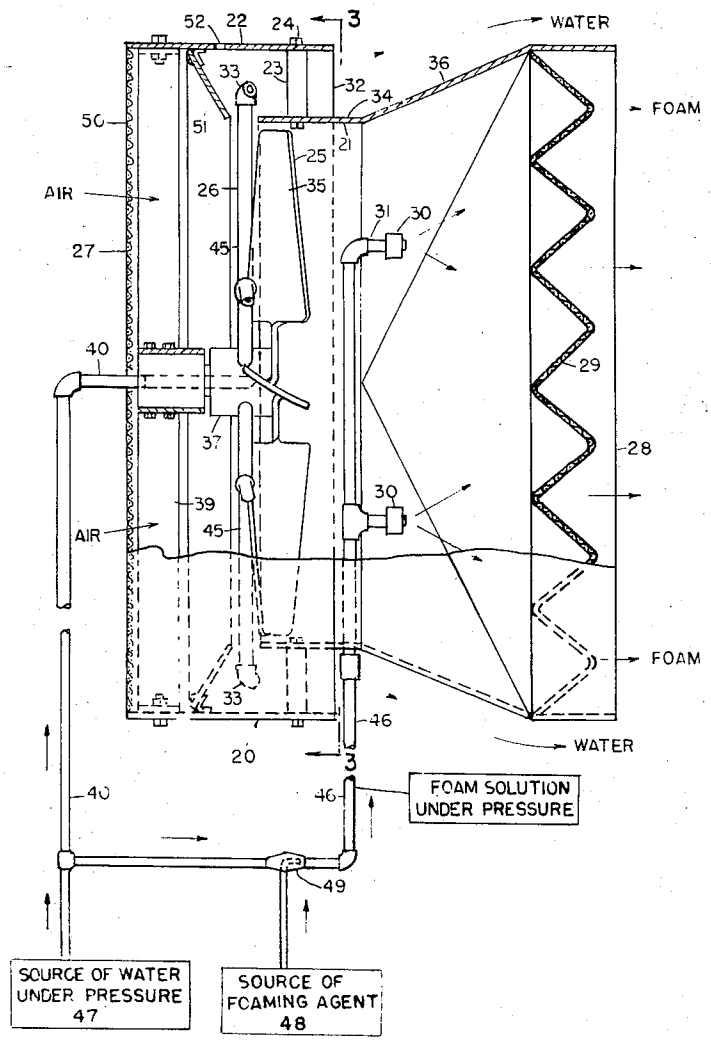


FIG. 1

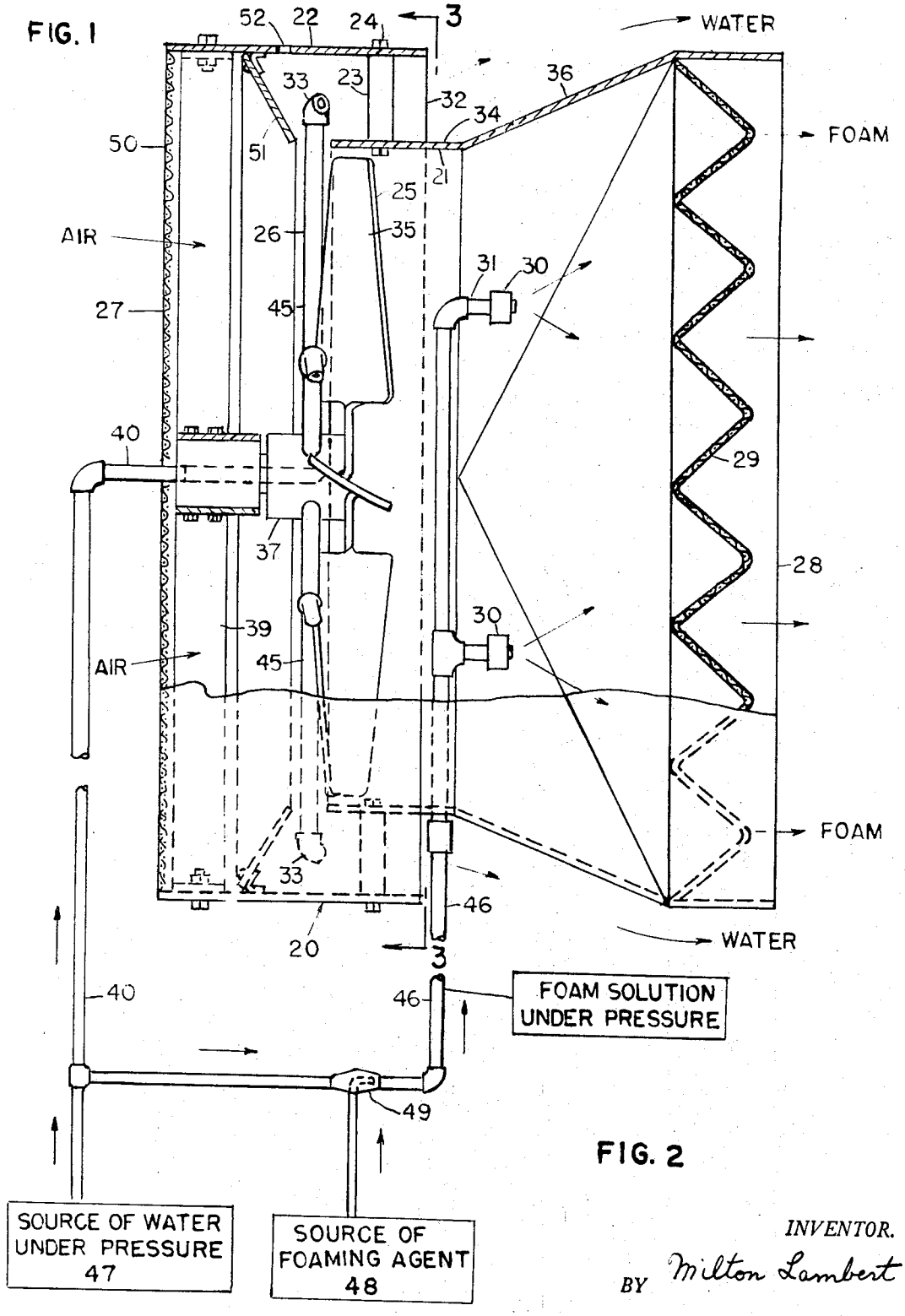


FIG. 2

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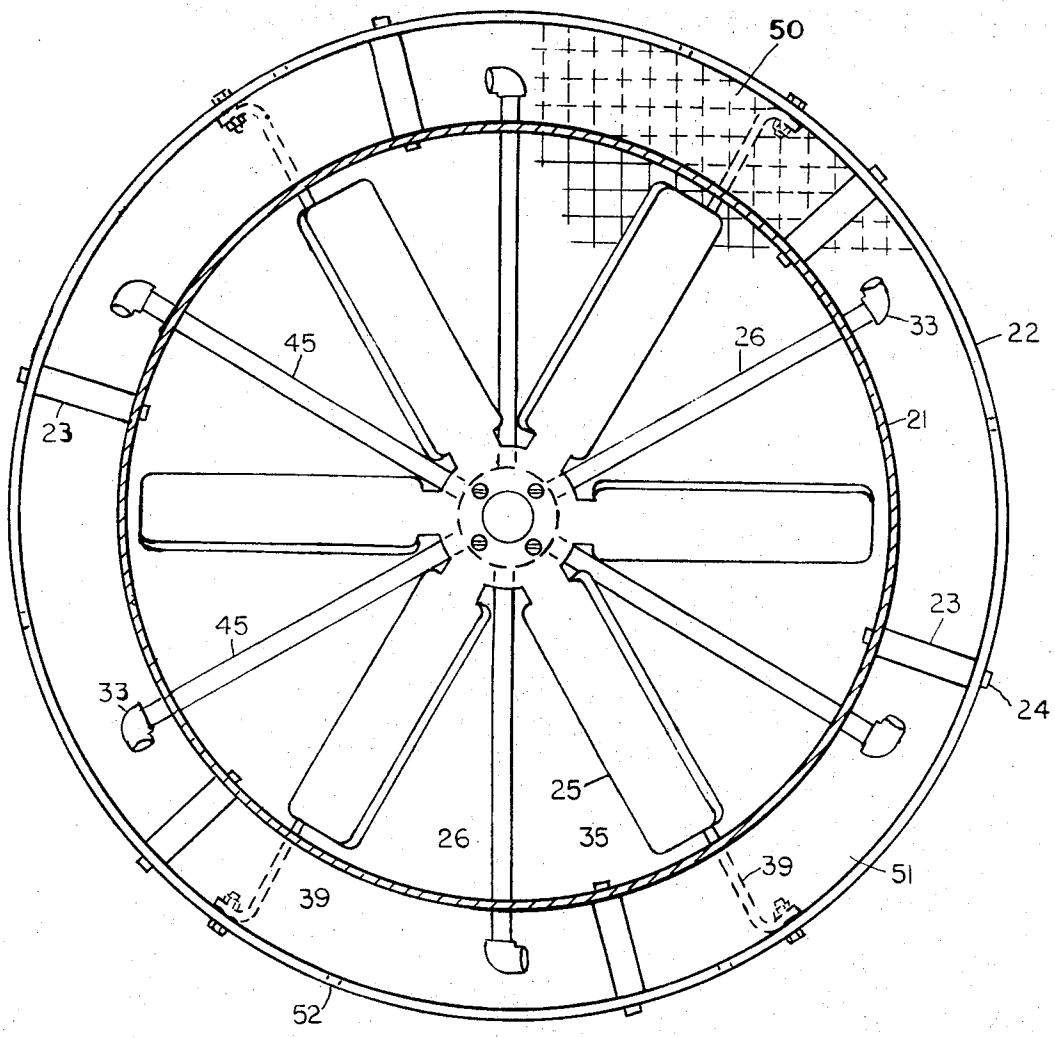


FIG. 3

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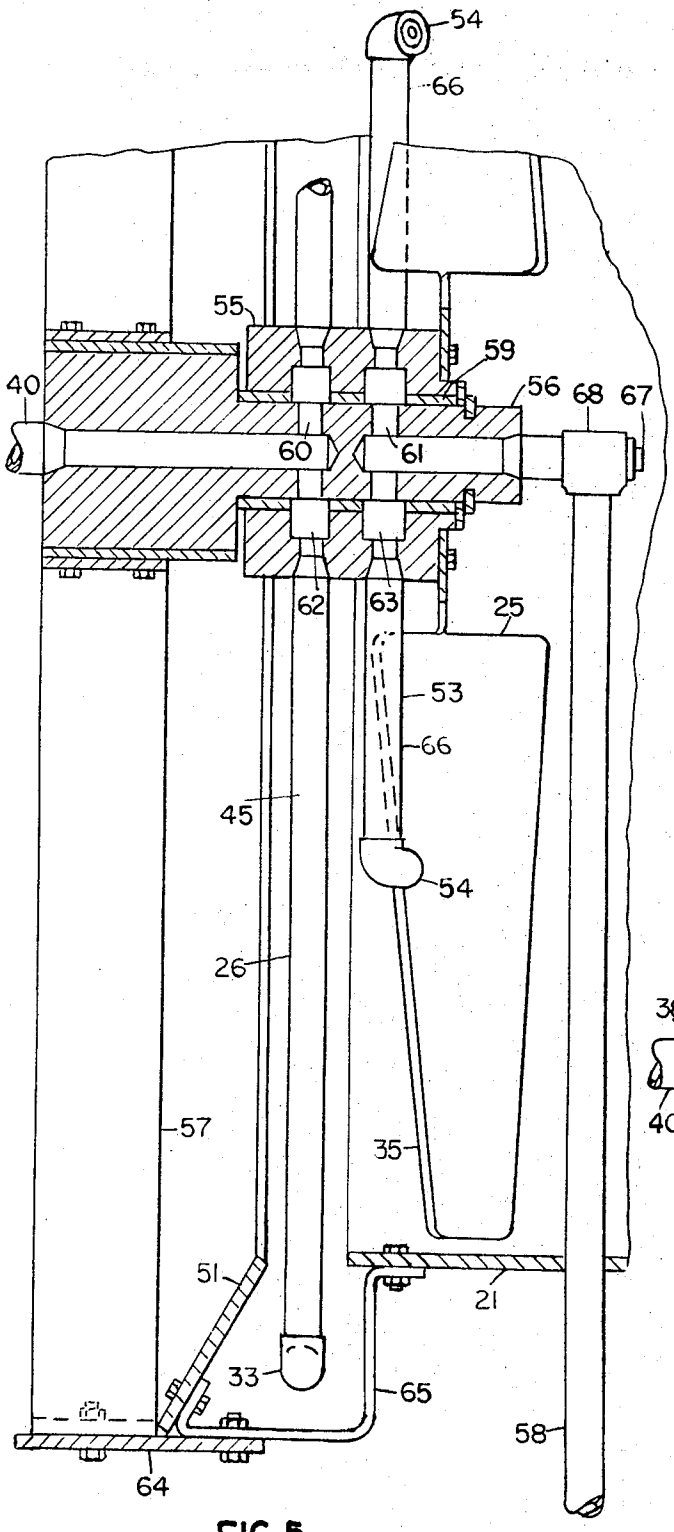


FIG. 5

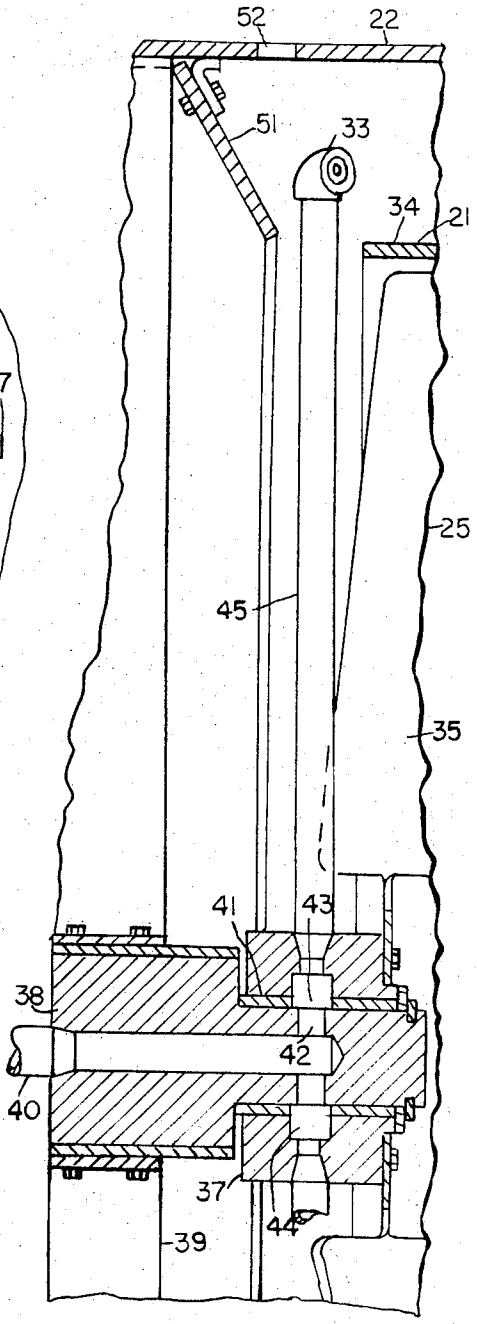
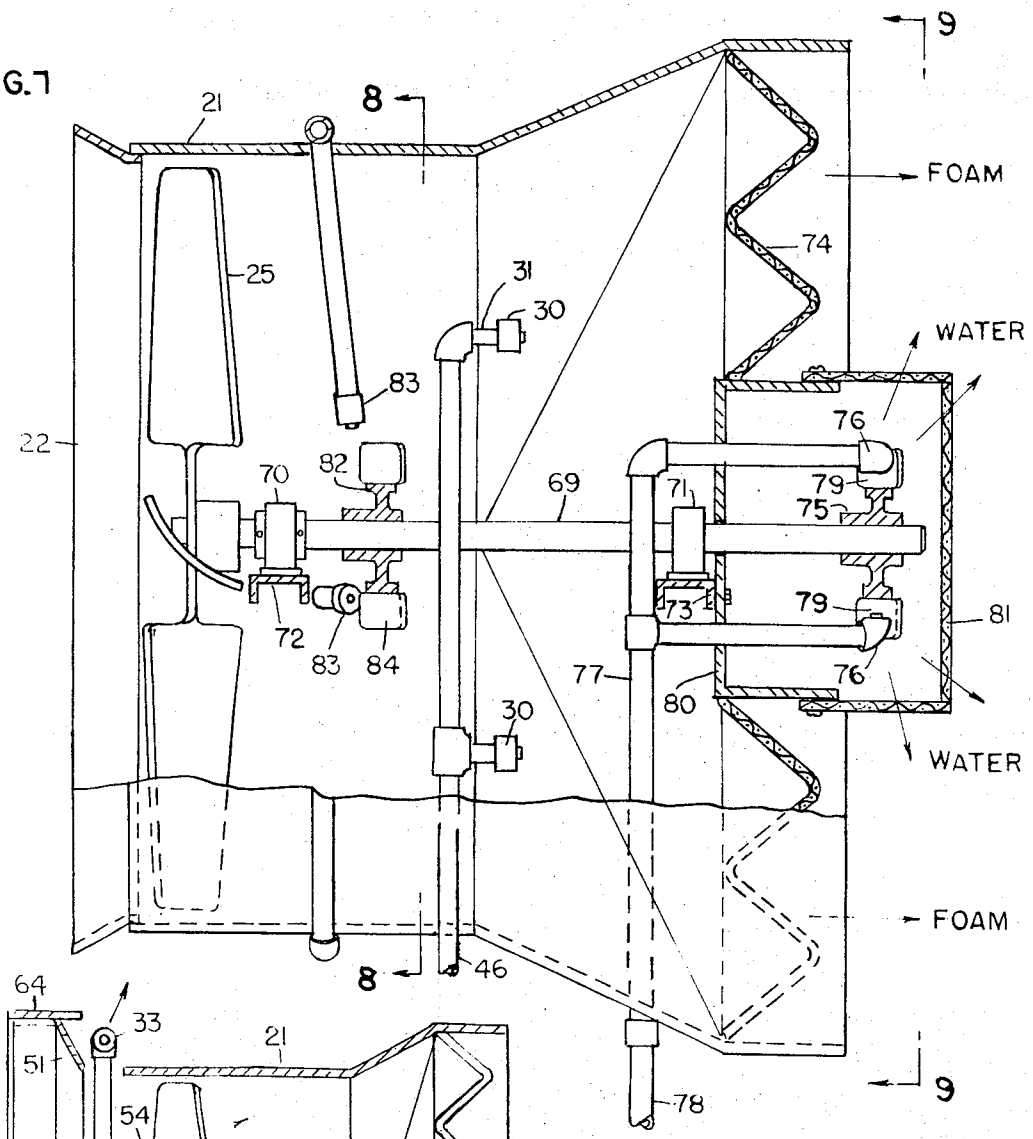


FIG. 4

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FIG. 7



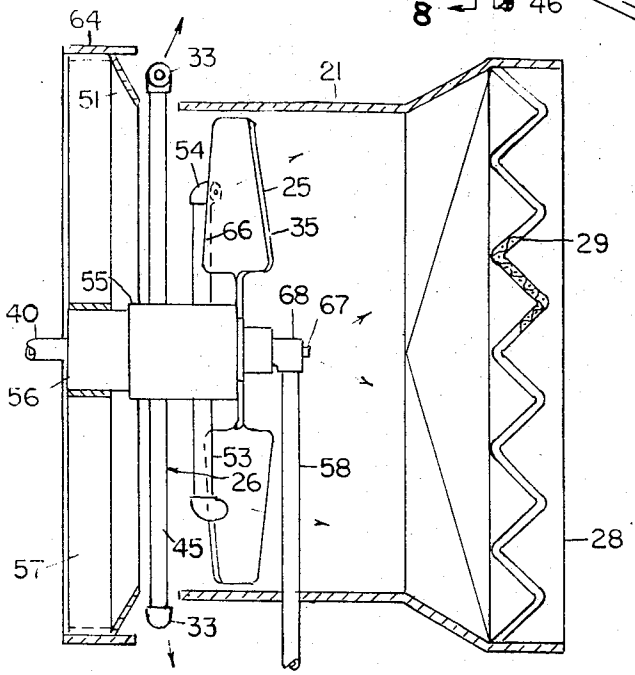


FIG. 6

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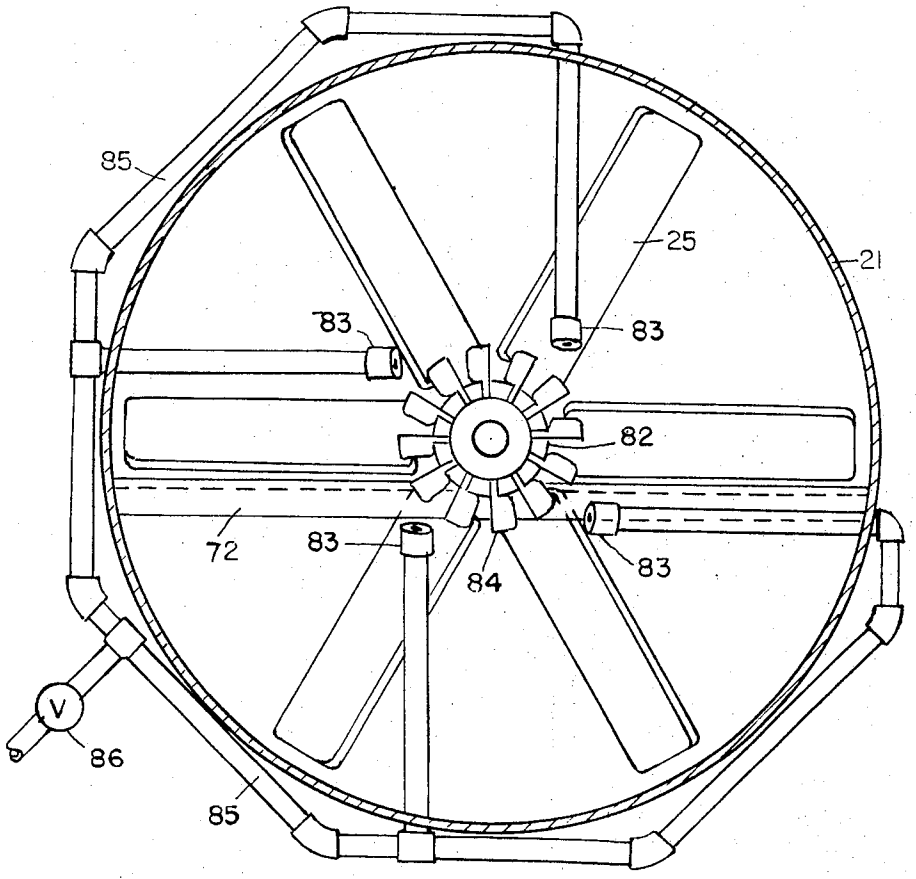


FIG. 8

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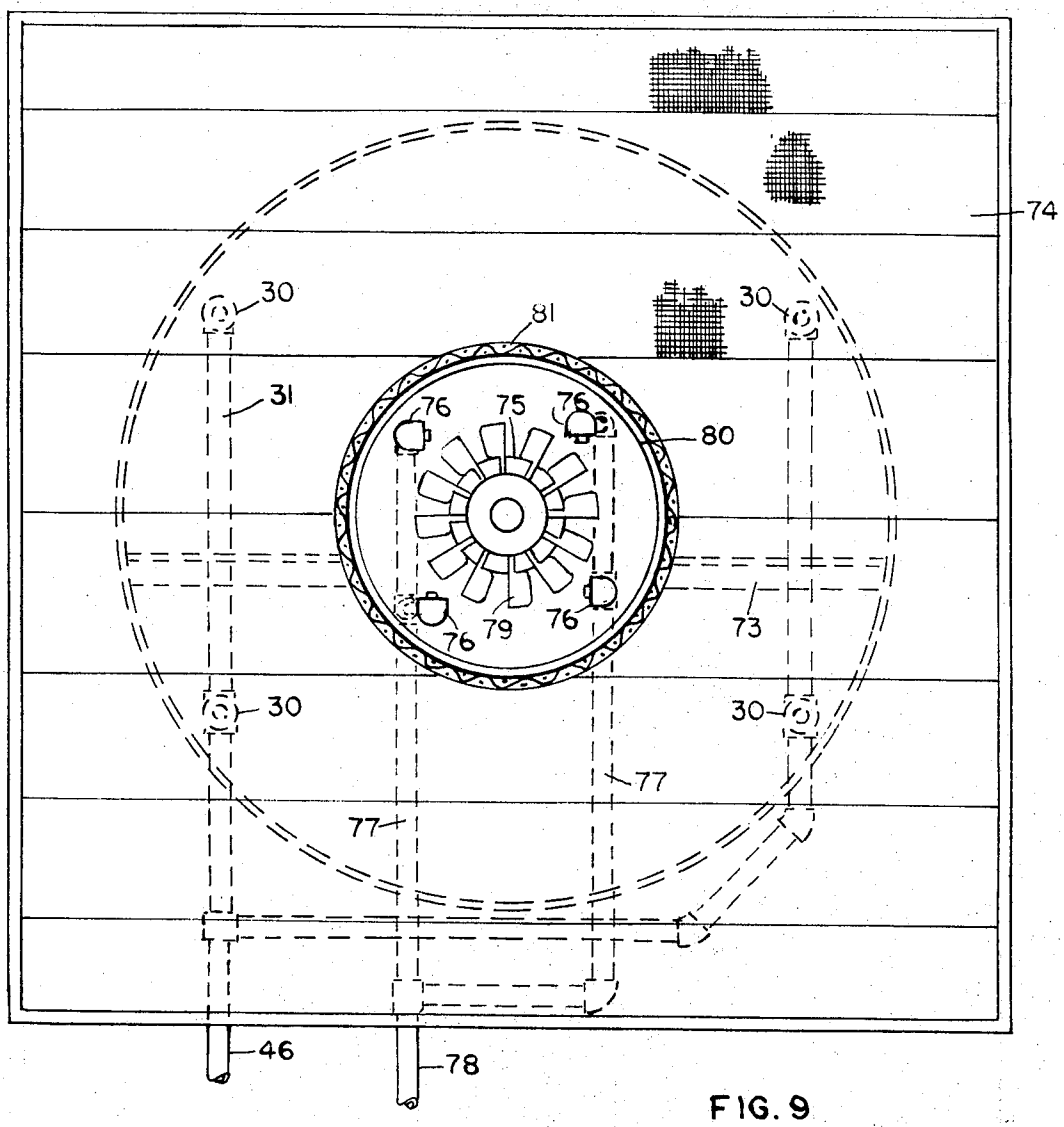


FIG. 9

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METHOD AND APPARATUS FOR GENERATING FIRE-FIGHTING FOAM

BACKGROUND OF INVENTION

This invention relates to high expansion foam apparatus and more particularly to a fire-fighting foam generator embodying a system in which a foam solution wets a perforated member and a fan forces air through the perforated member. Bubbles of foam are formed which are intended to cover the area to be protected.

DESCRIPTION OF PRIOR ART

This form of foam application is an outgrowth of a method of fighting fires in underground mines. Thereafter, self-contained apparatus was devised which made it possible to use the high-expansion foam method of fire-fighting not only in mine fires but also in building fires. Such apparatus is described more fully in U.S. Pat. Nos. 3,186,490, 3,241,617 and 3,272,263. These patents generally deal with foam generating equipment which contain, broadly, a wind-tunnel structure with a fan at one end and a perforated member at the other end. The fan was driven by an electric motor. U.S. Pat. Nos. 3,393,745, 3,420,310 and 3,428,131 developed foam generating devices utilizing the foam solution as the driving means.

Shortcomings of Prior Art

For effective fire-fighting it would be advantageous if the high expansion foams have sufficient fluidity and weight so that the foam bubbles will flow readily in all directions and enter all narrow passageways. The foams should contain sufficient water so that they can effectively fight the fire. Further, the foam bulk should have sufficient weight so that they are not blown away by wind nor repelled at the access to a compartment under fire by the updraft from the fire.

In practice, the prior art foam generators produce high expansion foams that are stiff and light, no attempt being made to fluidize the foam. The foams that are not fluid do not reach the fire. The foams could not pass through small spaces in sufficient quantity and quality to control and extinguish the fire. High expansion foams that do not contain enough water cannot effectively extinguish the fire. The liquid content of the foam that reaches the fire, determines the effectiveness of the foam.

Further, with respect to the prior art where foam solution powered the foam generators, the efficiency of the unit depends only upon the power available in the solution of water and foaming agent. This power is utilized to drive the fan to produce the air flow through the unit.

In prior arrangements maximum utilization of the available water power was not possible. In order to inject the foaming agent into the water stream an in-line proportioner is normally used. The proportioners are constructed internally in the form of a venturi. Water under pressure flow through the venturi and creates a vacuum thus inducing the foam forming agent into the water supply. This solution then passed to the foam generator for driving the fan rotor. However, the pressure drop is so great across an in-line proportioner that only about 65 percent of the inlet pressure of the water at the proportioner is available for driving the fan rotor. For example, with an inlet water stream pressure of 90 p.s.i., after passing through the proportioner, the discharged solution of water and foaming agent would be only 59 p.s.i. The solution of water and foaming agent at this lower pressure decreases the amount of power that can be extracted for the purpose of starting and driving the fan rotor. It is to be noted that when the fan is not turning fast enough, high expansion foam cannot be generated. Also, high pressure is needed to overcome the initial binding or tightness due to corrosion that is normally experienced in liquid foam solution powered rotors that have not been turned over for a few days.

The radial distance at which the reaction nozzles are positioned from the axis of the shaft must also be a factor. The greater the distance of the nozzles from the axis of the shaft, then the amount of power extracted from the liquid is greater. In the prior arrangements, the distance of the nozzles from the axis of the shaft had to be limited by the location of the foam generating perforated member.

SUMMARY OF THE INVENTION

The present invention overcomes the above listed weaknesses by a novel foam generator.

As an overall object, the present invention seeks to provide a method for readily fluidizing the high expansion foam and increase the fire-fighting ability of the foam. This is accomplished by water wetting the foam bubbles.

Another object is the provision of a new and improved fire-fighting foam generator which is operated by a source of power, namely water power, the water that is used to wet the foam bubbles.

Still a further object is the provision of new and improved fire-fighting foam generator containing fan driving and foam bubble fluidizing means.

In accordance with the invention, a spray of water wets the mass of foam bubbles. If the high expansion foam bubbles are thus sprayed, the foams will become fluid and be able to pass through small spaces. Also the foams will become more efficient in extinguishing the fire in that the foams will be carrying more fire-fighting water. Further, the foam bubbles will be less likely to be blown away by the wind or repelled by the fire updraft. Another object of the invention is to have the water that is used to spray the foam serve as the driving means of the fan in the foam generator.

The above and other objects and features of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings which form a part of this specification, and in which:

FIG. 1 is a side view of one embodiment of the invention;

FIG. 2 is a schematic view illustrating an arrangement for combining the foaming agent with the water supply;

FIG. 3 is front view of the fan and water jet embodiment of FIG. 1 taken along line 3—3;

FIG. 4 is an enlarged fragmentary view of the fan and water jet embodiments of FIG. 1 and 3;

FIG. 5 is an enlarged fragmentary view of fan, water jet and foam solution jet embodiment shown in FIG. 6;

FIG. 6 is a side view of a modified arrangement of the invention;

FIG. 7 is a side view of another embodiment of the invention;

FIG. 8 is a front view of the fan and foam solution jet embodiment of FIG. 7 taken along line 8—8 and

FIG. 9 is an end view from the discharge end of the embodiment of FIG. 7 taken along line 9—9.

Referring now to the drawings wherein the showings are for the purpose of illustrating preferred embodiments of the invention only and not for the purpose of limiting the same, in FIGS. 1 and 3 a foam generator 20 is shown to include two concentric housings, a fan housing 21 and a water spray housing 22 that are spaced apart by a plurality of circumferentially spaced cored bars 23 and secured by bolts and nuts 24.

A fan 25 positioned within the fan housing 21 is driven in accordance with the invention by a reaction jet water powered motor generally indicated by the numeral 26 and described more in detail hereinafter. The fan housing also includes a cylindrical central air intake opening 27 at one end and at the other end a foam discharge opening 28 that is rectangular or square in cross section. A perforated member 29 extends across the free passageway area of the housing adjacent to the discharge opening 28. Foam solution is sprayed by nozzles 30 from a spray battery 31 onto the perforated member forming film lenses over the perforations. The airstream, initiated by fan 25, and passing through the perforations is entrained with the foam solution to produce foam. The number of bubbles formed and consequently the volume of foam produced, can be increased to a degree, by increasing the velocity of the air flow. Under the prevailing dynamic pressure head, the foams produced detach themselves from the perforated member.

The water spray housing 22 is cylindrical in shape and forms with the outside of fan housing 21 an annular water spray passageway outlet 32. Water spray is introduced into the passageway by reaction nozzles 33 and is discharged onto the foam that has been discharged through the foam discharge opening 28.

Referring now particularly to FIGS. 1 and 4, the fan housing 21 has a round portion 34 closely surrounding the blades 35 of fan 25 which is joined by an outwardly tapered section 36 of increasing cross-sectional area. The fan 25 includes a hub 37 journaled on shaft 38 mounted axially of the housing 22 upon a spider support frame 39. The shaft is hollow and is connected at one end to a line 40 communicating with a source of water under pressure. The shaft 38 and bearing 41 have circumferentially spaced ports 42, 43 connecting to a chamber 44 in the fan hub. The fan hub 37 supports a plurality of radially extending pipes 45 each connecting with chamber 44 and spaced circumferentially between the fan blades 35. Each pipe carries a nozzle 33.

Each nozzle 33 points at an angle to the axis of fan rotation. Since the fan hub 37 which supports the nozzles 33 is free to rotate, the combined thrust from each of the nozzles 33 imparts rotation to the fan 25. The angulation of the nozzle 33 with respect to the fan shaft 38 is such that the stream strikes the inside of the water spray housing 22 and is deflected through the passageway 32 and falls on the foam being discharged from opening 28.

As shown in FIGS. 1 and 9, intermediate the fan 25 and the perforated number 29 is a battery of four foam solution spray nozzles 30. The battery 31 is connected at one end to a line 46 communicating with foam solution under pressure. In operation, the foam solution is sprayed by nozzles 30 onto the perforated member 29.

The source of foam solution is shown in FIG. 2 which comprises a source of water under pressure 47, a source of foaming agent 48, an in-line proportioner 49. Pipe 40 carries water under pressure while pipe 46 carries foam solution under pressure.

The water spray housing 22 is furnished with a fan guard 50 and an air intake cone 51. The pipes 26 containing the reaction nozzles 33 rotate between the air intake cone and the round portion 34. A plurality of circumferentially spaced vent holes 52 are provided in the water spray housing so that air will not be drawn into passageway 32 from the air intake 27.

In a second embodiment of the invention shown in FIGS. 5 and 6, the hydraulic powered fan 25 is powered in tandem by reaction jet water powered motor 26 and by reaction jet foam solution powered motor generally indicated by the numeral 53. The foam solution is introduced by reaction nozzles 54 which is then borne by the velocity of the air stream created by the fan 25 against the perforated member 29. Referring now in detail to FIG. 5 the fan includes a hub 55 journaled on shaft 56 mounted axially of the fan housing 21 upon the fan support frame spider 57. The shaft 56 is hallowed at ends with no through free passageway. At one end it is connected to line 40 communicating with a source of water under pressure. At the other end it is connected to a line 58 communicating with a source of pressurized foam solution. Under pressure in line 58, the fan 25 is aided in rotation by the reaction nozzles 54 which also introduces the foam solution to wet the downstream perforated member 29.

The shaft 56 and bearing 59 have circumferentially spaced ports 60 and 61 connecting to chambers 62 and 63 respectfully in the fan hub. The fan hub 55 supports near one end a plurality of radially extending pipes 45 each connecting with chamber 62 and extending outwardly between the air intake cone 51 and the fan housing 21. Each pipe carries reaction nozzle 33. An outer cylindrical housing 64 supports the air intake cone and the spider support 57 for the shaft 56. A plurality of circumferentially spaced narrow struts 65 secure the fan housing 21 to the outer cylindrical housing.

The fan hub 55 supports near another end a plurality of radially extending pipes 66 each connecting with chamber 63 and spaced circumferentially between the fan blades 35. Each pipe 66 carries a reaction nozzle 54. To insure wetting the center portion of the perforated member 29 a non rotatable spray nozzle 67 may be provided at the end of pipe fitting 68.

This particular embodiment of the invention lends itself for use where the generator is mounted in the vertical position so that the shaft 56 is vertical and the foam discharge opening 28 faces downward. It is to be noted that the greater the angle of the nozzles 33 to the fan shaft 56 the greater the power furnished. As shown in FIG. 6, the maximum angular deflection is obtained. Further it is to be noted in this embodiment, that the elongated arms of the nozzles from the axis of the shaft afford a greater amount of power to be extracted from the water.

In another embodiment of the invention as shown in FIGS. 7, 8 and 9 an axially oriented rotatable shaft 69 is supported by spaced bearing blocks 70 and 71 within the fan housing 21. These bearing blocks are in turn supported on spaced spiders 72 and 73. At the inlet end 27 of the fan housing, fan 25 is fastened to the shaft 69 to create an air stream. At the other end of the shaft, located outside the perforated section 74, an impeller

wheel 75 is fastened to the shaft to rotate the shaft. Water is discharged from a plurality of nozzles 76 from a battery of pipes 77. The battery of pipes communicates by line 78 to a source of water under pressure. The water discharging from the nozzles impinge on blades 79 of the impeller wheel 75 and then is deflected outwardly onto the foam bubbles discharging from the perforated section 74. FIG. 7 clearly shows that the fan 25 is hydraulically driven through shaft 69 by the impeller wheel. The perforated section has a centrally located annular opening in which is positioned a sheet metal baffle cylinder 80 that is open at one end and at the other end has a clearance hole for the shaft and holes for the battery of nozzle pipes 77. The baffle cylinder is secured to spider 73. The edges of the annular opening in the perforated section 74 and the edges of the pipes that are adjacent to the baffle cylinder are suitably sealed with caulking or welded to the baffle cylinder. The open end of the baffle cylinder is covered with heavy wire screening 81 fabricated in the form of an open ended cylinder. The wire screening is secured with screws to the baffle cylinder 80. The driving of the fan may be assisted by another impeller wheel 82 fastened to the shaft and positioned between the fan and the perforated section. This impeller wheel would be driven by the foam solution directed by the nozzles 83 onto the blades 84 of the impeller wheel. The foam solution would then be deflected to spray onto the perforated section. The foam solution is carried to the nozzles under pressure through a battery of pipes 85. A valve 86 connects the battery of pipes to a source of foam solution under pressure.

As various changes may be made in the form, construction and arrangement of the parts (and steps) herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. The method of generating high expansion foam comprising the steps of

introducing foam solution under pressure into a housing to be sprayed against a perforated member while simultaneously introducing water under pressure into said housing to power a fan by hydraulic means causing air to flow through the said perforated member, and

the air flowing through the perforated member entrains with the said foam solution to produce foam and cause continuous detachment of the foam from the perforated member while simultaneously the said detached foam is sprayed with the water discharged from the said fan hydraulic means.

2. Apparatus for producing fire-fighting foam comprising a housing having a hydraulically powered fan means for propelling air through a perforated member, foam solution spray nozzles positioned within said housing with a connection to a source of foam solution under pressure, said foam solution nozzles being directed generally toward said perforated member whereby the air flowing through said member is entrained with the foam solution to produce foam, the improvements comprising:

a plurality of water jet nozzles with a connection to a source of water under pressure and rotatably mounted and attached to said fan means, the said water nozzles pointed at an angle relative to their axis of rotation so as to produce a reaction force for rotating said fan means and laid out in an arrangement for wetting said foam.

3. Apparatus according to claim 2 wherein said rotatably mounted water jet nozzles are carried on elongated arms.

4. Apparatus for producing fire-fighting foam comprising a housing having a hydraulically powered fan means for propelling air through a perforated member, foam solution spray nozzles positioned within said housing and having a connection with a source of foam solution under pressure, said foam solution nozzles being directed generally toward said perforated member whereby the air flowing through said perforated member is entrained with the foam solution to produce foam; an impeller wheel rotatably mounted and attached to the fan means, the improvements comprising:

a plurality of fixed nozzles connected with a source of water under pressure, said water nozzles being directed toward the blades of said impeller wheel, said blades being positionally related so that said water is directed onto said foam after it impinges on said blades.

5. Apparatus for producing fire-fighting foam, comprising a hydraulically powered fan means for propelling air through a perforated member, said fan powered in tandem by introducing separately, foam solution under pressure and water under pressure; the said foam solution discharging from the said tandem arrangement to wet the said perforated member and entraining with the air flow to form foam; the said water discharging from the said tandem arrangement being directed to spray onto the said foam.

6. Apparatus for producing fire-fighting foam comprising a housing having a hydraulically powered fan means for propelling air through a perforated member; a plurality of nozzles for discharging foam solution rotatably mounted and attached to said fan means, the said foam solution discharging nozzles pointing at an angle relative to their axes of rotation so as to produce a reaction force for rotating said fan means and laid in an arrangement for wetting said perforated member whereby the air flowing through said member is entrained with the solution to produce foam, the improvements comprising:

a plurality of nozzles for discharging water and attached to said fan means, the said water discharging nozzles pointing at an angle relative to their axis of rotation so as to produce a reaction force for rotating said fan means in tandem with the rotating foam solution discharging nozzles, the said water discharging nozzles being laid out in an arrangement for wetting said foam that has been discharged from the said perforated member.

7. Apparatus for producing fire-fighting foam comprising fan means for propelling air through a perforated member, a plurality of impeller wheels rotatably mounted and attached to the fan means for driving in tandem the fan means; a plurality of foam solution discharging nozzles directed toward the blades on one of the impeller wheels, said blades being positionally related so that said foam solution is directed onto said perforated member after it impinges on said blades, air flowing through said perforated member is entrained with the foam solution to produce foam; a plurality of water discharging nozzles directed toward the blades of the second impeller wheel being positionally related so that said water is directed onto said foam after it impinges onto said blades of the second impeller wheel.

* * * * *