

PATENT SPECIFICATION

(11)

1246355

DRAWINGS ATTACHED

- (21) Application No. 41424/69 (22) Filed 19 Aug. 1969
(31) Convention Application No. 782343 (32) Filed 9 Dec. 1968 in
(33) United States of America (US)
(45) Complete Specification published 15 Sept. 1971
(51) International Classification A 62 c 31/30//1/12 5/04
(52) Index at acceptance

B1C B2E
A5A 1 9



(54) FOAM FIRE EXTINGUISHING SYSTEM

(71) I, HOWARD CHARLES STULTS, a Citizen of the United States of America, of 7630 South Bright Avenue, Whittier, California, United States of America, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a new type of foam fire extinguishing system of the type having a storage tank for supplying foam producing fluid to a foam generator for producing foam said system being especially adapted for installation in a store or other buildings.

A self-contained efficient and highly reliable high expansion foam system for the extinguishing of a fire in a building has long been a desired goal. High expansion foam is a relatively new development for fighting fires, especially in buildings. The prior art discloses some high expansion foam fire fighting systems, both portable and fixed. For the purposes of this invention, the term "high expansion foam" will be understood to mean a foam the volume of which is from 300 to 1,500 times the volume of water and foam producing fluid required as input components.

The basic problem to be solved by the invention is to provide a high expansion foam generating system to be used as a fire fighting system, and which is completely independent of external conditions.

According to the invention a fire extinguishing system of the type employing high expansion foam comprises a reservoir containing a pre-mixed, high expansion foam producing fluid; and a foam generator including a plurality of nozzles coupled to said reservoir, and a screen disposed opposite said nozzles, said generator defining an opening whereby ambient air would be drawn by the streams of fluid when the same is caused to be discharged through said nozzles for

projection upon said screen where said high expansion foam is generated.

The high expansion foam fire extinguishing system utilizes a pre-mixed high expansion foam producing fluid. When a sensor detects the presence of a fire, the valve is opened, placing the high expansion foam producing fluid under pressure from gaseous nitrogen which is an inert gas. Placing the high expansion foam producing fluid under pressure forces the fluid into a manifold having a plurality of attached nozzles. When the fluid is forced through the nozzles cones of fluid are emitted.

The cones of foam producing fluid are emitted into a foam generator defined by an upper wall, a bottom wall, a pair of side walls and a screen. The top wall extends from the inner wall of a building to a point beyond the nozzles. The top wall may extend from an intermediate wall within the building to a point beyond the nozzles. By this method foam generators can be placed back to back with the intermediate wall dividing the foam generators. The screen is attached between the upper wall and the bottom wall. It is placed at a specific angle to the cones of foam producing fluid. The bottom wall extends from the screen to a point substantially in the vicinity of the nozzles.

The foam is formed by a combination of air and high expansion foam producing fluid striking the screen. Air is drawn through the space defined by the lower wall of the foam generator and the inner wall of the building. The air heated by the fire can only enter the foam generator at this point because the upper wall fully covers the nozzle output.

The screen is made of steel or other fire-resistant medium which has a plurality of holes. The ratio of hole area to the total area of the screen is an important factor in creating the foam. The solid area of the screen is coated with hammertone or crackle paint, this being a paint of a kind which on

[Price 25p]

drying produces a rough surface. The rough surface of the paint creates the agitation necessary to create the foam. The nozzles are spaced along the manifold at a predetermined distance that is necessary to insure full coverage of the screen surface. Since the cones formed by emitted foam producing fluid fully cover the screen, the system constitutes a linear generator in that an even distribution of foam is created along the entire length of the foam generator.

The foam emitted from the screen is directed downward because of the angle of the screen. The heated air is drawn through the foam cooling the air. The foam will continue to be generated cooling the entire area of the building. Since the foam has a high water content, the fire will be extinguished. The high expansion foam producing fluid contains a detergent which acts to clean the inner areas of the buildings as well as extinguish the fire.

It is therefore an object of the invention to provide a fire fighting system which is independent of external water supplies, pressurization and electric power.

It is a further object of the invention to provide a fire fighting system which utilizes a high expansion foam producing fluid.

It is still a further object of the invention to provide a foam generator without the use of motors, fans or other air moving devices.

A still further object of the invention is to provide a linear foam generator.

Embodiments of the invention will now be described with reference to the accompanying drawings in which:—

Fig. 1 is a partial section view showing the presently preferred embodiment of this invention installed within a building and the manner in which it is employed to extinguish a fire which may have occurred within the building;

Fig. 1a is an alternative embodiment of the pressure system for the fluid and compressed gas motive means shown in Fig. 1;

Fig. 2 is an enlarged cross sectional view showing the foam generator portion of Fig. 1 enlarged in size;

Fig. 3 is an enlarged perspective view of the generator of Fig. 1;

Fig. 4 is a plan fragmentary view of the screen forming part of the generator of Fig. 3;

Fig. 5 is a view taken along lines 5—5 of Fig. 4;

Fig. 6 is an enlarged sectional view of an exemplary nozzle as may best be seen in Fig. 3 forming part of the generator; and

Fig. 7 is a schematic view showing the discharge cone of the fluid solution as it exits from one of the nozzles forming part of the generator of the present invention system.

Reference is now made to Fig. 1, wherein the presently preferred embodiment of this

invention is shown installed within a storage building generally numbered 10. The foam generator generally designated by the numeral 50 is shown suspended from the ceiling or roof of the building by cables or chain 53. An exterior wall of the storage building 10 is numbered 14 and an interior wall 16. The floor of the building is numbered 18. The fire extinguishing system of the present invention is self-contained and requires no external source of electric power, hydraulic power or gas power. Included within the system, in order to generate foam upon the occurrence of a fire within the building 10 there is provided a source of nitrogen, which is an inert gas, under pressure shown within a container 22. Container 22 is connected through an appropriate line 36 and pressure regulating valve 34 to a tank 24 containing foam producing fluid. A line 40 from tank 24 extends through an opening 42 in the wall 16 and connects to a manifold 44. As may best be seen in Fig. 2, the upper wall 52 of the foam generator 50 extends to and abuts against the interior wall 16 of the building, while the lower wall 54 of the generator extends from the vicinity of the manifold 44 forward to an inclined screen which is joined to the upper and lower walls 52 and 54 of the foam generator. The rear portion of wall 54 does not extend to or abut against the wall 16 of the building as does the upper wall 52 of the foam generator.

The foam system is activated when sensor 26 detects the presence of a fire. Sensor 26 is a heat detector which initiates an alarm upon detecting an ambient temperature of 135°F. Sensor 26 is a conventional heat detector manufactured by the Walter Kidde Corporation. The output of sensor 26 is transmitted along line 28 and energizes a relay 30 which causes an electrical signal to be transmitted along lines 32 to the pressure regulating valve 34. The pressure regulating valve 34 is an electrically activated device regulating the pressure to be imposed upon the foam producing solution tank 24. The pressure regulating valve 34 can be set for outlet pressures of approximately 70, 80, or 90 psig. Preferably the pressure regulating valve is required to produce a flow rate of 65.8 ± 1.0 standard cubic feet per minute for 80 gallon per minute delivery at 90 ± 1 psig. The pressure regulating valve 34 is manufactured by Accessory Products Corporation, Whittier, California, a division of Textron Industries and is designated as APCO No. 803500D—3. By opening the pressure regulating valve 34, gas from container 22 flows through line 36, pressure regulating valve 34, and line 38 into tank 24. Since the foam producing solution in tank 24 is under pressure, the foam producing solution is forced into line 40.

The high expansion foam producing solution is prepared from a concentrate composed of, in percent by weight, from 3.0 to 4.5 percent Neodol 25, 30 to 35 percent Neodol 23—3A, 26 to 30 percent mono butyl ether of ethylene glycol, the balance of 30.5 to 41 percent being water. The concentrate is diluted by water to form a solution containing, in percent by volume, 3 percent of the above concentrate and 97.0 percent water. Neodol 23—3A is defined in "Shell Chemical Bulletin, I.C:6741" as an aqueous solution of an ammonium salt of a sulphated primary alcohol ethoxylate containing on the average three ethylene oxide units. Neodol 23—3A has a molecular weight of approximately 423, a content of ethylene oxide by weight of 31.2 percent, a specific gravity at 25°C of 1.01, and a pH of 7.3. It is a light coloured viscous liquid containing about 60 percent by weight surfactant and ethanol is included as a solubilizer. Neodol 25 is commercially available from the Shell Chemical Company. Neodol 25 is a blend of linear primary alcohols with 12, 13, 14 and 15 carbon atoms. The physical characteristics of Neodol 25 are a molecular weight of approximately 207, a specific gravity at 25°C of 0.834, and a viscosity of 18.3 centipoise at 100°F. A high expansion foam is distinguishable from a low expansion foam by its greater expansion ratio which is defined by the volume of foam produced by a foam producing solution divided by the original volume of the foam producing solution. A high expansion foam has an expansion ratio of 500 to 1,500 while a low expansion foam has an expansion ratio of 10 to 20. For use in buildings it is preferred to use a foam having an expansion ratio of 650 to 700. The expansion ratio can be changed by changing the pressure imposed on the foam producing solution. Referring to Fig. 1, the pressure regulating valve 34 can be set for a pressure of 70, 80 or 90 psig. When the pressure is applied to the solution in the tank 24, the foam produced will have an expansion ratio of 600, 700 or 800, respectively. The amount of foam producing solution available for fire fighting can be increased by putting a plurality of solution tanks 24 in series. Referring to Fig. 1a, in which an alternate form for the tanks 20 is shown, three solution tanks 24 are serially connected with the result that approximately three times more foam can be produced. By putting a plurality of tanks 20 in parallel, the volume of foam generated per unit of time can be increased.

Referring to Fig. 2, the foam producing solution is forced through line 40 into manifold 44 existing at nozzle 60. The nozzle 60 can be attached to the manifold 44 in any suitable manner but preferably by a threaded joint 62 as shown in Fig. 6. The

nozzle 60 can have a chamber 64 provided with a spiral groove or rib leading to an annular flanged outlet 66 which will produce a discharge in the form of a cone. The arrangement of nozzles 60 along manifold 44 can be best seen in Fig. 3. The cones 68 of foam producing solution emitted from nozzles 60 are such that all parts of the screen 56 are reached by the solution. If the nozzles 60 are spaced 9 inches apart, nitrogen pressure of 80 psig. will produce 200 cubic feet of foam per minute per foot of generator. If the nozzle separation is only 3 inches, the foam generated will equal 600 cubic feet per minute per foot of generator. The cone 68 strikes the foam generating screen 56 which is attached to the lower wall 54 of the foam generator at an angle of $30^\circ \pm 5^\circ$ to flow axis.

The screen 56 is made of steel or other fire-resistant material in which a plurality of holes 58 are formed. The holes 58 in screen 56 should be $3/16$ inches in diameter with the hole centres $\frac{1}{4}$ inch apart. Preferably, the number of holes required is such that approximately 42 percent of the screen area is porous, that is the hole area constitutes less than half the total surface area of the foam generating screen. The figure 42 percent will insure a sufficient flow of foam. The solid surface of the screen is covered with hammertone or crackle paint 78 which, as stated above, is a paint which on drying produces a rough surface, this is indicated in Fig. 4. The rough surface produced by the paint 78 creates areas of extreme agitation which generate foam from the foam producing solution. The thickness of the paint 78 must be less than $1/1000$ of an inch thick. This is shown in Fig. 5.

The rough cracked surface of paint 78 covers all solid surfaces of the foam generating screen 56 with the result that in and around the holes 58, foam generation is caused.

Referring to Fig. 2, the foam generated at screen 56 falls from screen 56 in a downward direction because of the angle created by screen 56 and the lower wall 54. The flow of foam will create a pile of foam 70 through which the heated air 74 is drawn. The conic flow of foam producing solution will create a partial vacuum thereby causing movement of the heated air 74 through the foam pile 70. Because the upper wall 52 shrouds the nozzle 60, the only point of air entry to the foam generating system is area 72. By drawing the heated air 74, through the foam pile 70, the heated air 74 is cooled. The heated air 74 will carry particles emanating from the burning article 76 and this in turn, will partially contaminate the cone 68. Figs. 2, 3, 6 and 7, of foam producing solution. The outer surface or skin of the cone 68 will be impregnated with the con-

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 5 taminating particles but so long as the velocity of the foam producing solution is sufficient to prevent total impregnation of the cone 68, foam generation at the screen 56 will be effective.

10 From the foregoing it may be seen that in one embodiment of the invention there is provided a self-contained high expansion foam fire extinguishing system providing an independent source of pressurization to a container holding a foam producing fluid for delivery to a foam generator having a plurality of nozzle members and a screen to produce high expansion foam upon activation of the system by a fire detecting sensor.

WHAT I CLAIM IS:—

1. A fire extinguishing system of the type employing high expansion foam, comprising a reservoir containing a pre-mixed, high expansion foam producing fluid; and a foam generator including a plurality of nozzles coupled to said reservoir, and a screen disposed opposite said nozzles, said generator defining an opening whereby ambient air would be drawn by the streams of fluid when the same is caused to be discharged through said nozzles for projection upon said screen where said high expansion foam is generated.

2. A fire extinguishing system as claimed in Claim 1, wherein said screen is disposed at an acute angle relative to said streams of fluid discharged by said nozzles.

3. A fire extinguishing system as claimed in either Claim 1 or Claim 2, wherein said screen has disposed over the exterior surfaces thereof a coating of paint of a kind which on drying produces a rough surface.

4. A fire extinguishing system as claimed in Claim 2, wherein said angle is in the range from 25° to 35°.

5. A fire extinguishing system as claimed in any one of the preceding claims, wherein said generator is defined by a top wall, a bottom wall and a pair of side walls and where said bottom wall extends back from said screen to a point substantially in the vicinity of said nozzles and wherein said upper wall extends substantially therebeyond, said generator being adapted to be mounted

within a building so that the extension of said upper wall may abut the inner wall of said building leaving an opening below said extension through which air may be drawn into said generator when said fluid is flowing under pressure out of said nozzles.

6. A fire extinguishing system of the type using high expansion foam, comprising a self-contained source of pressurized gas; a reservoir coupled to said self-contained source wherein said reservoir contains a pre-mixed high expansion foam producing fluid; a foam generator coupled to said reservoir, said foam generator comprising a manifold for distributing the high expansion foam producing fluid said manifold having spaced openings therein; a plurality of nozzles coupled to said spaced openings in said manifold for discharging the foam producing fluid; and a screen, the arrangement being such that air being drawn into the foam generator is drawn into the manifold to flow past the nozzles for projection upon the screen where the high expansion foam is generated.

7. A system as claimed in Claim 6 wherein said pressurized gas is an inert gas.

8. A system according to Claim 6 or Claim 7, wherein the screen has a plurality of holes and is covered with a layer of paint which forms a rough cracked surface on said screen.

9. A system as claimed in Claim 8 wherein said holes in said foam generating screen are 3/16 inch in diameter and the distance between the hole centres is 1/2 inch.

10. A system as claimed in Claim 8 wherein the hole area constitutes less than half of the total surface area of the foam generating screen.

11. A system as claimed in Claim 8 wherein the paint is less than 1/1000 inch thick.

12. A fire extinguishing system substantially as described with reference to either Figs. 1, 2, 3, 4, 5, 6 and 7 or Figs. 1 to 7 as modified by the arrangement of Fig. 1a of the accompanying drawings.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1971.
 Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.



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within a building so that the extension of said upper wall may abut the inner wall of said building leaving an opening below said extension through which air may be drawn into said generator when said fluid is flowing under pressure out of said nozzles.

6. A fire extinguishing system of the type using high expansion foam, comprising a self-contained source of pressurized gas; a reservoir coupled to said self-contained source
60 wherein said reservoir contains a pre-mixed high expansion foam producing fluid; a foam generator coupled to said reservoir, said foam generator comprising a manifold for distributing the high expansion foam producing
65 fluid said manifold having spaced openings therein; a plurality of nozzles coupled to said spaced openings in said manifold for discharging the foam producing fluid; and a screen, the arrangement being such that
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