

March 18, 1941.

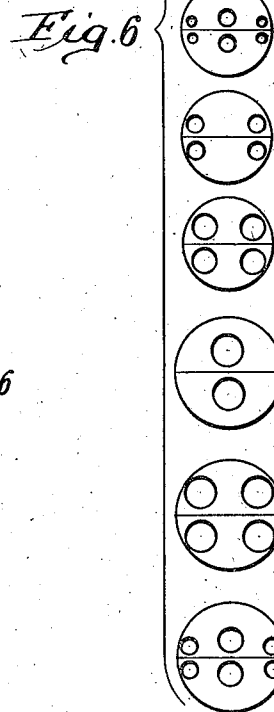
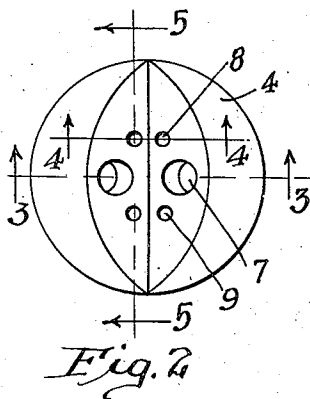
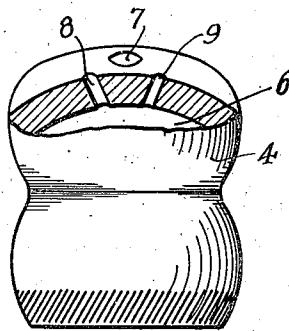
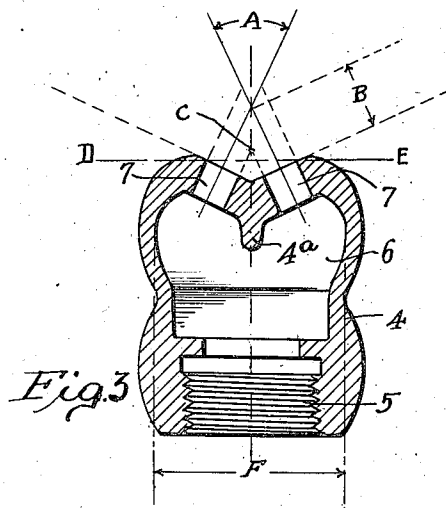
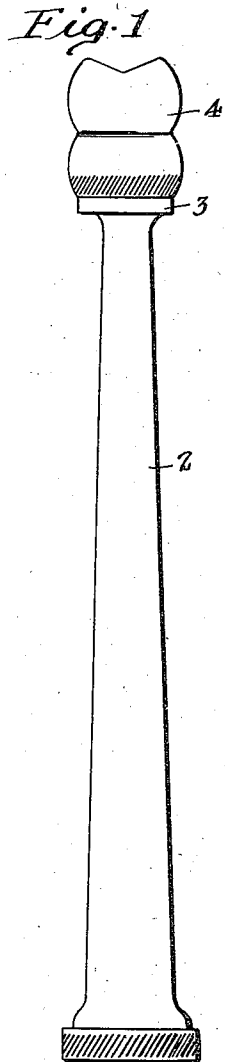
W. W. JONES

2,235,258

FIRE EXTINGUISHING NOZZLE

Filed June 25, 1940

3 Sheets-Sheet 1



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2,235,258

FIRE EXTINGUISHING NOZZLE

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3 Sheets-Sheet 2

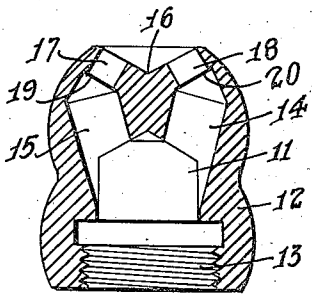


Fig. 7

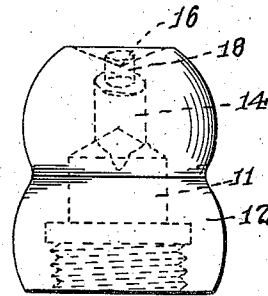


Fig. 8

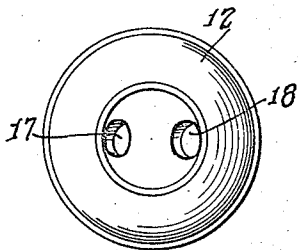


Fig. 9

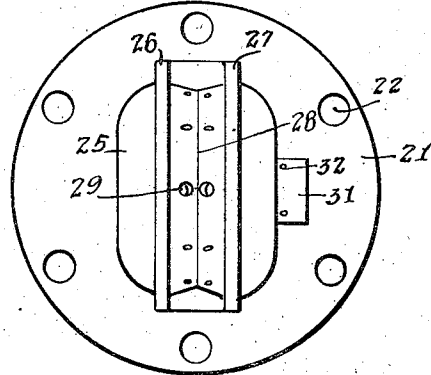


Fig. 10

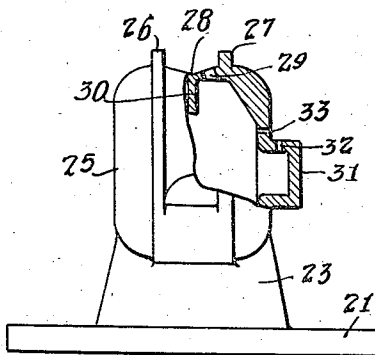


Fig. 11

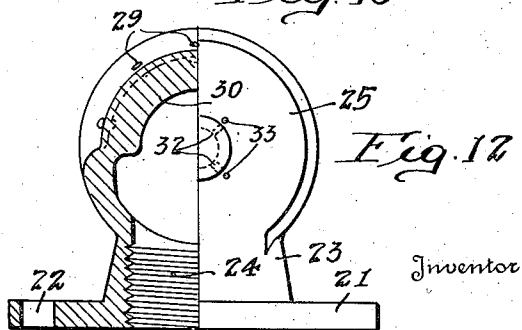


Fig. 12

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FIRE EXTINGUISHING NOZZLE

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3 Sheets-Sheet 3

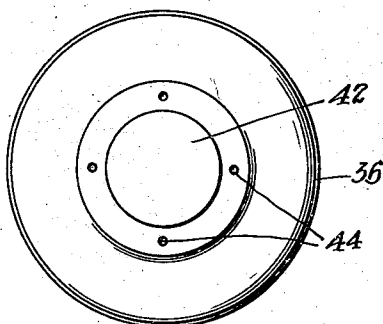


Fig. 15

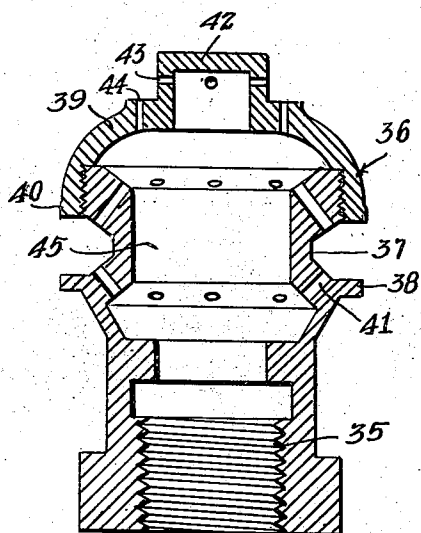


Fig. 14

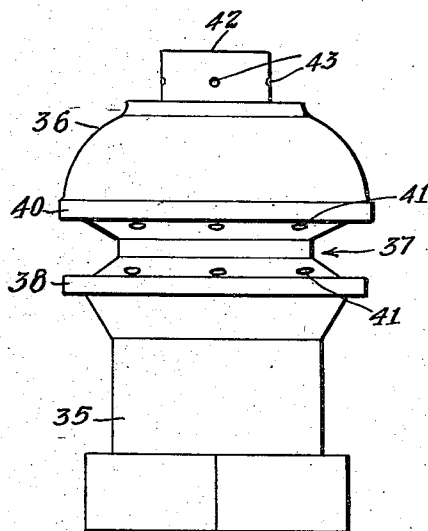


Fig. 13

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UNITED STATES PATENT OFFICE

2,235,258

FIRE EXTINGUISHING NOZZLE

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Application June 25, 1940, Serial No. 342,296

9 Claims. (Cl. 299-143)

This invention relates to a nozzle for the purpose of extinguishing fires with a liquid such as water, and refers particularly to the type of nozzle in which the liquid or water leaves the nozzle in the form of two or more streams which are caused to impinge against each other to thereby break up the liquid into the form of a spray.

It is a general object of the present invention to provide a nozzle capable of breaking the impinging streams of liquid into a spray, all particles of which spray are of substantially uniform size.

It is a further object of the present invention to provide a nozzle capable of breaking the water into a spray consisting of particles of uniform size without dripping of the liquid from the nozzle or the impingement area.

It is a further object of the present invention to provide a nozzle which is capable of creating a definite spray pattern throughout a wide range of liquid pressures back of the nozzle; that is to say, with the nozzle of the present invention, the spray is distributed over a fan-type area, the angle of the pattern of the spray leaving the nozzle or the dispersion angle remaining substantially constant throughout the use of the nozzle independent of the water pressure back of the nozzle. Furthermore, the actual coverage or maximum distance that the spray pattern extends in front of the nozzle of the present invention is through the design of the nozzle, also maintained substantially the same with variations of fluid pressure back of the nozzle.

While each specific nozzle incorporating the principles of the present invention produces a spray covering a substantially fixed area independent of variation in pressure back of the nozzle, the nozzle of the present invention is capable of being designed to afford a wide variation in the form of the pattern of the resulting spray. Thus, in accordance with the present invention, it is possible to provide a nozzle having either a large or a small dispersion angle, or to provide a nozzle having a large or a small distance of coverage.

In extinguishing fires by the use of solid streams of water, the fire is extinguished by the material undergoing combustion being wet and cooled by the water to a point where the material undergoing combustion will not produce vapors in sufficient concentration to support a combustion action. In order that a fire may be extinguished successfully through the use of solid streams of water, it is necessary that the flash point of the vapors produced by the body be lower than the

temperatures to which the body may be cooled by the water applied thereto. This method of extinguishing fires fails entirely to extinguish fires in case of certain materials, such for example as gasoline where the flash point of the vapors is lower than the temperature to which the material may be reduced by applying water thereto. Previous to the present invention, no satisfactory means existed for extinguishing gasoline fires. In the case of burning gasoline, for example, combustion takes place in the vapors above the gasoline. To extinguish such fire, it is necessary to dilute such vapors with a non-combustible material to a sufficient extent that the vapors will no longer support combustion. It is the discovery of the present invention that by applying to such fires a proper water spray the burning vapors may be so diluted as to quickly stop the combustion thereof. In order for such fires to be extinguished successfully and rapidly by water spray it is essential that the spray be of the type first provided by the nozzles of the present invention.

In accordance with the present invention, the water is applied in the form of a spray of finely divided particles, which particles are of substantially uniform size and evenly distributed over the area to be covered. When such a spray is applied to burning vapors the heat evolved from the fire is transmitted to the particles of the spray which are changed thereby to live steam. The changing of the particles of the spray to live steam results in an expansion of the volume occupied by the spray of 1700 times, which will produce a steam concentration in the vapor mixture undergoing combustion sufficiently to so dilute such vapors as to immediately extinguish the fire. Unless the spray is of the type indicated, i. e., composed of fine particles substantially uniform in size and distributed substantially uniformly over the area to be covered, the resulting effect is not produced. The reason for this is thought to be in that in cases where the spray is composed of particles differing materially in size or unevenly distributed, part of the spray is converted to steam previous to the conversion of other particles, so that the entire area of the fire is not diluted at one time, and channels of the combusting vapors continue to exist rendering it difficult if not impossible to extinguish the fire. The nozzle of the present invention is also effective for extinguishing all characters of fire. For example, in the case of wood fires the water particles of the spray of the present invention fall upon the wood vapor and cool and dilute vapors in the same manner as solid streams, but more effectively

because of the greater breaking up of the water using less water. Furthermore, the nozzle of the present invention is capable of extinguishing such fires with less damage resulting from the use of

5 the water.
In order for the nozzle to be able to accomplish the aforesaid objects of the present invention, it is not enough that the nozzle merely impinge two or more streams of water together to form a spray, 10 but various specific precautions must be taken in connection with the form of the orifices, their angle of impingement, their separation, and the design of the chamber back of the orifices. These several essential precautions will best be understood from a description of preferred forms of 15 nozzles embodying the present invention. I have, therefore, hereinafter described in connection with the accompanying drawings preferred forms of nozzles embodying the principles of the present 20 invention.

In the drawings:

Figure 1 is an elevation of one form of a nozzle embodying the present invention.

Figure 2 is an end view of the nozzle head.

25 Figure 3 is a vertical section of the nozzle head on the line 3—3 of Figure 2.

Figure 4 is a fragmentary vertical section on the line 4—4 of Figure 2.

Figure 5 is a section on the line 5—5 of Figure 2.

30 Figure 6 is a succession of diagrammatic illustrations of different positions for orifices suitable for use in connection with the nozzle of Figure 1.

Figure 7 is a vertical section of a modified form of nozzle and nozzle head.

35 Figure 8 is an elevation at right angles of Figure 7.

Figure 9 is an end view of the nozzle of Figure 7.

Figure 10 is an end view of a modified form of nozzle.

40 Figure 11 is an elevation partially in vertical section of the nozzle of Figure 10.

Figure 12 is an elevation partially in vertical section at right angles to Figure 11.

45 Figure 13 is an elevation of a further modified form of spray nozzle.

Figure 14 is a vertical section of the nozzle of Figure 13.

Figure 15 is a top view.

Referring to the drawings, in Figures 1 to 6 50 I have indicated a form of nozzle of the present invention particularly adapted for portable or stationary use as attached to a hose or applicator pipe and designed and intended to produce a spray pattern of essentially V-shape. The nozzle 55 is indicated as preferably including a leader member 2 designed to provide a long tapered throat extending to a pin 3, which is to be screw-threaded into the nozzle head 4, the nozzle head 4 being indicated as having a threaded socket 5. 60 The purpose of the leader 2 is to provide a means for better insuring that the stream of water entering the head of the nozzle 3 shall be flowing with smooth straight line motion so that a solid column of water enters the nozzle head rather 65 than a broken or turbulent stream of water.

The head 4 is indicated as preferably detachable from the leader section 2 in order that with a single leader and with a plurality of nozzle heads of different design various characters of 70 coverage may be secured. The nozzle head 4 consists essentially of a body part forming an enlarged chamber 6, which is provided with orifices from which the water may be ejected. In the case of the particular nozzle indicated in 75 Figures 1 to 5, inclusive, the head is indicated as

comprising a central pair of relatively large orifices 7 and two pairs 8 and 9 of relatively small orifices positioned at the sides of the central pair 7. Each pair of orifices is so arranged that the ejected streams of water leaving the nozzle 5 head from each individual pair of orifices are caused to impinge together in such a way that the resulting impingement will cause the two streams of water to be broken up into a spray 10 in which substantially all particles of the water are of substantially uniform size. This spray leaves the nozzle head with the spray of water filling to a substantial uniform density all portions of the space in front of the nozzle included 15 within the angle A defined by the axis of the orifices, the spray being projected ahead of the nozzle for a definite distance until the particles of the spray begin to lose their velocity.

It is characteristic of the nozzles of the present invention that the distance in front of the nozzle 20 that the particles of water are ejected before they lose their momentum so as to separate from the intended water pattern is relatively constant independent of the water pressure back of the nozzle. It is another characteristic of the nozzle 25 of the present invention that the desired spray not only subdivides the water into particles of uniform size and fills the previously described area in front of the nozzle with these particles at a substantially uniform density, but accom- 30 plishes this without allowing for water dripping from the face of the nozzle.

In order to carry out these intended effects, I have discovered that the nozzle must conform to certain prerequisites. These prerequisites, 35 among other things, are directed towards causing the impinging streams of water from the nozzle head meeting at their point of maximum velocity. It is a principle of the flow of fluids through orifices where a solid mass of water under pres- 40 sure is forced against one side of the orifice that the water leaving the opposite side in the form of a jet contracts to a minimum area where the water is flowing in a maximum velocity at a point a short distance in advance of the orifice. 45 This point is within a distance of less than twice the diameter of the orifice, and if two streams of water leaving such orifices are to be impinged together to form a spray produced by the nozzles 50 of the present invention, they should impinge at a point spaced from the surfaces of the orifice at a distance not greater than twice the diameter of the orifice.

In Figure 3 of the drawings, I have indicated by the dimension line B the distance referred to. 55 The dimension B of the nozzle of the present invention should not be greater than twice the diameter of the orifices as measured along the axis or central line of the orifices. Such distance of impingement is usually over about one and a half times, but slightly less than twice the diameter of the orifices in order for the correct 60 impingement to be secured.

A further requirement in order that the im- 65 pinging streams should produce a spray of uniform particle size and possessing the other desired characteristics of the present invention is that all portions of the area where the two streams leaving the orifices impinge together must be in front of the most advanced part of 70 the orifice surface, or, as stated another way, the inside point of impingement indicated by the reference character C of the two streams should be in front of the line DE. The point C is the point of intersection of the lines parallel to the 75

inner elements of the cylindrical orifices, whereas the line DE is a line drawn through the most advanced points of the outer orifice surfaces. 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 uniform characteristic of the nozzles of the present invention. The nozzles in which the inside point of impingement C is not in advance of the line DE will extinguish fire, such as gasoline fire, only with the greatest of difficulty, if at all.

The nozzle may have a great variety of orifices which may be arranged in a great variety of ways, depending upon the characteristic of the spray pattern which is desired to project in advance of the nozzle. In the particular form of the invention shown in Figures 1 to 5 of the drawings, three pairs of orifices are indicated, including a central pair of relatively large orifices and two side pairs of relatively small orifices. It is to be understood that each pair of orifices must be arranged and constructed in accordance with the principles described in connection with the orifices of Figure 3; that is to say, in the case of the orifices 8 and 9, their inside points of impingement must be in advance of the line drawn through the front of the orifice surfaces, and they must impinge at a point not greater than approximately twice the diameter of the orifices.

In Figure 6 of the drawings, I have indicated alternate arrangements of orifices, which I have found satisfactory for different purposes. The top view indicates two small orifices. The second view indicates two pairs of small orifices spaced widely. The third view indicates a single pair of orifices. The fourth view indicates two pairs of relatively large orifices spaced widely. The fifth view indicates a single pair of relatively large orifices. The sixth view is substantially that of Figures 1 to 5, and the remaining views should be self-explanatory.

In general, the thickness dispersion angle or depth of angle of the spray or angle of impingement of the streams of water leaving the two orifices may be increased or decreased. Where it is desired to increase the angle A it will be generally found necessary to spread the orifices a further distance apart if they are to conform with the principles of the present invention. Increasing the angle of dispersion generally decreases the distance forwardly of the nozzle, which will be covered by the uniform spray pattern.

A further important characteristic of the nozzles of the present invention has to do with the design of the water chamber 6 back of the orifices. In order that the streams of water leaving the nozzle 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 nozzle of Figures 1 to 5, I have indicated the head 4 as having a water chamber 6, the dimension F of which is larger than the diameter of the throat of the leader approaching the head. Or, in other words, the head is enlarged over the dimensions of the approaching stream of water. I have found that if the maximum area of the water chamber 6 back of the orifices be roughly

considered as that of a circle having the diameter F of the longest dimension of the water chamber that this area should be between eight to fifteen times the total area of the orifices 7, 8, and 9 of the head. When this relationship is true with each particular nozzle it will be found that there is a certain minimum pressure of water necessary to be imposed on the nozzle in order for it to produce its characteristic spray. If the minimum pressure is equal or exceeded, the pressure may be increased over a wide range without the character of the spray emitted from the nozzle varying. Increasing the pressure within the design limits of the nozzle will have substantially only the effect of increasing the density of the spray of water admitted from the nozzle without substantially altering either the thickness dispersion angle A or the distance to which the water is projected from the nozzle.

Where the nozzle is intended to be operated at high pressures the inside walls of the chamber 6 should be designed to minimize turbulence as much as possible, and in certain cases it will be found desirable to impose the baffle 4^a between the two orifices. The diameter of the orifices employed relative to the length of the orifices is another important design characteristic of the nozzles of the present invention. The size of the water particles of the produced spray is generally inversely proportional to the ratio of the length of the orifices to the diameter of the orifices, and, in general, this ratio should range from 1½ to 2½ in length as to diameter.

Now, referring to Figures 7, 8, and 9 of the drawings, I have shown a slightly modified form of the nozzle head of the present invention which is found useful both in portable work and in fixed installations, and the form is well adapted for the production of nozzles which produce a rather extended spray pattern.

In the drawings, 11 indicates a water chamber of the head 12, which is indicated as having a threaded socket 13. The water chamber 11 is formed in part by drill bores 14 and 15, which are drilled with a pointed drill. The discharge end of the head 12 is indicated as having a V-shaped surface 16 which provides for the orifices 17 and 18. The orifices 17 and 18 likewise produce projecting streams of water which impinge at a distance not over twice the diameter of the orifices and are likewise so constructed that the inside point of impingement is slightly in advance of the line drawn through the outer portions of the orifices 17 and 18. In the construction of a spray head of the type indicated in Figures 7, 8, and 9, it is important that the inside face of the orifices 19 and 20 be parallel to the outer faces of the orifices, which is preferably accomplished by the use of the correct taper on the tapered drills employed in forming the bores 14 and 15.

Now, referring to Figures 10, 11, and 12 of the drawings, I have shown a further modified form of nozzle, which is particularly designed to produce a broad D-shaped spray and is intended for fixed installation as a fire protection for oil tanks, pits, electric transformers, and similar services. The nozzle head of Figures 10, 11, and 12 is indicated as provided with a mounting plate 21 having suitable openings 22, by which it may be fixed in position. The mounting plate is provided with a short neck 23 which provides a threaded socket 24. The neck 23 is integrally connected with the head portion 25, which head is indicated as substantially circular in cross-section, as indicated in Figure 12, and provided

with ridges 26 and 27 between which there is a V-shaped portion 28 which serves to provide for the converging pairs of orifices 29. Any number of such pairs of orifices may be provided extending around the head a distance equal to at least one-half the diameter thereof whereby to secure a broad spray pattern. Each individual pair of the orifices 29 is constructed and arranged in accordance with the principles previously described with respect to their points of impingement. Interiorly of the head between the orifices there is preferably provided a baffle 30. Projecting from one side of the head, which is the bottom side as the head is mounted, is a boss 31 which provides additional discharge orifices 32, which are intended to impinge with orifices 33 in the lower wall of the head to produce a spray downwardly from the head. The sum of the areas of the orifices 29, 32, and 33 should be between eight and fifteen times the maximum area of the water chamber within the head.

Now, referring to Figures 13, 14, and 15, a further modified form of nozzle head is indicated especially designed to produce a ball-shaped spray. The nozzle is provided with a socket portion 35 of any desired form, by means of which the same may be attached to a source of water supply. The nozzle portion 35 joins with a head member 36, which is provided with a tapered wall groove 37 extending annularly around the head in a plane at right angles to the axis of the socket 35, and adjacent the groove 37 the head is indicated as provided with a flange 38, and the head is indicated as including a cap 39 which has a similar flange portion 40. Circumferentially spaced around the annular groove 37 are pairs of orifices 41 designed to create impinging streams of water which impinge between two flanges. These orifices, as in the case of each of the nozzles of the present invention, are so arranged that their inside point of impingement will be in advance of the outer portions of the orifices, and so that the distance of impingement from the faces of the orifices does not exceed twice the diameter of the orifices. The cap 39 is indicated as provided with a boss 42, which is provided with orifices 43 intended to cooperate with orifices 44 in the body of the cap to form additional impinging streams, which additional impinging streams likewise comply with the prerequisites heretofore indicated. The water chamber 45 of the nozzle, indicated in Figures 13, 14, and 15, should have a maximum area of between eight and fifteen times the sum of the total areas of all of the orifices 41, 43, and 44.

While the particular nozzle herein described for the purposes of illustrating the principles of the present invention are in actual practice well adapted to carry out the objects of the invention, it will be understood that nozzles of the present invention may be constructed in various forms, and the invention includes all such modifications and changes as come within the scope of the appended claims.

I claim:

1. A fire extinguishing nozzle, comprising a nozzle body having spaced apart and angularly related orifices for forming impinging jets effective for producing a spray of particles of substantially uniform size, the angular relationship and spacing of the orifices being adapted 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.

2. A fire extinguishing nozzle, comprising a nozzle body having spaced apart and angularly related orifices for forming impinging jets effective for producing a spray of particles of substantially uniform size, the angular relationship and spacing of the orifices being adapted 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, said body forming a fluid chamber back of the orifices the maximum cross-sectional area of which is between eight to fifteen times the combined areas of the orifices.

3. A fire extinguishing nozzle for producing a spray in advance of the nozzle having a definite pattern and composed of particles of substantially uniform size, the nozzle comprising a nozzle body having spaced apart and angularly related discharge orifices, the angular relationship and spacing of the 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.

4. A fire extinguishing nozzle for producing a spray in advance of the nozzle having a definite pattern and composed of particles of substantially uniform size, the nozzle comprising a nozzle body having spaced apart and angularly related discharge orifices, the angular relationship and spacing of the 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, 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 areas of the orifices.

5. A nozzle for producing a spray of liquid projecting from the nozzle at a dispersion angle which is substantially independent of a range of pressure of fluid imposed upon the nozzle and which spray consists of liquid particles of substantially uniform size, the nozzle including a body having a pair of discharge orifices, the axes of the discharge orifices if extended intersecting at a point exterior of the nozzle and at a distance not over twice the diameter of the orifices from the orifices, the orifices being spaced apart sufficiently to together with their angular relationship produce jets having their inside point of impingement in advance of the orifices.

6. A nozzle for creating a fire extinguishing spray of particles of substantially uniform size, which nozzle comprises a body having a liquid chamber and means for connecting the same to an inlet for liquid, a pair of discharge orifices with a division baffle interiorly of the body between the discharge orifices, said discharge orifices having axes which if extended intersect exteriorly of the body at a distance of between one and a half and twice the diameter of the orifices in advance of the orifices, the spacing and angular relationship being such as to cause the inside

point of impingement of jets leaving the orifices to be in advance of the orifices.

- 5 7. A nozzle for creating a fire extinguishing spray of liquid containing spray particles of substantially uniform size and substantially uniformly distributed over a predetermined spray pattern, which nozzle comprises a body member having a plurality of sets of pairs of discharge orifices, certain of the pairs of discharge orifices being of greater area than certain other pairs of discharge orifices, each pair of discharge orifices being angularly related and spaced apart so that the centers of the jets issuing therefrom impinge at points spaced from the orifices at not over 10 twice the diameter of the orifices and so that the inside point of impingement of the jets takes place in advance of the outermost edges of the orifices, each pair of orifices impinging at separate points from each other pair of orifices.
- 15 8. A nozzle for creating a fire extinguishing spray having a definite pattern and having a substantially uniform distribution of liquid particles of substantially uniform size, which nozzle includes a body having a pair of discharge orifices, 20 said discharge orifices having axes which inter-

sect beyond the body at distances not exceeding twice the diameter of the orifices, the ratio of length to diameter of said orifices being between one and one-quarter to two and one-half, the orifices being adapted to produce impinging jets 5 the inside point of impingement whereof is in advance of the outer faces of the orifices.

9. A nozzle for creating a fire extinguishing spray having a definite pattern and having a substantially uniform distribution of liquid particles 10 of substantially uniform size, which nozzle includes a body having a pair of discharge orifices, said discharge orifices having axes which intersect beyond the body at distances not exceeding twice the diameter of the orifices, the ratio of 15 length to diameter of said orifices being between one and one-quarter to two and one-half, the orifices being adapted to produce impinging jets the inside point of impingement whereof is in advance of the outer faces of the orifices, said 20 body providing an enlarged water chamber back of the orifices, the maximum cross-sectional area of which is between eight and fifteen times the total areas of the discharge orifices.

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