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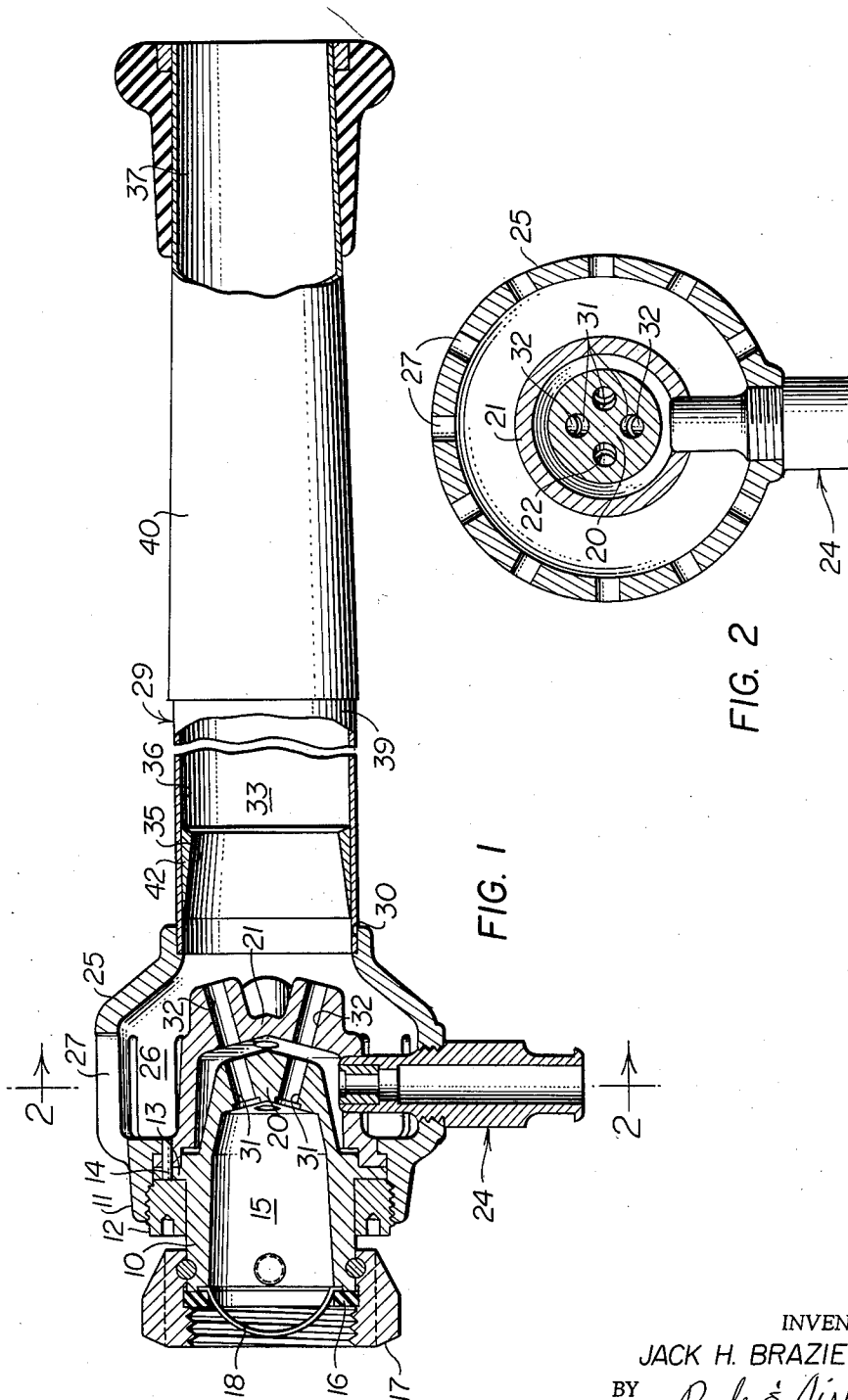
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METHOD AND APPARATUS FOR PRODUCING FIRE EXTINGUISHING FOAM

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METHOD AND APPARATUS FOR PRODUCING FIRE EXTINGUISHING FOAM

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9 Claims. (Cl. 169—1)

This invention relates to fire fighting apparatus, and more particularly to an apparatus for producing mechanical or air foam for the extinguishment of fires.

In fighting fires, it is often desirable to produce a smothering blanket of foam. Under present techniques "mechanical" or "air" foam is produced by entraining air in a solution of water and a detergent or protein foam producing agent to expand the solution. Such entrainment seeks to provide the maximum volume expansion and at the same time provide a stable, lasting, foam. This invention discloses a novel and improved nozzle for introducing such a foam producing agent into a stream of water and thereafter entraining air in the water-agent mixture to produce mechanical foam.

One of the principal objects of this invention is to provide a novel and improved mechanical foam nozzle which will provide greater volume expansion than prior known nozzles and which will at the same time project foam over a greater range than prior known nozzles operated under comparable conditions.

Another object of the invention is to provide a novel and improved nozzle for expanding mechanical foam, which nozzle has an unobstructed expansion and guidance outlet barrel.

A further object of the invention is to provide a novel and improved mechanical foam producing nozzle which is free from susceptibility to clogging.

An additional object of the invention is to provide a novel and improved nozzle which is simpler and less expensive to make than prior known nozzles.

Still another object of the invention is to provide a novel and improved fire fighting nozzle which maintains the velocity head of the supply stream to provide a greater range than prior known nozzles.

An important but more specialized object of the invention is to provide a novel and improved foam producing nozzle in which one set of manufacturing tooling may be used to make nozzles of different sizes.

Other objects and a fuller understanding of the invention may be had by referring to the following specification and claims taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a foreshortened side elevational view with parts broken away and removed of one embodiment of the novel and improved nozzle of this invention; and,

FIGURE 2 is a sectional view of the device as seen from the plane indicated by the line 2—2 of FIGURE 1.

Referring to the drawings, first and second body members 10, 11 are provided. The first and second body members 10, 11 are suitably fixed together as by a connection ring 12. The ring 12 threads into the second body member 11 and clamps a radially extending flange 13 of the first body member 10 between the second body member and the ring. A pin 14 is provided to prevent relative rotation of the body members 10, 11. The first and second body members together define a main nozzle body.

The first body member 10 has a water inlet passage 15. The water inlet passage 15 has an inlet end 16. The female fire hose coupling element 17 is swivelably carried by the first body member 10 at the inlet end 16. A strainer 18 may be positioned in the inlet opening.

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The first body member 10 includes a baffle portion 20 defining the outlet end of the water inlet passage 15. The passage 15 has a diminishing diameter from the inlet end 16 to the baffle 20 to provide an increase in velocity head with some decrease in pressure head. These changes in velocity and pressure head facilitate the venturi like introduction of a foam producing agent and the entrainment of air as will subsequently be described with more clarity and detail.

The second body member 11 includes a second baffle portion 21. The baffles 20, 21 are spaced from one another to define a foam agent introduction cavity 22 therebetween. The second body member 11 includes a foam agent inlet aperture 23. A foam agent supply tube connection assembly is shown generally at 24. The foam agent supply assembly 24 extends into the foam agent aperture 23 to conduct a foam producing agent to the introduction cavity 22.

The second body member 11 includes an annular skirt 25 which circumscribes the baffles 20, 21. The skirt 25 defines an air supply cavity 26 and air inlet openings 27 which permit ambient air to pass into the cavity 26. Air is drawn from the supply cavity 26 by the flow of the water-foam agent solution as will also be described in more detail.

A tubular foam expansion and ejection barrel 29 is fixed to the second body member 11 at 30. The barrel 29 is a thin walled member which defines a passage 33 which is an elongated, unobstructed foam expansion and air entrainment chamber.

The baffles 20, 21 each have a plurality of divergent nozzle or jet passages 31, 32 respectively formed therein. Each of the jet passages 31 is axially aligned with one of the jet passages 32 and vice versa. The introduction cavity 22 is disposed between the jet passages 31, 32 so that each such passage communicates with the cavity. The jet passages 31, 32 together form connecting passages between the water inlet passage 15 and the expansion chamber 33.

The divergent jet passages 31, 32 are preferably substantially cylindrical in contour. The axes of the jets locate a cone which is axially aligned with the water inlet passage 15 and the chamber 33. The cone is, therefore, coaxial with the entire nozzle. The axes of the divergent passages have a locus along the axis of the water inlet passage 15, which locus is at the apex of the cone. The cone has an acute apex angle.

The second baffle jet passages 32 are of slightly greater diameter than the first baffle jet passages 31. The jet passages provide a plurality of separate and distinct divergent streams or jets of water. As the streams are projected from each of the passages 31 through the cavity 22 to the passages 32, it will be seen that there will be some stream expansion, and therefore, the passages 32 are of slightly greater diameter. It will also be seen that the stream passing through the divergent jet passages create a venturi-like action in the cavity 22 to draw the supplied foam producing agent into the water streams.

The divergent jet passages provide several of the outstanding advantages of this invention. One of these advantages is that the passages are of sufficient size to permit practically all foreign substances which may be present to pass freely through. For this reason clogging, which has been an extreme problem in prior nozzles, is eliminated. Any particle which can pass through the strainer 18 can pass through the jet passages 31, 32.

Another of the advantages of the jet passages 31, 32 is that one set of tooling is suitable for all sizes of nozzles. With a large size nozzle a relatively large number of divergent jet passages are provided to conduct the relatively large quantity of water. In a smaller nozzle, a

lesser number of jet passages are formed to accommodate the lower volume of water. Thus, it will be seen that it is possible to use one set of jigs and fixtures for forming of the jet passages in all sizes of nozzles.

As water is diverted outwardly from the second baffle jet passages 32, the streams are impinged against an impingement portion 35 of inner wall 36 of the barrel 29. The ejected jet streams strike the impingement portion 35 and are diverted inwardly toward the axis of the barrel 29 and chamber 33 in fan shaped streams. Air is drawn from the air cavity 26 into the passage 33 and entrained in the foam producing solution. The impingement of the fan shaped streams upon one another creates a turbulence which causes continued entrainment of air as the foam producing substance passes along the barrel toward the outlet end 37.

The separation of the supplied water stream by the divergent jet passages 31, 32 into a plurality of independent jet streams provides another of the outstanding advantages of the invention. Air is drawn between the streams into the expansion chamber and the streams are widely spread in fan-like patterns before turbulence occurs. When the turbulence is set up, maximum expansion can occur. This invention provides direct communication between the turbulence and the ambient atmosphere. Air is drawn directly into the turbulence area without attempting to draw it through a curtain of water or other air flow obstructions.

The barrel 29 includes an air entrainment and a foam expansion portion 39 which is generally cylindrical in contour and in which the majority of foam expansion occurs. The fan-like streams are impinged upon one another to create the turbulence area within this expansion portion 29. The barrel 29 also includes a foam guidance portion 40 which is a gradually convergent frusto-conical shaped tube in which additional foam expansion occurs. The guidance tube also aids in giving direction and range to the ejected foam.

An impingement or deflection ring 42 is provided. The deflection ring 42 preferably has a frusto-conical shaped inner surface which is convergent in the direction of fluid flow and which is the impingement surface 35. The impingement surface 35 is so disposed that an extension of the jet passage axes in a direction opposite from the locus extension, i.e. in the direction of fluid flow, will intersect the surface 35. The impingement surface may be defined by rotating a line about a locus to provide a geometric figure that may be a cylinder, but is preferably a frusto-conical shaped surface. It has been discovered that provision of this conical impingement surface increases the expansion which is achieved with this nozzle. It is believed that the convergent frusto-conical impingement surface 35 better creates the fan-like streams and therefore more widely spreads the water foam agent mixture for the entrainment of air.

The coaction of the jet streams and the impingement surfaces contributes to another of the outstanding advantages of the invention. The deflection creates widely dispersed fan-like streams which are obtained without the creation of turbulence. The turbulence is created thereafter when the fan-like streams are impinged upon one another. It is believed that these factors are the major reasons that very little loss of velocity head is experienced with this nozzle. Therefore, exceptional range is obtained which permits a fireman to fight hotter fires more effectively than was possible with prior art nozzles.

The outstanding performance of this device can best be appreciated by comparing the barrel 29 with the barrels of prior art devices. The barrel 29 is substantially straight walled and the chamber passage 33 is completely unobstructed. No abrupt constricting throat or contraction mechanisms are required at the outlet 37. At the same time, this nozzle provides an increase of up to 20% or more in foam expansion and an increase of up to 25% or more in projection range when compared to the best

prior known nozzles of comparable capacity operated under comparable conditions.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

I claim:

1. In an apparatus for producing fire extinguishing foam, a main body having an inlet passage and a first baffle defining one end of the passage, said body having a second baffle, said baffles defining a cavity therebetween, each of the baffles having a plurality of individual jet passages formed therein, the axes of each of the first baffle jet passages being aligned with the axis of one of the second baffle jet passages and vice versa, each of said jet passages being in communication with said cavity, the axes of said jet passages when extended having a locus on said inlet passage axis, said passages being of sufficient longitudinal extent to divide a flowing liquid into a plurality of individually constituted divergent streams.

2. In an apparatus for producing fire extinguishing foam, a main body having an inlet passage and a baffle defining one end of the passage, the baffle having a plurality of individual jet passages formed therein, the axes of said jet passages when extended having a locus on said inlet passage axis and, an impingement ring fixed to the main body, the ring having a frusto-conical shaped inner deflector surface convergent in the direction of fluid flow, said ring surface being intersected by an extension of each of said jet passage axes in a direction opposite from such locus extensions.

3. A fire fighting foam producing nozzle comprising, an elongated tubular body having an inlet end and an outlet end, the body having inner walls defining a water inlet fluid passage and an air entrainment outlet fluid passage, the fluid passages together extending substantially from the inlet end of the outlet end, the body having a water divergent baffle disposed between and transversely of the inlet and outlet passages, the baffle having a plurality of spaced, fluid diverting, jet passages extending transversely therethrough and longitudinally with respect to said body, said jet passages connecting said inlet passage to said outlet passage, the axes of said jet passages together defining a cone in substantial axial alignment with the outlet passage axis and flaring outwardly in the direction of fluid flow, said outlet passage walls including a diverter stream deflection portion intersected by an extension of the axis of each of said jet passages, said stream deflection portion having a geometric contour substantially generated by rotating a line about a locus, said body having a foam agent inlet passage communicating with each of the baffle passages, said body also having an air opening communicating with the air intrainment outlet passage, and said body including means to connect a fire hose to the first end.

4. A fire fighting foam producing nozzle comprising, an elongated tubular body having an inlet end and an outlet end, the body having inner walls defining a water inlet fluid passage and an air entrainment outlet fluid passage, the fluid passages together extending substantially from the inlet end to the outlet end, the body having first and second water divergent baffles disposed between and transversely of the inlet and outlet passages, the baffles defining a foam introduction cavity therebetween, the baffles having a plurality of spaced, fluid diverting, jet passages extending transversely therethrough and longitudinally with respect to said body, said jet passages each being in communication with said cavity, said jet passages connecting said inlet passage to said outlet passage, the axes of said jet passages together defining a cone in substantial axial alignment with the outlet passage axis and

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flaring outwardly in the direction of fluid flow, said body having a foam passage communicating with said cavity, said body also having an air opening communicating with the air entrainment outlet passage, and said body including means to connect a fire hose to the first end.

5. A fire fighting foam nozzle comprising a first tubular body member having an inlet end and a water inlet passage extending from the inlet end, fire hose connection means carried by the first body member at the inlet end, the first body member including a first baffle disposed transversely of the first body member axis and defining an outlet end of said water inlet passage, a second body member fixed to said first body member, said second body member including a second baffle disposed adjacent said first baffle, said body members together defining a nozzle body, said baffles defining a foam agent cavity therebetween, said body including a foam agent inlet passage communicating with the cavity, the body also including means to connect a foam agent supply tube to the agent inlet passage, an elongated tubular foam expansion barrel fixed to said body and forming an unobstructed air entrainment and foam ejection outlet passage, each of said baffles having a plurality of cylindrically contoured, water divergent, jet passages formed therein, each of said jet passages being in communication with the cavity, the axis of each of the divergent jet passages of the first baffle being coextensive with the axis of the divergent jet passages of the second baffle, the first baffle divergent jet passages being spaced from the second baffle divergent jet passages by said cavity, the divergent jet passages of said second baffle being of slightly greater diameter than the divergent jet passages of the first baffle, said divergent jet passages forming connecting passages between said water inlet passage and said barrel passage, the axes of said jet passages locating a cone having an acute apex angle, the cone and the barrel passage being axially aligned, said divergent jet passages being divergent in the direction of fluid flow, said barrel having an entrainment and foam expansion portion and a foam guidance portion, the expansion portion being disposed between the body and the guidance portion, the expansion portion having a cylindrically contoured inner wall defining a section of said outlet passage, a deflection ring carried in the expansion portion, the deflection ring having an inner frusto-conical surface converging in the direction of fluid flow, the ring being positioned such that an extension of each of the jet passage axes intersects the ring inner surface, said body having an air entrance cavity communicating with the ambient atmosphere and with the barrel passage, said barrel foam guidance portion being a slightly convergent frusto-cone having an inlet opening only slightly larger in diameter than the outlet.

6. A fire fighting foam nozzle comprising a tubular first body member having an inlet end and a water inlet passage extending axially from the inlet end, a female hose connection element swivelably carried by the first body member at the inlet end, the first body member including a first baffle disposed transversely of the body axis and defining an outlet end of said water inlet passage, said water inlet passage having walls generally converging from the inlet to the outlet end, a second body member fixed to said first body member, the second body member including a second baffle disposed adjacent said first baffle, said body members together defining a nozzle body, said baffles defining a foam agent cavity therebetween, said body including a foam agent inlet passage communicating with the cavity, the body also including means to connect a foam agent supply tube to the agent inlet passage, an elongated tubular foam expansion barrel fixed to said body and forming an unobstructed air entrainment and foam ejection outlet passage, the barrel passage axis

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being an extension of the inlet passage axis, said baffles having a plurality of cylindrically contoured water divergent jet passages formed therein, each of said divergent jet passages being in communication with the cavity, the axis of each of the divergent jet passages of the first baffle being coextensive with the axis of the divergent jet passages of the second baffle, the first baffle divergent jet passages being spaced from the second baffle divergent jet passages by said cavity, the divergent jet passages of said second baffle being of slightly greater diameter than the divergent jet passages of the first baffle, said divergent jet passages forming connecting passages between the water inlet and barrel passage, the axes of said jet passages locating a cone having an acute apex angle and symmetrically disposed about the coextensive axes of said water inlet passage and said barrel passage, said jet passages being divergent in the direction of fluid flow, said barrel having an entrainment and foam expansion portion and a foam guidance portion, the expansion portion being fixed to the body and having a cylindrically contoured inner wall defining a section of said passage, a deflection ring carried in the expansion portion, the deflection ring having an inner frusto-conical surface converging in the direction of fluid flow, the ring being positioned such that an extension of each of the jet passage axes intersects the ring inner surface, said body having an air entrance cavity communicating with the ambient atmosphere and with the barrel passage between said second baffle and said ring, said barrel foam guidance portion being a convergent frusto-cone having an inlet opening only slightly larger in diameter than the outlet opening, and the guidance portion outlet opening diameter being greater than the water inlet passage diameter.

7. The method of providing fire fighting foam which method comprises, providing a stream of water under pressure dividing the stream of water into a plurality of individual and divergent jet streams, injecting a foam producing agent into the water, deflecting each of said jet streams into a fan shaped stream, causing said fan shaped streams to impinge upon one another to create a turbulence, and introducing air between said divergent jet streams directly to said turbulence.

8. A fire fighting foam nozzle comprising an elongated tubular body having a through fluid passage extending from an inlet to an outlet end, the body having a plurality of air inlet apertures formed intermediate the ends, said body including first and second longitudinally spaced air entrainment stations between the apertures and the outlet end, said body having an inner wall portion defining a water stream deflection surface at said first air entrainment station, said body including a baffle disposed transversely across said passage and fixed to the remainder of the body between the inlet and the apertures, said baffle including means to break a flow of fluid into a plurality of individually constituted separate and divergent streams directed against said deflection surface and said deflection surface being formed to deflect said streams against one another in said second air entrainment station.

9. The device of claim 8 wherein said means comprises a ring of jet passages outwardly diverging in the direction of fluid flow.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,990,885

July 4, 1961

Jack H. Brazier

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 41, for "of" read -- to --; column 5, line 35, for "ngle" read -- angle --; column 5, line 52, for "that" read -- than --.

Signed and sealed this 21st day of November 1961.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

DAVID L. LADD

Commissioner of Patents

USCOMM-DC