March 7, 1944. R. B. LARTER 2,343,305

FIRE EXTINGUISHING NOZZLE

Filed Feb. 17, 1941

Fig. 1

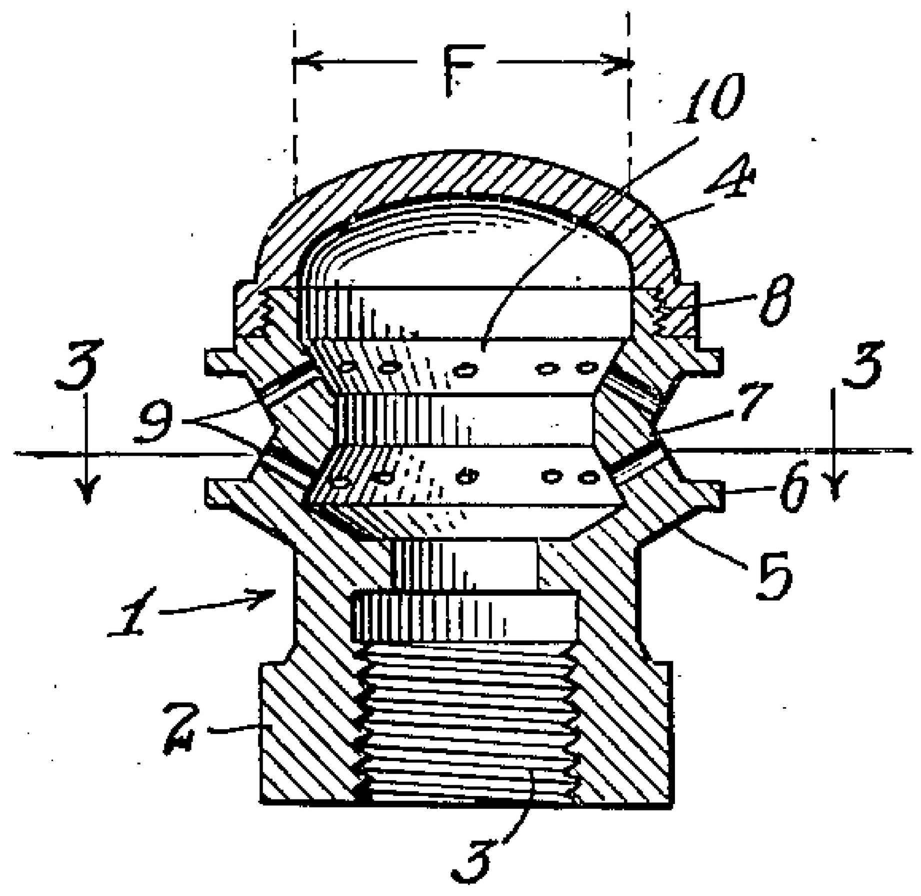


Fig. 2

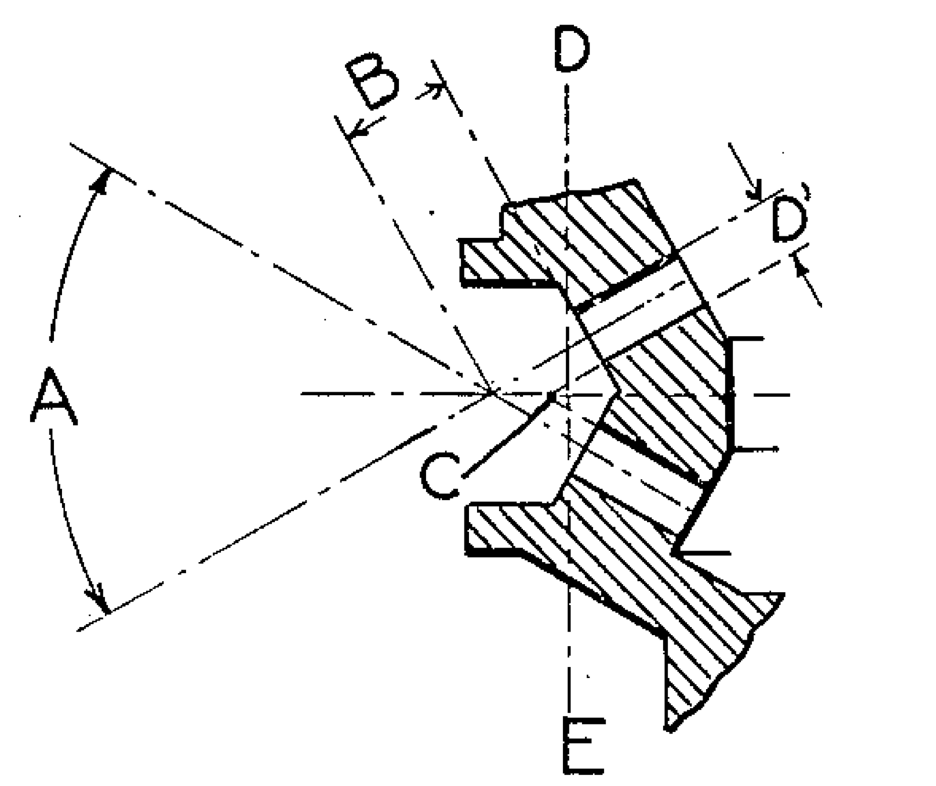
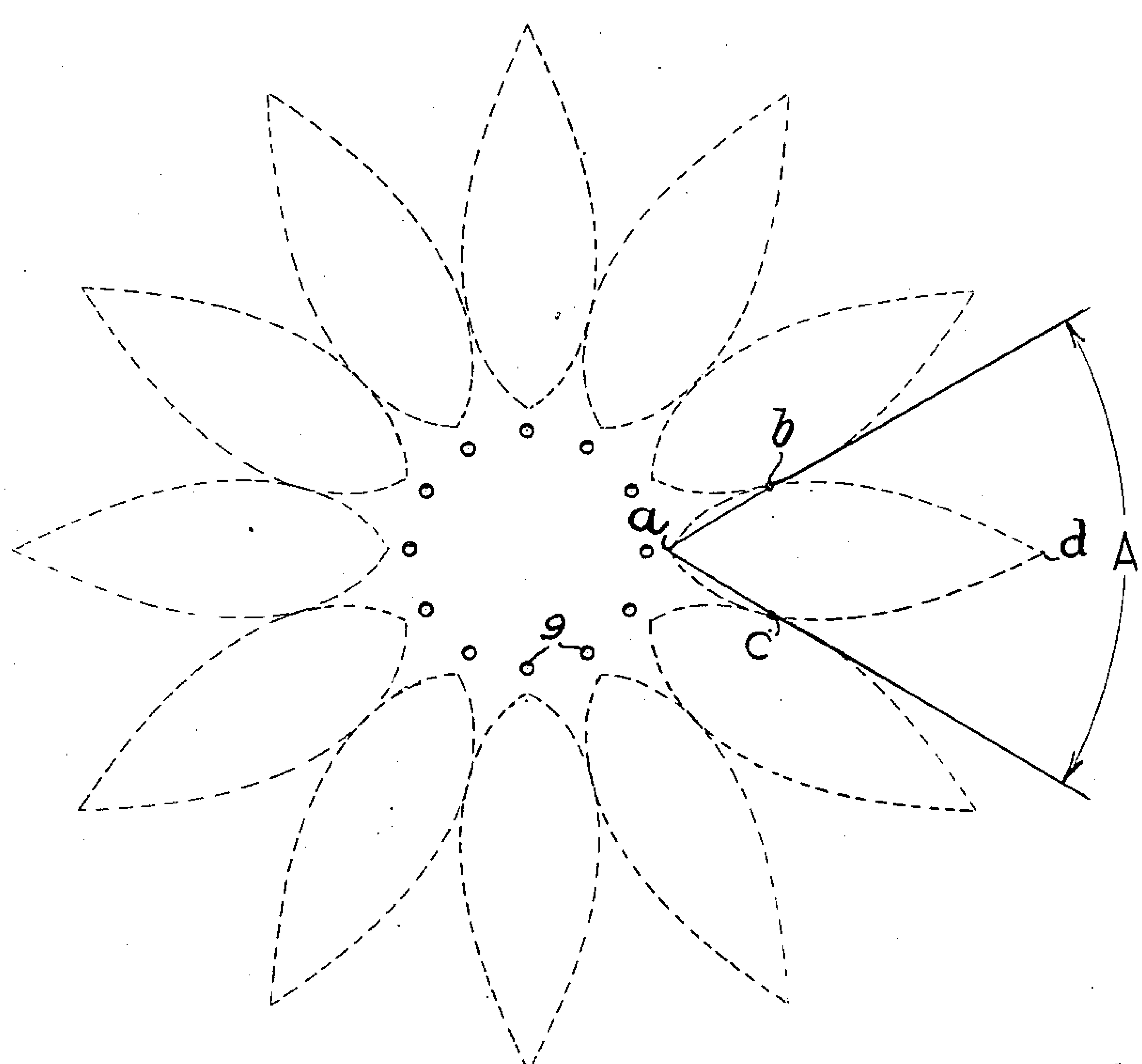


Fig. 3



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FIRE EXTINGUISHING NOZZLE

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5 Claims. (Cl. 299—143)

This invention relates to a nozzle for extinguishing fire with a liquid such as water, and refers particularly to a type of nozzle in which the liquid or water leaving the nozzle is broken up into a spray or fog. The invention relates to the type of fire extinguishing nozzles described and claimed in the application of William W. Jones, filed June 25, 1940, Serial No. 342,296, Patent No. 2,235,258, issued March 18, 1941, in which there is described a form of nozzle in which the liquid leaving the nozzle is broken up into a form of spray or fog by impinging two streams of liquid against each other under conditions therein described, operative for causing particles of the spray thus produced to be of substantially uniform size.

In the manufacture of nozzles of the foregoing type it is frequently desirable, in order to enlarge the area of the fog pattern which will be created by the nozzle, to employ a plurality of pairs of orifices in the nozzle. In order for such a nozzle to be fully effective, the spray patterns formed by each pair of orifices should be properly combined with the spray patterns formed by each other pair of orifices so that the nozzle will be capable of producing a single spray pattern in which the density and size of the liquid particles is uniform throughout. If the spray pattern produced by one pair of orifices fails to properly meet the spray pattern produced by an adjacent pair of orifices, there will result an area or a channel between the two spray patterns not properly occupied by the spray and the efficiency of the nozzle in extinguishing fires will not properly extend over the combined area of the two spray patterns. On the other hand, if the spray patterns produced by adjacent pairs of orifices improperly intersect or impinge one against the other, a combined spray pattern will result which may be serrated in appearance and is not uniform with respect to density and size of water or liquid particles.

It is the object of the present invention to provide a nozzle containing a plurality of pairs of orifices operating in conjunction with each other to produce a combined spray pattern which is uniform throughout in density of liquid or water particles and in respect to the size of the liquid or water particles occupying the spray.

I have discovered that a nozzle may be produced having a plurality of pairs of orifices designed to operate in conjunction with each other to produce a single proper spray, provided that in the design of such nozzle certain controlling critical factors are observed. The first of such factors is that each individual pair of orifices is so designed, preferably in the manner described in the aforesaid copending application of William W. Jones, as to be capable of producing a spray of particles of substantially uniform size through the employment of the proper angular relationship and spacing of the orifices, to cause the center point of the impinging jets to be at distances from the discharge faces of the orifices not exceeding twice the diameter of the orifices, and to cause the inside point of impingement of the jets leaving the orifices to be in advance of the discharge faces of the orifices. The second factor is that the body of the nozzle which provides the discharge orifices provides a proper fluid chamber leading to the orifices, which fluid chamber has a maximum cross-sectional area which is between eight to fifteen times the combined area of the orifices.

The third controlling factor is the design of the pairs of cooperating orifices in such manner that the spray patterns produced by adjacent pairs properly meet. Each pair of orifices of such nozzles form two streams of liquid or water which impinge against each other to break up the liquid into the form of a spray. Such impingement I refer to as the primary impingement of the orifices. Where a plurality of pairs of orifices are employed, the spray patterns produced by each pair must properly impinge against the spray pattern produced by each adjacent pair, and such impingement I refer to as the secondary impingement of the liquid or water. Where this secondary impingement is made to occur at a proper point, ranging from one-half inch to three inches outward from the first impingement (depending upon the design of the nozzle), the particles of the liquid or water at the point of contact of adjacent patterns are given greater projected velocity, rounding out the combined spray or fog pattern resulting from the nozzle, so that the nozzle no longer possesses a plurality of distinct spray patterns but possesses a single spray pattern effectively covering a combined area.

The necessary factors to be incorporated in a nozzle to create such a desired secondary impingement, together with various objects and advantages of the present invention, will be most clearly understood from a description of a nozzle embodying the present invention. For that purpose I have hereafter described in connection with the accompanying drawing such a nozzle.

In the drawing—

Figure 1 is an elevation in section of one preferred form of nozzle embodying the invention.

Figure 2 is an enlarged fragmentary section illustrative of the design factors adhered to in the formation of each individual pair of orifices.

Figure 3 is a diagrammatic view on the line 3—3 of Fig. 1, indicating certain factors in connection with the form of the water spray produced by the nozzle of the present invention.

Referring to the drawing, I have indicated the principles of the invention as incorporated in a nozzle of a particular form, but it is to be understood that the specific form of the nozzle may undergo wide variations. The specific nozzle illustrated includes a body 1 made in two parts, the part 2 having the socket 3 for attachment to a source of water supply and a cap 4. The source of water supply may be any usual or desired form of leader pipe connected to a hose, or a stationary pipe where the nozzle is intended to be installed in a stationary installation. The part 2 flares outwardly as at 5 to an annular horizontally positioned ring or flange 6. The part 2 is again reduced in diameter above the flange 6, as shown at 7, and the upper end is threaded as indicated at 8 to the cap portion 4.

In the reduced portion 7 of the body there is formed a plurality of pairs of orifices 9. Each individual pair of such orifices is designed in accordance with the factors indicated more particularly in connection with Fig. 2 of the drawing. In the drawing, A indicates the angle at which the streams of water emitted from the orifices intersect each other. This angle of impingement may undergo wide variations. The more acute the angle the further outwardly will be projected the spray formed by the nozzle, but the spray will cover a more narrow pattern. The angle A is determined by the design characteristics of the purpose which the nozzle is supposed to perform. The orifices 9 should be constructed so that the distance B, which the streams of water emitted from the orifices travel to the center point of impingement, will be not greater than twice the diameter D′ of the orifices 9. It is the principle of the flow of fluids through orifices that where a solid mass of water under pressure is forced against one side of the orifice, the water leaving the opposite side in the form of a jet contracts to a minimum area where the water is flowing at a maximum velocity at a point at a distance from the face of the orifice not exceeding twice the diameter of the orifice. To effect the proper breaking up of the water of the two jets by impinging the jets one against the other, they should undergo such primary impingement where the water is flowing at its maximum velocity. The proper point of impingement is at a distance B from the orifices usually over about one-and-a-half times but slightly less than twice the diameter of the orifice.

A further factor in designing the orifices to produce a proper spray is that the inner point C of the primary impingement of the two streams should be in front of the most advanced part of the orifice surface; or, stated another way, the inside point of impingement C of the two streams should be in front of the line marked DE. If the inside point of impingement C of the two streams is not in advance of the line DE, two detrimental results are secured. One is that water drips from the nozzle, and the other is that the water which is projected forward as a spray has not the desired uniform characteristics.

Now referring to Fig. 3 of the drawing, this figure illustrates in dotted lines the water pattern produced by such a nozzle when operated under low pressures. It is to be understood that the plane of the water pattern *a, b, c, d* is at right angles to Fig. 3 of the drawing. When two streams of water impinge together at low pressures, there is a solid film of water such as indicated at *a, b, c, d* formed near the point of impingement, the center of which is the point *a*. At larger pressures of water the leaf-like pattern *a, b, c, d* is not observed, but on the other hand the water immediately at the point of impingement appears to have been broken into a spray or fog. If the two streams of water (at low pressure) were aimed directly at each other, the water film pattern would be exactly round, with the impingement point exactly in the center. As the streams are directed to each other at reduced angles, the resulting water film pattern is projected outwardly from the original axis, forming the elongated film pattern *a, b, c, d* indicated. Such a film pattern possesses a maximum width *b, c*, and I have found that the angle *b, a, c*, i. e., through the points of maximum width of the leaf and the center of impingement, is identical with the angle A indicated in Fig. 1, which is the angle of impingement of the orifices.

With the foregoing explanation of the action of each individual pair of orifices, the proper spacing of the pairs of orifices 9 circumferentially of the body of the nozzle, in order to form one uniform spray pattern from the nozzle, will now be explained in connection with the drawing Fig. 3. As indicated in Fig. 3 of the drawing each pair of the orifices 9 is placed at a distance circumferentially around the body 1 of the nozzle so as to have a secondary impingement of the type indicated. As illustrated, the leaflets *a, b, c, d*, formed by each pair of orifices, contact the adjacent leaflets at their points *b, c* of maximum area. When the orifices are so designed to create such a secondary impingement, a single circular spray is emitted at high pressures from the nozzle, having a substantially uniform density of water particles, all of which particles are of substantially uniform size. The water pattern emitted from the nozzle no longer possesses the serrated appearance or channels characteristic of prior nozzles containing a plurality of orifice pairs.

As an example of the invention, I have found that where the orifices 9 are made to have a center point of impingement at a distance of .75 inch from the axes of the body 1 and an impingement angle of 50°, a proper nozzle is formed by providing twelve pairs of orifices one-sixteenth of an inch in diameter. At 100 pounds pressure these orifices will deliver 24.72 gallons of water per minute. The following is a table showing the size orifices which intersect at an angle of 50°.

	Size of orifice				
	1/16″	3/32″	1/8″	5/32″	1/4″
	Inches	*Inches*	*Inches*	*Inches*	*Inches*
Length of water leaf at low pressure	2	3	6	9	12
Width of same	3/4	1	1½	2½	3

A further important characteristic of the nozzle of the present invention has to do with the design of the water chamber 10 back of the orifices 9. In order that the streams of water leaving the orifices of the nozzle may be of the character capable of producing the intended spray, the water approaching the rear faces of the orifices must be of relatively solid character; that is to say, the advancing water should not be broken or turbulent. In order to carry out this purpose with the type of nozzle indicated, the head 1 should have a water chamber 10, the dimension F of which is larger than the diameter of the throat of the leader connected with the socket 3, or, in other words, the head should be enlarged over the dimensions of the approaching stream of water. I have found that if the maximum area of the water chamber 10 back of the orifices be roughly considered as that of a circle having the diameter F of the longest dimension of the water chamber, this area should be between eight to fifteen times the total area of the orifices 9 of the head.

The nozzle herein described will be found to in effect produce a single spray of liquid rather than a plurality of sprays from the different orifice pairs. This single spray is substantially uniform in density of water, and the size of the water particles in the spray is substantially uniform throughout.

While the particular form of the nozzle herein described is well adapted to carry out the objects of the present invention, it is to be understood of course that the principles of the present invention are adapted to be included in a great variety of nozzle designs and that the present invention applies to any nozzle having a plurality of pairs of orifices, whether or not such pairs of orifices are intended to form a completely circular spray as indicated, and the present invention includes all such modifications and changes as come within the scope of the appended claims.

I claim:

1. A fire extinguishing nozzle for producing a combined spray pattern composed of particles of substantially uniform size by secondary impingement of the sprays produced by the primary impingement effected by individual pairs of orifices, which nozzle comprises a body having a plurality of pairs of orifices, the orifices of each pair being spaced apart and angularly related in such manner as to cause issuing jets to have a center point of impingement at distances from the discharge faces of the orifices not exceeding twice the diameter of the orifices and to cause the inside point of impingement of the jets leaving the orifices to be in advance of the discharge faces of the orifices, whereby each of such pairs of orifices is capable of producing at the zone of impingement a leaf-like liquid pattern, said pairs of orifices being arranged and spaced in said nozzle to cause the leaf-like patterns produced by adjacent pairs of orifices to contact at their points of maximum width.

2. A fire extinguishing nozzle for producing a single combined substantially uniform spray from the spray patterns produced by a plurality of pairs of orifices, which nozzle comprises a body having such a plurality of pairs of orifices, the orifices of each individual pair of orifices being spaced apart and angularly related, the angular relationship and spacing of the orifices of each pair of orifices being adapted to cause the issuing jets to have a center point of impingement at distances from one-and-a-half to twice the diameter of the orifices from the outer faces of the orifices and to cause the inside point of impingement of the jets from the orifices to be in advance of the faces of the orifices, such pairs of orifices thereby being capable of producing a leaf-like water pattern, said pairs of orifices being arranged and spaced in the nozzle body to cause the leaf-like patterns of adjacent pairs of orifices to meet at their edges without substantial tendency to overlap.

3. A fire extinguishing nozzle for producing a single combined spray from the spray patterns produced by a plurality of pairs of orifices, which nozzle comprises a body having such a plurality of pairs of orifices, the orifices of each individual pair of orifices being spaced apart and angularly related, the angular relationship and spacing of the orifices of each pair of orifices being adapted to cause the issuing jets to have a center point of impingement at distances from one-and-a-half to twice the diameter of the orifices from the outer faces of the orifices and to cause the inside point of impingement of the jets from the orifices to be in advance of the faces of the orifices, such pairs of orifices thereby being capable of producing a leaf-like water pattern, said pairs of orifices being arranged and spaced in the nozzle body to cause the leaf-like patterns of the adjacent pairs of orifices to meet at their edges without substantial tendency to overlap, the body being provided with a fluid chamber from which said orifices extend, said fluid chamber having a maximum cross-sectional area of from eight to fifteen times the combined area of the orifices.

4. A nozzle for producing a combined spray of liquid projecting from the nozzle through proper union of the sprays ejected from the nozzle from a plurality of pairs of orifices forming impinging streams, which nozzle comprises a body having a plurality of pairs of orifices, the orifices of each pair having axes at an angle to each other which if extended intersect at a point exterior of the nozzle at a distance not over twice the diameter of the orifices of the nozzle, the orifices of each pair of orifices being spaced apart sufficiently to together with their angular relationship produce jets having their inside point of impingement in advance of the orifices, each pair of orifices producing in a plane at right angles to the plane of the axes of the orifices a leaf-like water pattern, adjacent pairs of orifices being arranged and spaced apart so that such leaf-like water patterns produced thereby contact at their points of maximum width.

5. A fire extinguishing nozzle for producing a single circular spray pattern composed of particles of uniform size, which nozzle comprises a body having a plurality of pairs of orifices uniformly circumferentially spaced apart with respect to the body, each pair of said orifices being angularly related, the angular relationship and spacing of the orifices of each pair causing issuing jets to have a center point of impingement at distances from one-and-a-half to twice the diameter of the orifices from the outer faces of the orifices and causing the inside point of impingement of the jets from the orifices to be in advance of the faces of the orifices, each pair of orifices thus being capable of producing a leaf-like liquid pattern in a plane at right angles to the plane of the angle of impingement of the orifices, the spacing of adjacent pairs of orifices being such that the leaf-like patterns produced thereby contact at their points of maximum width.

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