

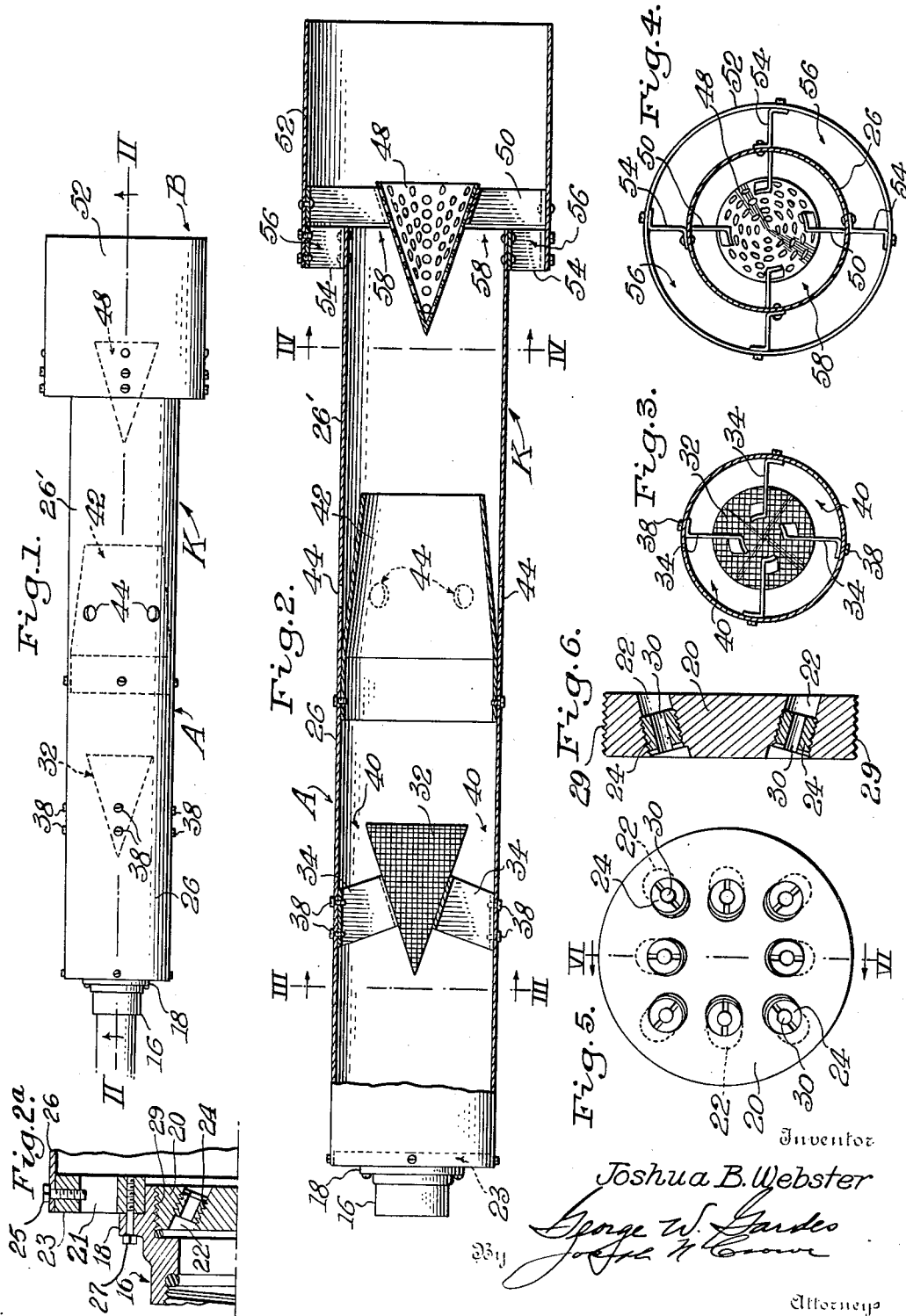
May 27, 1952

J. B. WEBSTER
FIRE FOAM NOZZLE

2,597,913

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3 Sheets-Sheet 1



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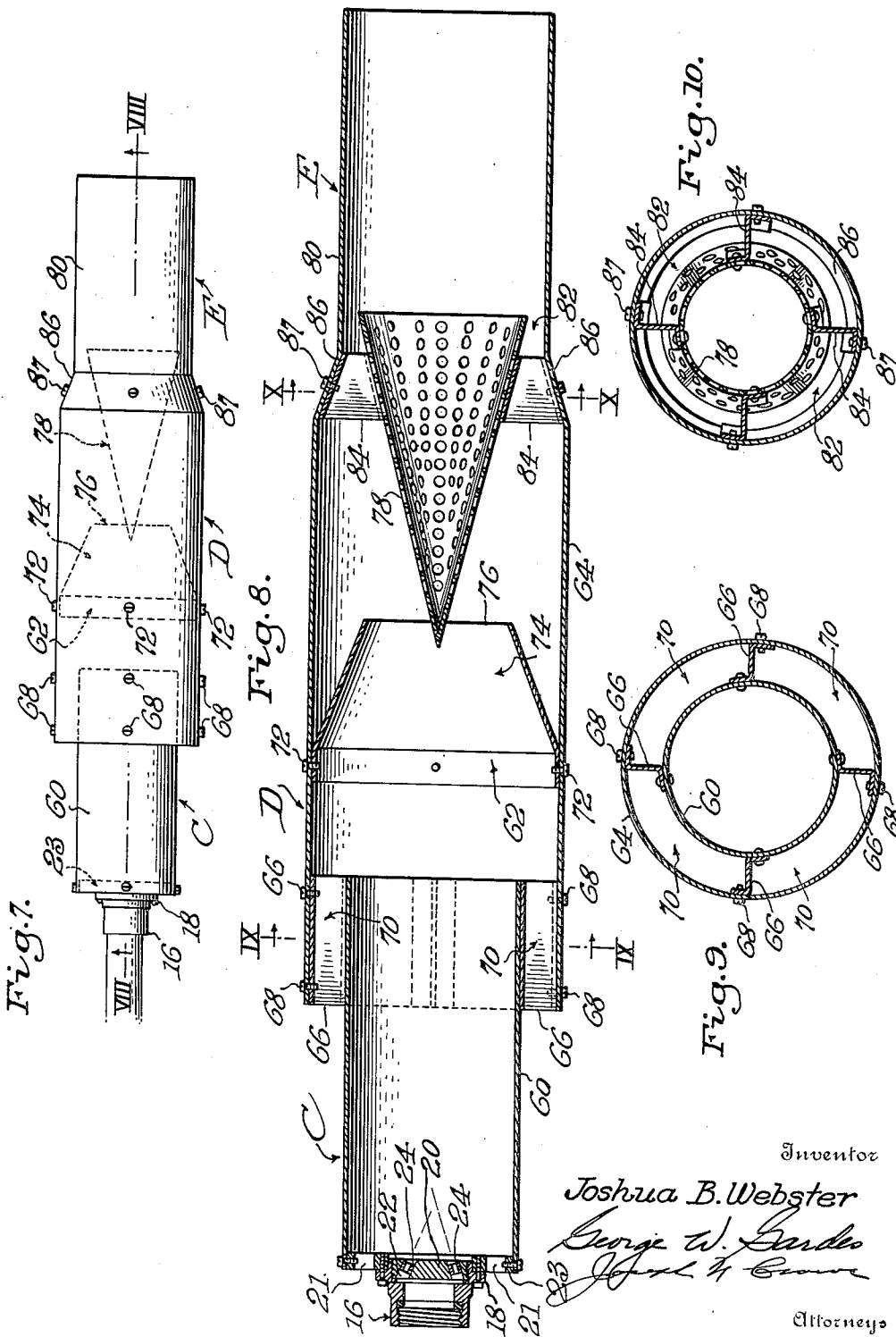
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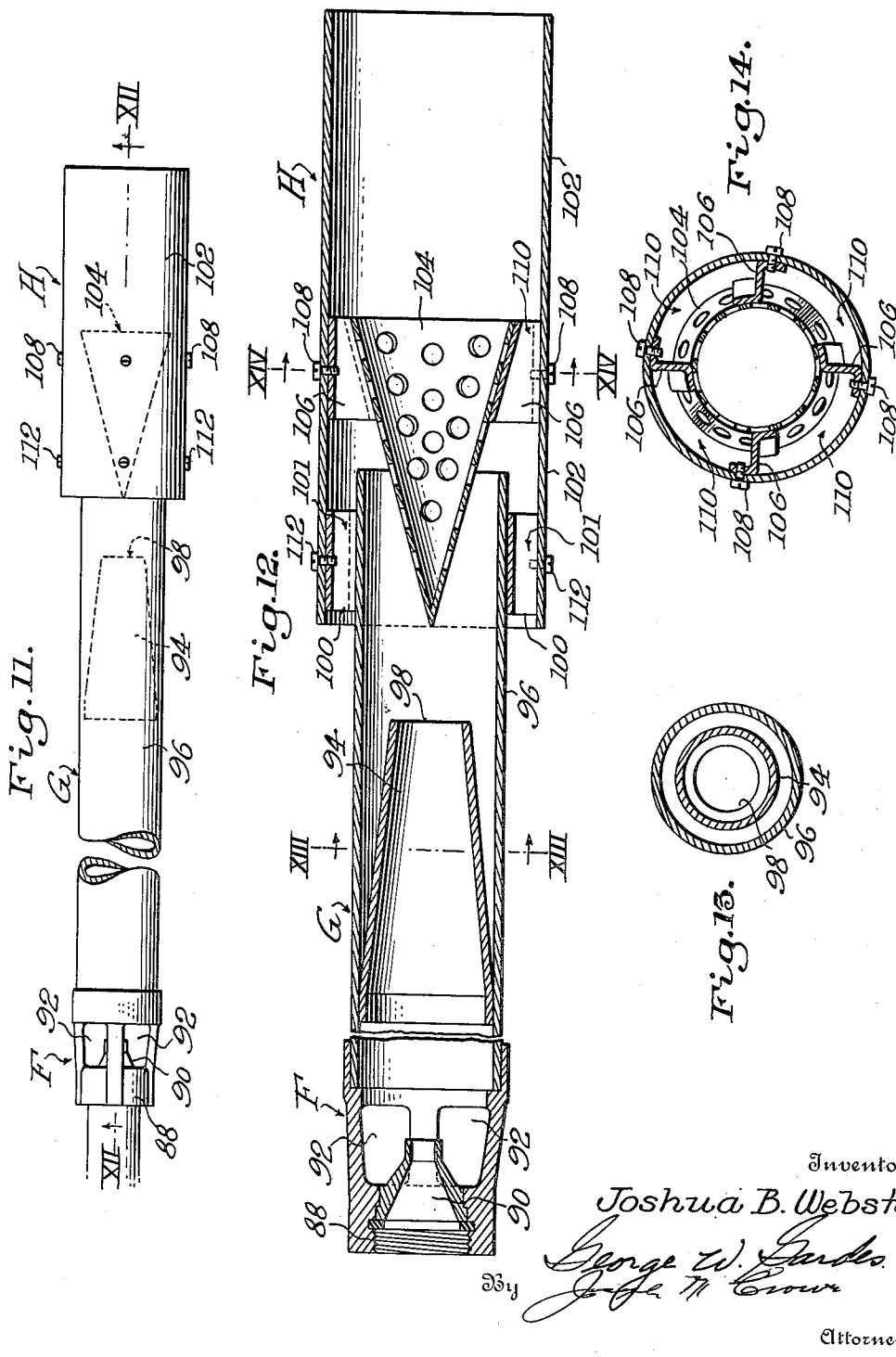
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UNITED STATES PATENT OFFICE

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FIRE FOAM NOZZLE

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(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without payment to me of any royalty thereon.

For the combating of fires produced from the combustion of inflammable chemicals, oils, and other materials not affected by water, the use of foam-producing compositions for producing an air-excluding blanket around such fires is well known. Various compositions of such fire foam-producing materials are available for fire extinguishing purposes, the compositions producing a liquid foam that envelops a mass of burning material and, by blanketing the fire from access of air, quickly smothers and extinguishes the same.

The foam-producing compositions are directed to the site of the blaze by nozzles attached to hose lines leading from the supply of foam-producing compounds, which compounds may or may not be mixed to produce foam prior to reaching the nozzle.

The present invention provides an improved nozzle for handling any type of fire-foam producing materials, and more particularly it provides a nozzle construction which produces enhanced mixing of the foam-producing materials, regardless of their base or composition, the construction of the invention being adapted to be used either as a distributing foam nozzle itself or connected to a usual form of distributing nozzle for increasing efficiency thereof.

Further objects of the invention will become apparent as the description proceeds, and the features of novelty will be pointed out in particularity in the appended claims.

The invention will be understood more clearly by reference to the accompanying drawings, which show several embodiments or modifications embodying the structural features and principles of the invention.

In the drawings:

Fig. 1 is a plan view of one form of a foam-producing and stabilizing nozzle embracing structural features of the present invention;

Fig. 2 is a longitudinal sectional elevation taken generally on the section line II—II of Fig. 1, looking in the direction of the arrows;

Fig. 2A is a fragmentary detailed sectional view of the intake end of the present construction, showing the manner of mounting the parts;

Fig. 3 is a transverse sectional elevation taken on the line III—III of Fig. 2, looking in the direction of the arrows;

Fig. 4 is a transverse sectional elevation taken on the line IV—IV of Fig. 2, looking in the direction of the arrows;

Fig. 5 is a front elevation of a liquid-injection plate mounted adjacent to the liquid intake of the nozzle, the said plate being viewed as looking towards the left in Figs. 1 and 8;

Fig. 6 is a sectional elevation of the plate of Fig. 5, the view being taken on the line VI—VI of Fig. 5, looking in the direction of the arrows;

Fig. 7 is a plan view of a modified embodiment of the invention;

Fig. 8 is a sectional elevation taken along the line VIII—VIII of Fig. 7;

Fig. 9 is a transverse sectional elevation taken on the line IX—IX of Fig. 8;

Fig. 10 is a further transverse sectional elevation taken on the line X—X of Fig. 8;

Fig. 11 is a plan view of a further modified form of nozzle embodying the features of the present invention;

Fig. 12 is a transverse sectional elevation taken on the line XII—XII of Fig. 11;

Fig. 13 is a further transverse sectional elevation taken on the line XIII—XIII of Fig. 11; and

Fig. 14 is a further transverse elevation taken along the line XIV—XIV of Fig. 12.

Referring more particularly to the drawings and to the modification of Figs. 1 through 5, the nozzle shown in these views is composed of two concentrically arranged cylindrical sections, these being a long cylindrical intake section A which enters a mixing section K, this being structurally a prolongation of the housing of section A, and a short cylindrical section B which is substantially larger in diameter than sections A and K and receives the section K concentrically. Section B constitutes the discharge end of the nozzle.

The cylindrical section A is provided with an intake end 16 having an intake connection 18 for receiving premixed foam solution from a suitable supply thereof, not shown. The connection 18 delivers the foam solution to an intake disc 20 over which the foam is distributed to a plurality of openings 22, preferably arranged as shown, which openings 22 are sloped as shown, and controlled by threaded orifice members 24.

The intake end of the intake section A is closed by an apertured cap on which is mounted the connection 18 for connecting the nozzle to a turret line, not shown. The connection 18 leads to the disc 20 (see Figs. 2A, 7 and 8) provided with the openings 22, which are inclined as illustrated in Fig. 6, and which are arranged preferably as shown in Fig. 5, wherein eight of these openings are shown. This number, however, is not critical, but may be changed without departing from the invention. The converging angles of the openings are different, however, so that the resulting in-

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coming jets meet at different points, thereby producing maximum agitation and expansion of the incoming foam-producing liquid, which expansion aspirates air into the liquid through air-intake ports 21 which pass through end closure 23 of housing 26 of the intake section A. The closure 23 is secured to the housing 26 by screws 25, and the connection 18 is secured to the closure by screws 27. The connection 18 is threaded internally for receiving threads 29 on the periphery of the plate 20, for holding this plate. The openings 22 are controlled by the threadedly inserted plugs or orifice members 24 having the passages 30 therethrough of predetermined diameter, these plugs being removable and replaceable as desired with other plugs having different diameter passages therethrough.

In advance of the meeting jets of foam-producing liquid, there is positioned concentrically, in the housing 26 of section A, a reticulated screen 32 of conical shape, the apex of the cone facing the incoming mixture of liquid and air. The reticulated cone 32 is secured in position by webs 34, secured to the cone and to the inside of the housing 26 of the mixing section A, by rivets or equivalent fastening means 38. The webs 34 are welded to the cone 32 and hold the cone rigidly in proper position in the housing. The cone 32 provides an annular passage 40 around it of progressively decreasing thickness and area so that progressive amounts of the agitated foam-producing liquid will pass through this cone and become progressively intimately mixed with the air being aspirated through the air-intake ports 21. The conical screen 32 has sufficient area to pass major portions of the foam, or liquid-and-air mixture, and not completely fill the diameter of the housing 26. The screen 32 acts as a mixer and diffuser for the portions of the foam-producing liquid and air introduced through openings 22 and ports 21.

The air-liquid mixture then passes into a frusto-conical member 42, the large end of which completely fills the diameter of the housing 26. This frusto-conical member 42 restricts the flow of the foam-liquid material, the member converging in direction of the flow of the material. Distributed around this member 42 are air-intake ports 44 through the housing 26 of the mixing section K, exit of the foam-liquid material through the restricted outlet of the member 42 aspirating further quantities of air through the ports 44, this air intermixing with the liquid as the latter expands to fill the housing 26.

Mounted at the juncture of the mixing section K and discharge section B of the nozzle, is a perforated conical mixing and spreading member 48 which is mounted concentrically with sections K and B by means of the mounting and spacing webs 50, which are riveted to housing 52 of section B and welded to the perforated cone 48. Also, spacers 54 maintain housings 26 and 52 in rigid, concentric relation. The perforated cone 48 passes about fifty per cent of the liquid, air and foam mixture and aspirates air through air intakes 56 between the webs 50 and 54, the remainder of the foam passing around the cone 48 through passage 58 and thence into discharge section B of the nozzle for discharge onto the site of a fire or for receiving a further and conventional distributing nozzle. The passage of a portion of the mixture around the perforated cone into the enlarged space of the discharge section increases the velocity of the stream of mixture and aids aspiration at air intakes 56.

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The frusto-conical member 42 also serves to focus and direct the stream of mixture passing therefrom onto the apex of cone 48.

In the construction shown in Figs. 7 through 10, which views represent the features of the present invention applied to a long-range turret nozzle, the substantially cylindrical intake section C opens into a substantially cylindrical section D that tapers towards the discharge end into a discharge section E.

The intake end of the cylindrical section C is similar to that described above, as will be apparent.

Housing 60 of the cylindrical intake section C opens into the frusto-conical member 62. Because of the fact that this nozzle is adapted to handle substantially larger volumes of foam-producing materials than the nozzle of Figs. 1 through 6, the intermediate section D is made of substantially larger diameter than the intake section C, the latter being comparable in diameter to the diameter of the cylindrical section A of the above-described modification. Housing 60 is spaced concentrically from the housing 64 of the intermediate section D by webs 66 secured by fastening means or the like 68, to housings 64 and 60, respectively. As is clear from Fig. 9 the spaces intermediate the webs 66 are open, thus providing for intake of air, as indicated at 70.

The large, or intake end of the frusto-conical member 62 fills the inside diameter of the housing 64, and is secured to the housing by fastening means 72. The converging throat portion 74 of this frusto-conical member is formed at an angle which will retard or choke the passage of the foam-forming liquid flowing through the open mouth 76 of this member, the resulting expansion around a perforated cone 78 creating a suction in the frusto-conical member 62, which aspirates air through openings 79 and intimately mixes this air with the foam-forming liquid passing through the frusto-conical member 62.

The perforated cone 78 has its apex extending into the frusto-conical member 62 and its wide end or base fills the inside diameter of the housing 80 of the nozzle discharge section E, except for a narrow annular space 82. The perforated cone 78 is held by webs 84 that are secured by fastening members 87 to the connecting portion 86 between the intermediate or mixing section D of the nozzle and the discharge section E. This tapering portion guides further quantities of the foam mix through the perforated cone 78, and, by retarding the flow of foam liquid, causes the air-liquid mixture to pass into the cone 78 through the perforations thereof, thereby becoming intimately diffused and commingled into a stable foam.

In this embodiment, pre-mixed foam liquid enters the left-hand end of the nozzle, as viewed in the drawings by a series of jets produced by openings 22, controlled by plugs 24, and mixes with air streams entering through ports 21, the air being aspirated through these ports by suction created by the flow of liquid through the mixing section C of the nozzle. As has been pointed out above the openings 22 may be adjusted to fit the requirements of a given task by means of regulating the gallons-per-minute rate of liquid to be used in comparison with the pressure which may be available. These adjustments also are of value in making the equipment more highly effective in covering the types and sizes of proposed fire hazards.

The mixed air and liquid passes from the initial

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mixing section C into the frusto-conical member 62. Upon emerging from the mouth 76 of this member, the air-foam mixture expands to fill the diameter of the section D, and draws, by this expansion, additional air into the liquid through openings 70, the resulting mixture then striking the perforated cone 78. The resulting agitation and intimate mixing caused by this cone produces an intimate mixing of air and foam liquid, and produces a wide spread of flaky and effective fire-extinguishing foam which effectively protects the fire-fighter from heat radiation. The perforated cone is made with enough area to provide perforations to allow maximum amount of foam to pass through the same, the area and perforations being sufficient to allow at least half of the liquid mixture to pass through the cone. As is pointed out above, this embodiment of the invention projects larger volumes of foam for substantially greater distances than does the short range nozzle of Figs. 1 through 4.

In order to adapt the construction of Figs. 1 through 4 to short range work, as has been pointed out above, the volume of material passed by the nozzle in a given time is less and the velocity is less than is the case with the long range construction of Figs. 7, 8 and 9. The wire-mesh cone 32, which is used as an agitator, mixer, and diffuser, also reduces the velocity of the air-liquid mixture. In common with the embodiment of the invention shown in Figs. 7, 8 and 9, pre-mixed foam solution enters the left-hand end of the nozzle, as viewed on the drawings, by jets through openings 22 and mixes with air passing through the passages 21. The frusto-conical section 42 is longer and is of less slope than is the frusto-conical member 62. The resulting mixture as it leaves the member 42, mixes with further quantities of air drawn through ports 44 as the mixture expands.

In the embodiment of the invention illustrated in Figs. 11 through 14, there is represented an improved nozzle for connection with handlines, which embraces, generally, the features described above but adapted to dimensions of the nozzle for handline use.

The intake section F has a threaded hose connection 88 that enters into a conical liquid intake 90, the resulting injection of foam liquid drawing air through lateral ports 92. This air mixes with the incoming foam liquid, the resulting mixture entering the frusto-conical member 94 mounted in the cylindrical section G of the nozzle, the large end of which completely fills the entire inside diameter of the housing 96 and is secured to the inner wall of the housing. As in the case with the embodiment of the construction of Figs. 7 through 10, the frusto-conical member converges in the direction of the flow of the air-liquid mixture, this mixture being compressed and retarded by the converging shape of this member until it passes out of the mouth 98 of this member. The cylindrical section G opens into a discharge section H, which also is cylindrical in shape and is of enlarged diameter, which is disposed concentrically about the section G, and is maintained thus by webs 100 secured to housings 96 of the section G and 102 of section H, these webs 100 defining air intake passages 101 therebetween in the end of the housing 102.

Mounted in this housing 102 is a perforated distributing and mixing cone 104, held in position by webs 106 secured as indicated at 108 to housing 102. The cone 104 enlarges in the direction of the air-liquid flow, to form a restricted annu-

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lar passageway 110 around the cone through which a portion of the stream of liquid, air and foam mixture may pass to cause additional turbulence and velocity of the stream. The apex of the cone 104 extends into the housing 96, so that air-liquid mixture will aspirate additional quantities of air through air passages 101 between the webs 100, the air becoming intimately mixed and commingled with the liquid through the agitation resulting from the passage of the mixture through and around the cone, and thence to the discharge end of the nozzle. The concentric disposition of sections G and H, which is maintained by the webs 100, is secured by fastening means 112. The embodiment shown in Figs. 11 through 14 produces a long range throw of foam from a handline.

It will be observed that in each form there is provided a foam-producing nozzle in which air is introduced into the nozzle at a plurality of spaced points along the length of the nozzle, the air and foam-producing liquid being intimately agitated and mixed adjacent to each intake, followed by diffusing and expanding means adjacent to the nozzle outlet, producing in each instance a wide curtain or shield of fire-extinguishing material which effectively protects the fire fighter from heat radiation from the fire being treated. The perforated diffusing cone extending into the discharge section both spreads the foam into the protective curtain and produces an extremely intimate mixture of the air and foam liquid by additional agitation and mixing action due to the passage of the mixture through and around the final perforated cone.

Having thus described my invention, what I claim as new and wish to secure by Letters Patent is:

1. A nozzle for projecting fire-extinguishing foam upon a blaze of flaming combustibles, comprising an elongated tubular housing having a plurality of sections in successive communication whereby foam producing liquid may be passed through the housing, one of which sections is an intake section, a second of which sections is a mixing section, and a third of which sections is a discharge section, the intake section including an intake end for connection to a supply of foam producing liquid, jet means for the introduction of liquid and ports for the introduction of air responsive to the flow of liquid through the jet means to form a stream of a mixture of liquid, air and foam, the discharge section including a perforated conical mixing and spreading member mounted coaxially therein, having its apex extending from the discharge section toward the intake section and having its base supported in spaced relation to the walls of the discharge section whereby a portion of the stream impinged thereon may flow around the perforated conical member for imparting additional velocity to the stream while the remaining portion of the stream will be caused to flow through the perforations of the conical member for additional foaming, the mixing section being interposed between the intake and discharge sections and receiving the apex of the perforated conical member and including a frusto-conical compressing and mixing member mounted therein with its base contiguous to the walls of the mixing section and converging away from the intake section and towards the discharge section whereby the stream of liquid, air and foam is compressed and mixed therein and directed therefrom onto the apex of the perforated conical member, the compressing and

mixing member being spaced from the jet means so that the mixture of liquid, air and foam resulting from the action of the jet means may impinge upon the interior of the compressing and mixing member, the housing including at least one group of additional ports for the aspiration of the stream spaced about the periphery of the housing.

2. A nozzle for projecting fire-extinguishing foam upon a blaze of flaming combustibles, comprising an elongated tubular housing having a plurality of axially aligned sections in successive communication whereby foam producing liquid may be passed through the housing, one of which sections is an intake section, a second of which sections is a mixing section, and a third of which sections is a discharge section, the intake section including an intake end for connection to a supply of foam producing liquid, a single jet in axial alignment with the housing for the introduction of liquid and ports for the introduction of air responsive to the flow of liquid through the jet to form a stream of a mixture of liquid, air and foam, the discharge section including a perforated conical mixing and spreading member mounted coaxially therein, having its apex extending from the discharge section toward the intake section and having its base supported in spaced relation to the walls of the discharge section whereby a portion of the stream impinged thereon may flow around the perforated conical member for imparting additional velocity to the stream while the remaining portion of the stream will be caused to flow through the perforations of the conical member for additional foaming, the mixing section being interposed between the intake and discharge sections and receiving the apex of the perforated conical member and including a frusto-conical compressing and mixing member mounted therein with its base contiguous to the walls of the mixing section and converging away from the intake section and towards the discharge section whereby the stream of liquid, air and foam is compressed and mixed therein and directed therefrom onto the apex of the perforated conical member, the compressing and mixing member being spaced from the jet so that the mixture of liquid, air and foam resulting from the action of the jet may impinge upon the interior of the compressing and mixing member, the discharge section being of greater cross-sectional area than the mixing section and having its walls offset therefrom to provide ports spaced about the periphery of the housing in addition to the ports in the intake section for the additional aspiration of the stream by the introduction of air responsive to the expansion of the stream as it passes from the mixing section to the discharge section.

3. The combination of claim 1 wherein said additional ports are located in the walls of the mixing section opposite the walls of the compressing and mixing member to allow air to pass from the atmosphere into the space between the housing walls and the compressing and mixing member.

4. The combination of claim 1 wherein the cross-sectional area of the mixing section is greater than that of the intake section and the walls of said sections are spaced to provide said additional ports.

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