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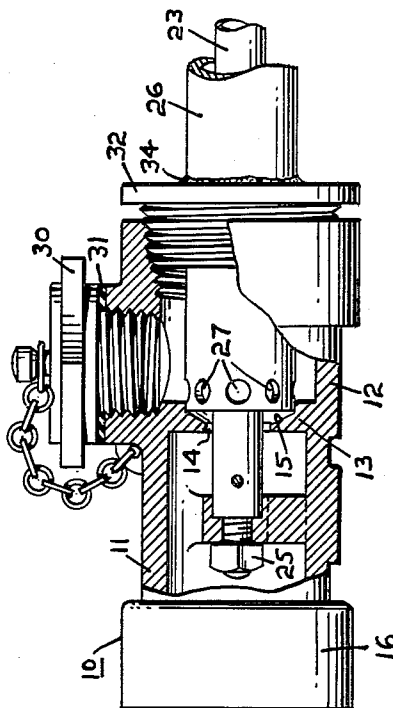
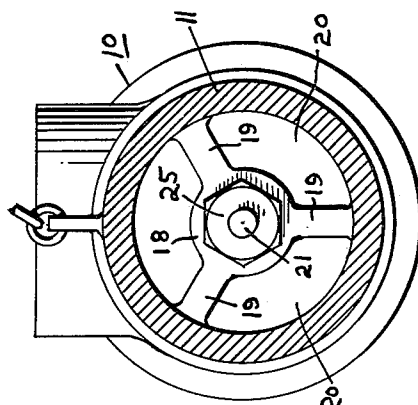
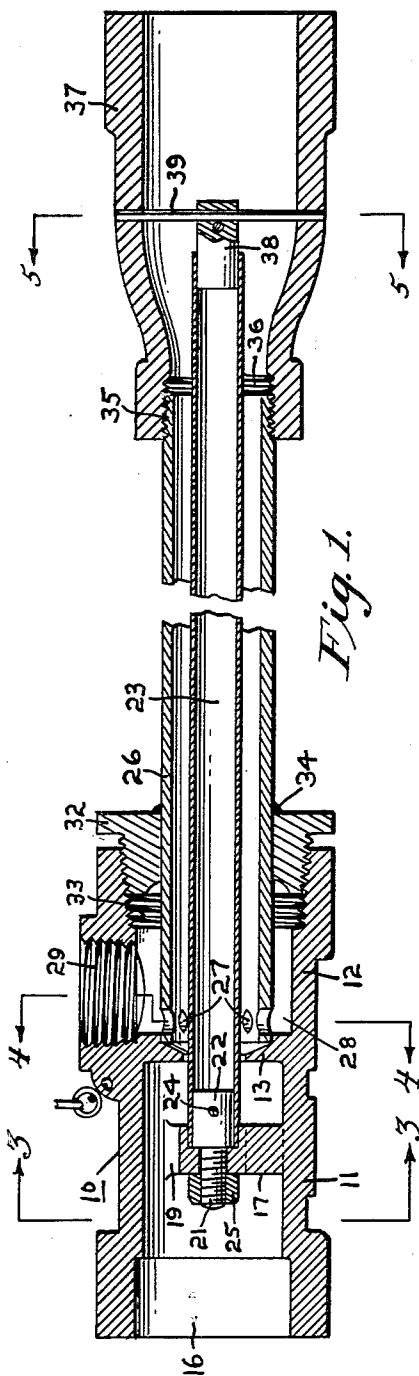
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3,122,327

FIRE EXTINGUISHING FOAM DISCHARGE NOZZLE

Filed Aug. 20, 1962

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

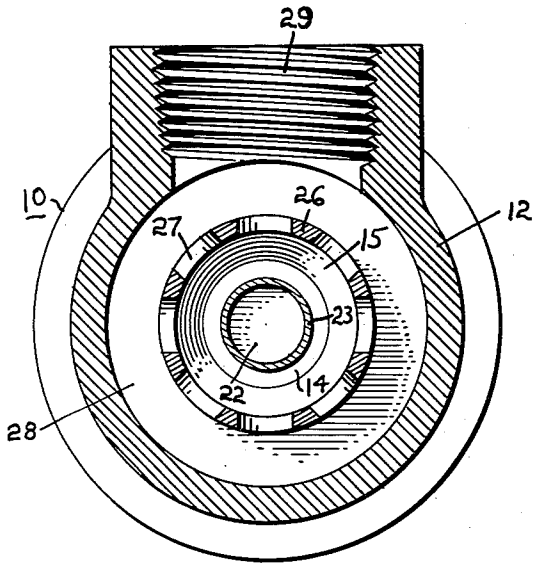


Fig. 4.

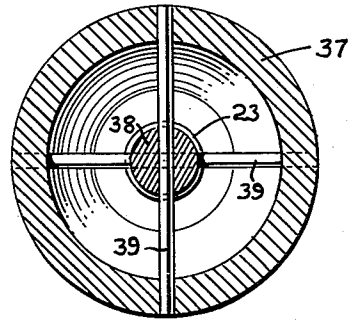


Fig. 5.

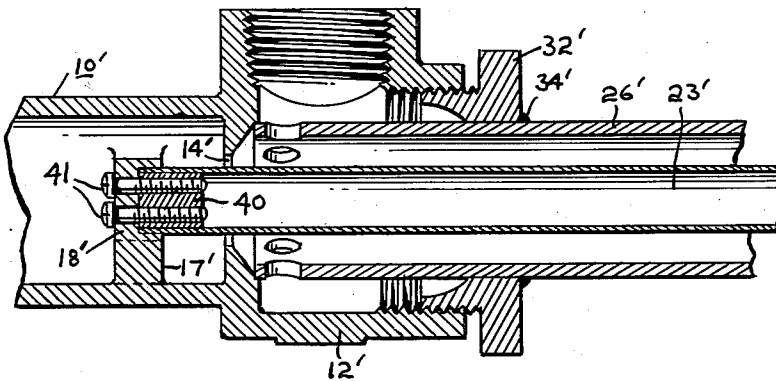


Fig. 6.

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3,122,327 FIRE EXTINGUISHING FOAM DISCHARGE NOZZLE

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8 Claims. (Cl. 239—431)

This invention relates generally to the production of foam employed in the extinguishing of fires, and more particularly to certain improvements in the design and construction of apparatus for applying fire extinguishing air foam to the surface of a flammable liquid such as oil or gasoline.

Flammable liquids such as oil, gasoline and other petroleum derivatives, as well as polar solvents such as alcohols, esters and ketones, are generally stored in large tank structures often of considerable height. The hazard of fire and explosion is always present because of the high volatility of these substances, and consequently it is necessary to install fire fighting apparatus upon each tank in such manner that an air-excluding foam blanket may be laid down on the upper surface of the stored flammable liquids to thereby extinguish any fire which might occur. The fire extinguishing foam must therefore be elevated to the upper region of the tank structure. This can be accomplished by either forming a fire extinguishing foam at ground level or below and pumping it upward through conduits to the top of the tank, or by installing a foam generating nozzle structure on the tank structure itself somewhere between ground level and the top of the tank. The location of a foam generating nozzle on a tank structure at points above ground level is frequently necessary because it is not a simple matter to make a foam forming nozzle which will function to produce foam against the substantial back pressure which results when the foam nozzle is required to drive a column of foam through any substantial vertical distance, as for example the height of a tank. Thus, in the past it has been the general practice to install such foam forming nozzles near the top of such tanks to reduce the pressure against which the nozzle must operate when producing foam. The elevated location of a foam forming nozzle is not particularly desirable since the nozzle is thus not readily accessible for inspection and normal maintenance. Accordingly, a primary object of this invention is to provide a novel foam forming nozzle capable of producing a fire extinguishing foam under conditions of considerable back pressure.

Another object of this invention is to provide a novel fire extinguishing foam forming nozzle which may be located at or below ground level and deliver foam to an elevated discharge point against a discharge pressure substantially equal to one-quarter of the inlet pressure within the limits of ordinary fire fighting pressure ranges.

Still another object of this invention is to provide a novel fire extinguishing foam discharging nozzle as aforesaid which may be located at a considerable distance away from the tank structure and therefore protected so that ready access may be had thereto even during use, the distance being limited only by the usual fluid conduit friction losses.

The foregoing and other objects of the invention will become clear from a reading of the following specification in conjunction with an examination of the appended drawings, wherein:

FIGURE 1 is a longitudinal sectional view through the foam forming nozzle device according to the invention;

FIGURE 2 is a detail of the inlet end of the foam producing nozzle structure of FIGURE 1 with some parts being broken away to show interior details, partly in section and partly in elevation, and with an anti-aspirating plug engaged with the air inlet of the nozzle structure;

FIGURE 3 is an enlarged cross-sectional view through the nozzle structure of FIGURE 1 as would be seen when viewed along the line 3—3 thereof;

FIGURE 4 is a greatly enlarged cross-sectional view through the foam forming nozzle structure of FIGURE 1 as would be seen when viewed along the line 4—4 of that figure;

FIGURE 5 is an enlarged cross-sectional view through a discharge gauge connector or conduit end fitting as would be seen when viewed along the line 5—5 of FIGURE 1, beyond the discharge end of the foam forming nozzle according to the invention and looking upstream thereinto; and

FIGURE 6 is a somewhat modified nozzle structure similar to that seen in FIGURE 1 but illustrating an alternate method of mounting the turbulator tube within the nozzle structure.

In the several figures, like elements are denoted by like reference characters.

Considering first FIGURES 1 to 4, there will be seen a foam making nozzle designated generally as 10 having a hollow upstream inlet chamber portion 11 and a downstream portion 12 separated by a centrally apertured transversely extending wall 13, the central aperture through the wall 13 including a narrow edged orifice 14 joined to an axially divergently tapered portion 15. Disposed transversely within the upstream portion 11 on the inlet 16 side of the centrally apertured wall 13 is a spider 17 having a centrally disposed hub 18 from which radially extend equiangularly spaced arms 19 to thereby define arcuate openings 20.

The spider hub 18 is centrally drilled and counterbored so that the threaded shank 21 of a headed stud may be passed axially therethrough, the head 22 of the stud being close fittingly disposed within the end of a turbulator tube 23 with the latter seated down into the spider hub counterbore. The turbulator tube 23 is tightly anchored to the stud head 22 as by means of the pin 24 and welding and is rigidly secured in position to the spider hub 18 by means of the nut 25 threaded upon the stud shank 21 and pulled up tightly. The turbulator tube 23 extends axially centrally through the narrow edged orifice 14 in the apertured wall 13 and coaxially through and beyond the aspirating discharge tube 26 which has its upstream end seated into the wall 13 coincident with the outer periphery of the axially tapered section 15 which extends downstream from the orifice 14.

The upstream end of the discharge tube 26 immediately adjacent to the downstream face of the apertured wall 13 is provided with a peripherally extending row of aspirating holes 27 through which air may be drawn radially inward from the surrounding chamber 28, this chamber being open to atmosphere through the threaded bore 29 when the latter is not sealed shut by the threaded plug 30 and gasket 31 in the manner illustrated in FIGURE 2. The discharge tube 26 is held rigidly in position by means of the centrally apertured threaded plug 32 which close fittingly surrounds it and which is threaded tightly into the axially extending bore 33 of the downstream portion 12 of the nozzle 10, the plug 32 and discharge tube 26 being rigidly secured together by means of the peripherally extending weld 34. The upstream end of the discharge tube 26 could also be spaced axially downstream from the wall 13 to provide an aspiration entry in lieu of the holes 27, as for example shown in United States Patent 2,868,301.

As seen in FIGURE 1, the downstream end of the discharge tube 26 is externally threaded as at 35 so that it may be threadedly secured into the threaded end 36 of a pipe section 37 which is the terminus of a pipe line leading to standpipes which run upward to the top of the storage tanks previously mentioned. Since in a typical

case, the turbulator tube 23 may be a three-quarter inch pipe of approximately 18 inches in length, in some circumstances it may be desirable to support the downstream end thereof. One satisfactory form of end support for the turbulator tube is illustrated in FIGURES 1 and 5 wherein it is observed that a plug 38 is disposed within the end of the turbulator tube 23 and is positionally fixed centrally within the pipe section 37 by means of the cross pins 39 projected through the plug 38 and secured in the wall of the pipe section 37.

In FIGURE 6 there is illustrated a foam nozzle 10' which is substantially the same as the foam nozzle 10 previously described in connection with the showings of FIGURES 1 through 5. A comparison of FIGURES 1 and 6 discloses that the turbulator tube 23', discharge 26' and orifice 14' of FIGURE 6 are exact counterparts for their unprimed corresponding elements in FIGURE 1 with regard to both general structure and organization. Similarly, the discharge tube 26' is welded as at 34' to a threaded plug 32' which holds it in proper position secured within the downstream portion 12' of the foam nozzle 10' in precisely the same manner as that shown by the unprimed elements of FIGURE 1. The basic difference between the foam nozzle 10' of FIGURE 6 and the foam nozzle 10 of FIGURE 1 is in the manner of securing the turbulator tube 23' to the hub 18' of the spider 17'. In the foam nozzle 10' the upstream end of the turbulator tube 23' is secured to the spider hub 18' by fitting the turbulator tube with a plug 40 drilled and tapped to threadedly receive a pair of bolts 41 which are projected through properly sized holes drilled through the hub 18' of the spider.

In use, the foam nozzle according to the invention would have its downstream end connected into a pipe line, as for example shown in FIGURE 1 as the pipe section 37, and would have its inlet end 16 connected to a source of foam forming liquid under pressure, supplied for example from a pump. The pipe section 37 would be connected to a line which feeds a riser conduit on a tank, with the conduit terminating at the top in a foam chamber of any suitable construction. This well known type of conduit fire fighting system carried by a storage tank is shown for example in FIGURE 15 of U.S. Patent 2,868,301, and a typical foam chamber is illustrated in U.S. Patent 2,524,421. Fire fighting conduit systems of this type are generally provided with a seal at the top end thereof to prevent leakage of tank vapors, and, in addition, to prevent dirt clogging of the line during the normal protracted periods of non-use. For this reason, the threaded bore 29 of the foam nozzle is first closed off as illustrated in FIGURE 2 with the threaded plug 30 to prevent the occurrence of any aspiration so that the previously mentioned seal and any line obstruction may be initially blown out by a solid column of liquid from the pump supplying foam forming liquid to the system. Thereafter, the plug 30 is removed so that the chamber 28 surrounding the upstream end of the discharge tube 26 communicates with the atmosphere.

The foam forming liquid introduced at the inlet 16 under pressure passes through the arcuate openings 29 of the spider 17, around the upstream end of the turbulator tube 23 and through the narrow edged orifice 14 as a cylindrical sheet which diverges in conical fashion as it goes through the orifice 14. As the cone of high velocity foam liquid diverges it peripherally contacts the inside surface of the discharge tube 26 at a point downstream from the aspiration holes 27, filling the annular space between the inside of the discharge tube 26 and the outside surface of the turbulator tube 23. As this tube of liquid moves rapidly downstream, it necessarily pulls with it the air cylinder lying immediately upstream of it to thereby cause additional air to be drawn into the discharge tube 26 through the aspiration holes 27 from the chamber 28 and ultimately from the outside atmosphere. The air drawn into the discharge tube 26 intimately mixes

with the turbulent foam forming liquid to form a highly stable fire extinguishing foam.

With foam nozzles of the type illustrated, high quality fire fighting foam can be produced even when the back pressure at the downstream end of the discharge tube rises to values substantially equal to one-quarter of the inlet pressure. This is an exceedingly important characteristic in a foam maker, being considerably superior to the results produced by other known types of foam makers, because not only does it permit the foam nozzle to be located at ground level rather than at some elevated point on the tank structure, but it also permits the use of long hoses or pipe lines which connect the foam maker to the fire fighting tank conduit lines from a point considerably removed from the tank structure. This of course permits the foam forming nozzle to be located away from the maximum danger area to thereby protect operating personnel.

The ability of the foam making nozzle according to the invention to produce good quality foam under such high back pressures is due to several factors. The most important feature is that the turbulator tube 23 extend completely coaxially through and beyond the downstream end of the discharge tube 26. In a typical case, the turbulator tube may extend approximately two inches beyond the end of the discharge tube, which latter may be approximately fourteen inches in length. The actual length of the discharge tube is determined by drawing a line from the orifice 14 at an angle to the horizontal which represents the divergence of the envelope of foam forming liquid as it comes through the orifice 14 under pressure. This line should intersect the inside wall of the discharge tube 26 at a sufficient distance upstream from the downstream end thereof to insure entrapment of the air when the back pressure on the nozzle is zero p.s.i., or in other words when the discharge tube 26 of FIGURE 1 is disconnected and removed from the pipe section 37. In general, this point of intersection should be at least two inches from the downstream end of the discharge tube 26 under these conditions. Also of importance are the relative cross-sectional areas of the turbulator tube 23, orifice 14 with the turbulator tube removed therefrom, and the discharge tube 26. Excellent results have been obtained with the ratio of the areas of orifice 14 to turbulator tube 23 held between 1.78 and 1.85 while simultaneously the area ratio of discharge tube 26 to orifice 14 was held between 1.75 and 2.18, optimum values of these ratios being respectively 1.8:1 and 2.0:1. It should be noted that the orifice 14 need not necessarily be circular, the important factors being the area and sharp aperture edge. Moreover, the turbulator and discharge tubes are also not necessarily limited to a circular cross-sectional shape so long as the relative area conditions are maintained.

Having now described my invention in connection with particularly illustrated embodiments thereof it will be appreciated that variations and modifications of the same may now occur from time to time to those persons normally skilled in the art without departing from the essential scope or spirit of my invention, and accordingly it is intended to claim the same broadly as well as specifically as indicated by the appended claims.

What is claimed as new and useful is:

1. An aspirating nozzle device for producing fire extinguishing foam, comprising in combination, a hollow nozzle body having an inlet at one end adapted for coupling to a source of foam forming solution under pressure, an apertured wall across said nozzle body in downstream spaced relation to the inlet end thereof, an elongated turbulator body extending freely through the apertured area of said wall where said wall has a minimum effective thickness, said turbulator body being carried by and mounted in fixed relation to said nozzle body, the aperture defining edge of said wall and the circumferentially extending outer surface area of said turbulator

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body that is opposed to said aperture defining edge being conjointly operative to define an annular orifice through which foam forming solution is discharged in the form of a hollow sheet, and a hollow discharge conduit carried by said nozzle body and mounted in downstream axial extension thereof coaxially with said turbulator body for receiving said hollow sheet of foam forming solution, said discharge conduit proximate its upstream end having an inlet to admit air to the interior thereof, and said turbulator body extending completely through said discharge conduit and beyond the downstream end thereof.

2. Apparatus for producing fire extinguishing foam as defined in claim 1 wherein the nozzle body is provided internally with an open spider formation extending transversely of said nozzle body in upstream spaced relation to the apertured wall, and the turbulator body is carried by said spider formation.

3. Apparatus for producing fire extinguishing foam as defined in claim 1 wherein the wall across the nozzle body has a narrow aperture defining edge and a surface area on the downstream side thereof that extends about said aperture and flares outwardly and downstream from said narrow aperture defining edge.

4. Apparatus for producing fire extinguishing foam as defined in claim 1 wherein the area of the wall aperture through which said turbulator body extends is between 1.78 and 1.85 times the cross-sectional area of the turbulator body lying in the plane of the wall aperture, and the hollow cross-sectional area of said discharge conduit is between 1.75 and 2.18 times the area of the aforesaid wall aperture.

5. An aspirating nozzle device for producing fire extinguishing foam, comprising in combination, a hollow nozzle body including an upstream chamber and a downstream chamber disposed in axial continuation of one another and separated by an apertured wall, an inlet to said upstream chamber for coupling to a source of pressurized foam forming solution, an open ended discharge conduit carried by said nozzle body and extending axially through and beyond said downstream chamber with the upstream open conduit end disposed concentric with the aperture defining edge of said apertured wall, an elongated turbulator body carried by said nozzle body and extending axially in opposite directions from and freely through the aperture of said apertured wall, said turbulator body extending coaxially completely through said discharge conduit and beyond the downstream end thereof with the outer surface of said turbulator body being everywhere parallel to the inner surface of said conduit throughout the lengthwise extent of said conduit, the aperture defining edge of said wall and the circumferentially extending outer surface area of said turbulator body that is opposed to said aperture defining edge being conjointly operative to define a narrow edged annular orifice through which foam forming solution from said upstream chamber is discharged into said downstream chamber between the outer surface of said turbulator body and the inner surface of said discharge conduit in

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the form of a hollow sheet, said conduit being provided with inlet means for communication of the interior thereof with the interior of said downstream chamber, and said downstream chamber being provided with means for selectively sealing the same from communication with the atmosphere.

6. Apparatus for producing fire extinguishing foam as defined in claim 5 wherein the nozzle body is provided internally with an open spider formation extending transversely of said nozzle body in upstream spaced relation to the apertured wall, and the turbulator body is carried by said spider formation.

7. Apparatus for producing fire extinguishing foam as defined in claim 5 wherein the area of the wall aperture through which said turbulator body extends is between 1.78 and 1.85 times the cross-sectional area of the turbulator body lying in the plane of the wall aperture, and the hollow cross-sectional area of said discharge conduit is between 1.75 and 2.18 times the area of the aforesaid wall aperture.

8. An aspirating nozzle device for producing fire extinguishing foam, comprising in combination, a hollow nozzle body having an inlet at one end adapted for coupling to a source of foam forming solution under pressure, a circular apertured wall across said nozzle body in downstream spaced relation to the inlet end thereof, an elongated turbulator body circular and uniform in transverse section extending freely through the circularly apertured area of said wall where said wall has a minimum effective thickness, said turbulator body being carried by and mounted in fixed relation to said nozzle body, the aperture defining edge of said wall and the circumferentially extending outer surface area of said turbulator body that is opposed to said aperture defining edge being conjointly operative to define a circular annular orifice through which foam forming solution is discharged in the form of a hollow cylindrical sheet, and a circular tubular discharge conduit of larger inside diameter than the overall diameter of said turbulator body carried by said nozzle body and mounted in downstream axial extension thereof coaxially with said turbulator body for receiving said hollow cylindrical sheet of foam forming solution, said discharge conduit having an inlet proximate its upstream end to admit air to the interior thereof, and said turbulator body extending completely through said discharge conduit and beyond the downstream end thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

1,221,861	Hull	Apr. 10, 1917
2,423,618	Ratzer	July 8, 1947
2,513,417	Lindsay	July 4, 1950
2,597,913	Webster	May 27, 1952
2,609,240	Faulkner et al.	Sept. 2, 1952
2,630,183	Foutz	Mar. 3, 1953
2,774,583	Haftke	Dec. 18, 1956
2,868,301	Wiedorn	Jan. 13, 1959