March 16, 1943. J. W. GRANT 2,313,994

SPRAY NOZZLE

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Fig. 1

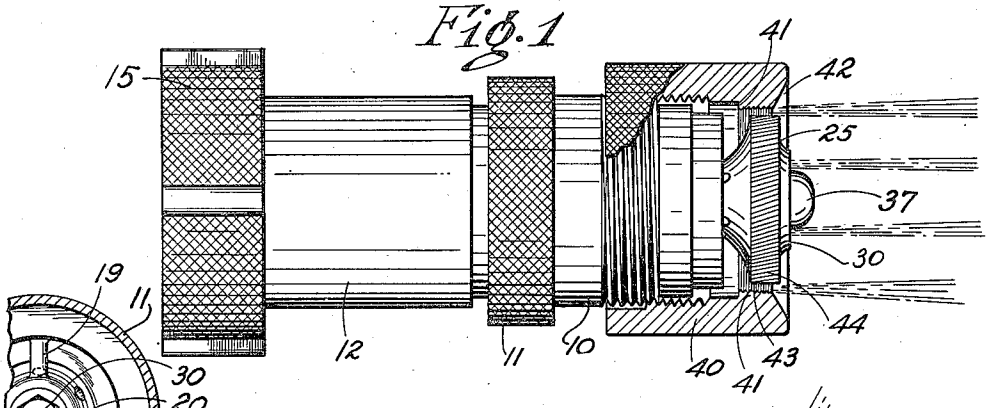


Fig. 5

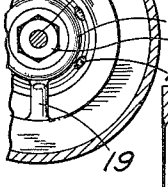
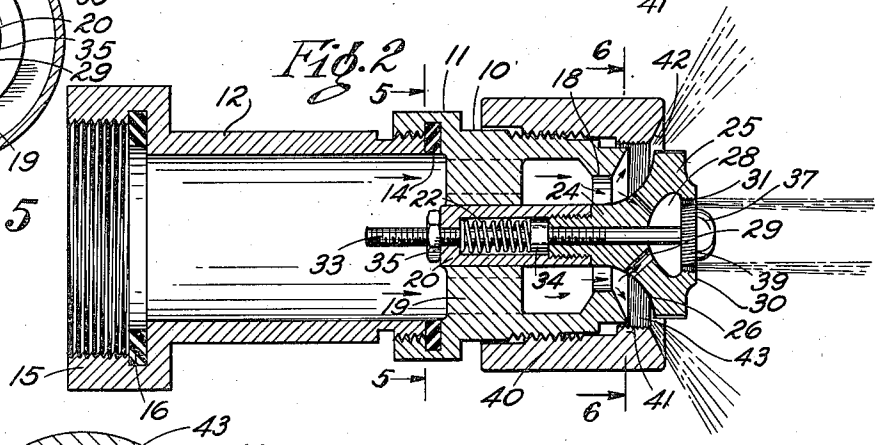


Fig. 2



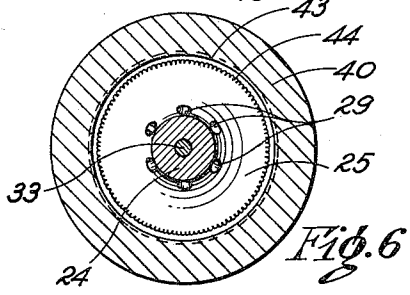
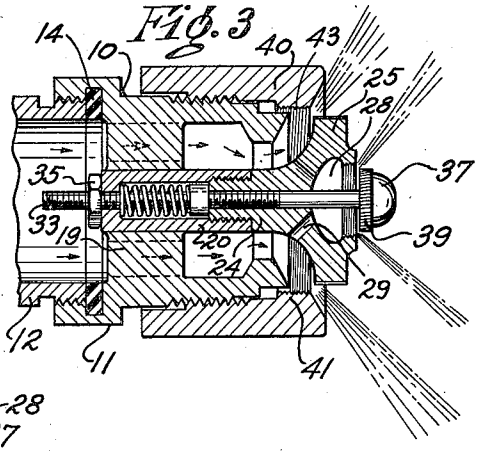


Fig. 6

Fig. 3



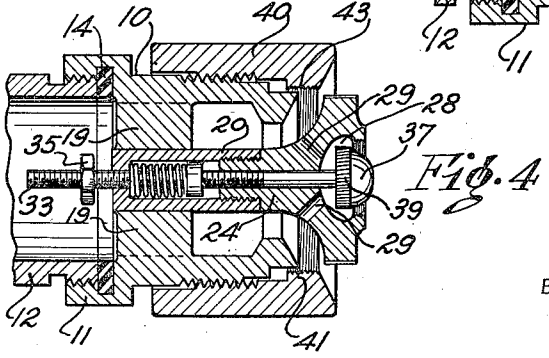


Fig. 4

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SPRAY NOZZLE

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Fig. 7

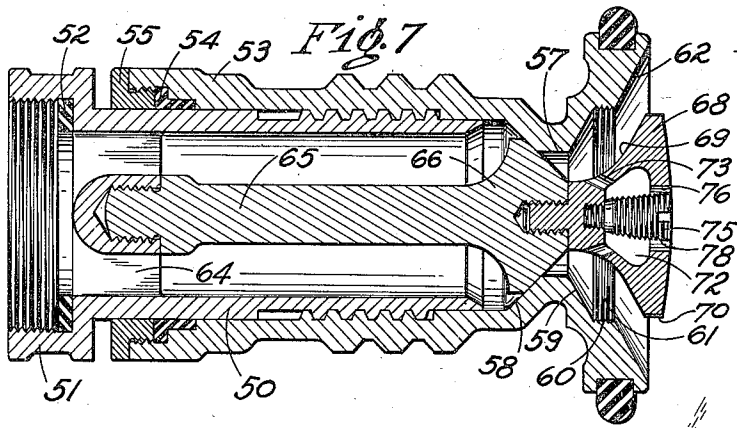


Fig. 8

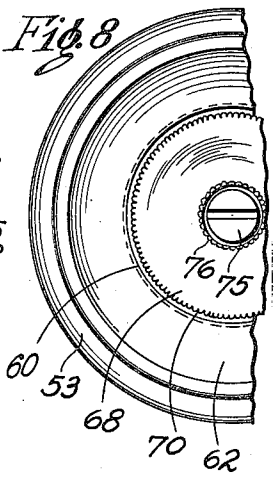


Fig. 9

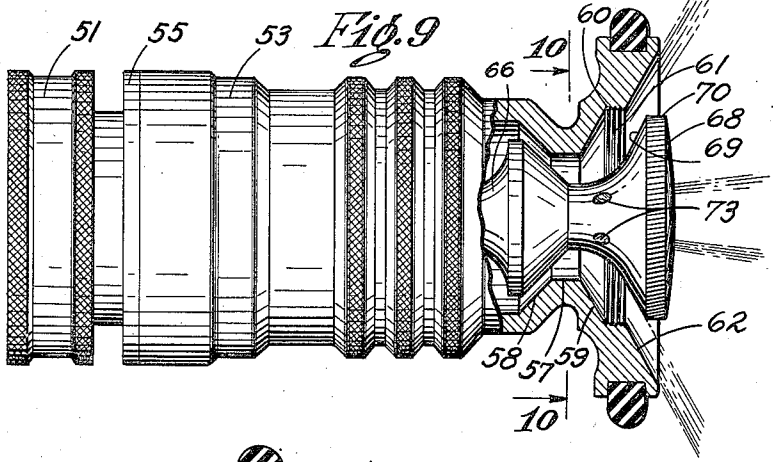


Fig. 10

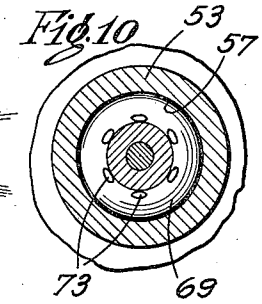


Fig. 12

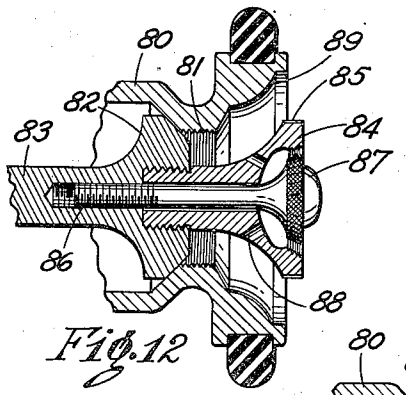


Fig. 11

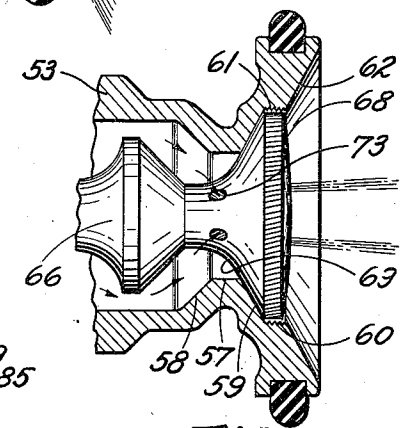
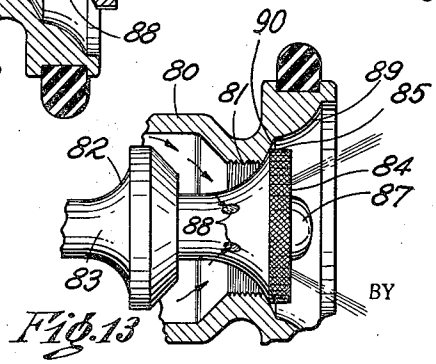


Fig. 13



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UNITED STATES PATENT OFFICE

2,313,994

SPRAY NOZZLE

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Application July 24, 1941, Serial No. 403,854

5 Claims. (Cl. 299—145)

This invention relates to improvements in spray nozzles for ejecting a stream in the form of a dense cloud of vapor or mist.

Heretofore in the construction of spray nozzles the ultimate object has always been to produce an extremely fine stream having all the characteristics and qualities of vapor or mist. However the spray obtainable through the use of the prior art nozzles is more aptly termed a coarse mist having for all purposes the appearance and feel of a spray consisting of small particles or streams of liquid. Furthermore, it was necessary, in the use of such prior nozzle, to eject the fluid therefrom under relatively high pressures which in itself materially restricted their use.

In the construction of these prior nozzles numerous designs have been employed in an effort to produce a spray of the desired volume and fineness, the most common of these being either the use of a rotor within the nozzle or an adjustable sleeve telescopically engaging the discharge end of the nozzle and adapted to coact with a deflector head for breaking up the stream. Neither of these particular nozzle designs are capable of producing a spray having the density and fineness that is obtainable with a nozzle of the present invention. With the nozzle of the present invention the liquid is ejected therefrom as a spray consisting of closely spaced minute globules of liquid which might for all intents and purposes be described as a dense blanket or cloud of cold steam.

One of the objects of the present invention is to provide a nozzle having suitable mechanism associated therewith to produce a dense fluidic cone of vapor or mist.

Another object of the invention resides in the provision of a nozzle having the inner surface of the outlet end configured to intercept and break up a liquid stream into a dense mist of minute particles.

Another object of the invention is to construct a nozzle having a deflector head associated therewith, the peripheral surface of said head being formed to intercept and break up a liquid stream into a dense cone of minute globules of liquid.

A further object of the invention is to provide a nozzle capable of producing a dense cloud of vapor or mist at a relatively low pressure.

A further object is to provide the deflector head with a passage therethrough configured to produce a smaller or inner cone of vapor or mist.

A still further object is to construct the deflector head in such a manner as to be capable of independent adjustment to change the contour of the inner cone of vapor or mist.

Other objects of the invention are to construct a nozzle that is simple and compact, relatively light in weight, economic of manufacture and which is efficient in operation.

Other objects and advantages more or less ancillary to the foregoing and the manner in which all the various objects are realized will appear in the following description, which considered in connection with the accompanying drawings, sets forth the preferred embodiment of the invention.

Referring to the drawings:

Fig. 1 is an elevational view of the improved nozzle with a portion of the discharge end thereof shown in section;

Fig. 2 is a longitudinal sectional view of the improved nozzle showing the outer sleeve and deflector head in an actuated position;

Fig. 3 is a longitudinal sectional view of a fragmentary portion of the nozzle illustrating another position of the sleeve and deflector head;

Fig. 4 is a fragmentary view similar to Fig. 3 showing the nozzle in still another actuated position;

Fig. 5 is a transverse sectional view showing the supporting medium for the deflector head, the view being taken on a plane indicated by line 5—5 of Fig. 2;

Fig. 6 is a transverse sectional view of the discharge end of the nozzle, the view being taken on a plane indicated by line 6—6 of Fig. 2;

Fig. 7 is a longitudinal sectional view of a modified form of the invention, showing the nozzle in its closed position;

Fig. 8 is an end view of a portion of the nozzle disclosed in Fig. 7;

Fig. 9 is an elevational view partially in section of the modified form of the nozzle, showing the nozzle in one of its actuated positions;

Fig. 10 is a transverse sectional view of the discharge end of the nozzle, the view being taken on a plane indicated by line 10—10 of Fig. 9;

Fig. 11 is a longitudinal view of a fragmentary portion of the nozzle illustrated in Figs. 7 to 10, showing the nozzle in position for producing the inner cone of vapor or mist;

Fig. 12 is a longitudinal sectional view of a fragmentary portion of another modified form of the nozzle;

Fig. 13 is a fragmentary view similar to Fig.

12 showing the nozzle in one of its actuated positions;

As shown in Fig. 2, the nozzle comprises a tubular inner sleeve 10 formed with an enlarged end portion 11 which is threaded internally for engagement with an elongated hose coupling member 12. Interposed between the coupling member 12 and the enlarged end 11 there is a resilient washer 14 for sealing the connection between the sleeve and coupling member. The outer end of the coupling member 12 is provided with an enlarged head 15, the inner surface of which is threaded for engagement with a hose line in the usual manner. A washer 16 is positioned within the head 15 to insure a fluid-tight connection between the hose and nozzle.

The outer or forward end of the sleeve 10 is provided with an inwardly projecting annular shoulder 18 defining a cylindrical discharge passageway of reduced diameter. Formed at the inner end of the sleeve 10 there is a pair of diametrically disposed inwardly extending arms 19, Fig. 5, having one end of a tubular member 20 secured thereto which terminates adjacent the inner edge of the shoulder 18. The tubular member 20 is bored throughout the major portion of its length for the reception of a coil spring 22. Within the outer end of the tubular member 20, which is counterbored and tapped, there is a stem 24 of a deflector head 25 arranged in axial alignment with the passageway defined by the shoulder 18. The outer diameter of the deflector head 25 is greater than the diameter of the passageway defined by the shoulder 18 and the rear or inner wall of the head 25 is provided with a concave surface 26 extending from the stem 24 to the outer edge of the head. The surface 26 of the head provides the nozzle with a flared outlet to facilitate the ejection of a conical stream.

The deflector head 25 is formed with an internal chamber or recess 28 which is in direct communication with the interior of sleeve 10 at all times through ports 29 provided in the concave rear wall 26. Formed on the outer face of the deflector head 25 circumambient the chamber 28 there is an annular bead or lip 30, the inner face 31 of which is preferably serrated, although it is within the scope of the present invention to provide the face 31 with a threaded, knurled, corduroy or ribbed surface.

The stem 24 of the deflector head 25 is bored throughout its length for the reception of a rod 33, the inner end of which projects through the coil spring 22 and an aperture formed in the base of the tubular member 20. A collar 34 is threaded upon the rod 33 intermediate the spring 22 and the inner end of the stem 24, while a nut 35 is threaded upon the rod subjacent the tubular member 20. The outer end of the rod 33 projects into the chamber 28 of the head 25 and is provided with an integrally formed head 37 which is spaced from the serrated surface 31 of the bead 30 to provide an inner annular discharge passage. Formed on the peripheral surface of the head 37 adjacent the base thereof there is a plurality of grooves 39 which are inclined slightly with respect to the vertical axis of the head. The grooves 39 coact with the serrated surface 31 for intercepting and breaking up a stream of water into a dense cloud of vapor or mist. The outer or forward end of the head 37 is spherical and of a diameter slightly less than that of the grooved base portion to facilitate the ejection of any fluid that might possibly enter the grooves 39. Although the head 37, as shown, is formed with grooves 39, it is within the scope of the present invention to provide the head 37 with surfaces of other types, such as threaded, knurled or ribbed. When two grooved surfaces define a passageway the grooves on one surface must be at a substantial angle to the grooves on the other surface.

An outer sleeve or member 40 is threaded upon the tubular inner sleeve 10 for movement longitudinally thereof. An inwardly extending annular shoulder 41 formed on the sleeve 40 adjacent the forward end is arranged to seat within a recess provided in the outer surface of the inner sleeve 10 upon the retraction of the outer sleeve 40. The diameter of the deflector head 25 is slightly less than the internal diameter of the annular shoulder 41 so as to form an outer annular discharge passage. The portion of the sleeve 40 beyond the shoulder 41 is flared outwardly to form an enlarged conical discharge opening 42. The annular shoulder 41 is provided with a grooved or threaded surface 43 arranged to cooperate with diagonal grooves 44 formed on the peripheral surface of the deflector head 25 in a plane substantially normal to the threaded surface 43, Fig. 1, for intercepting and breaking up a stream of water into a dense cloud of vapor or mist. The contour of the outer cloud of vapor or mist ejected from the nozzle is determined by the position of the annular shoulder 41 with respect to the deflector head 25. It is to be understood that other types of surfaces such as serrated, knurled or ribbed may be formed on the shoulder 41 and deflector head 25 and still come within the spirit of the present invention.

The peripheral surface of the outer sleeve 40 and the enlarged end 11 of the sleeve 10 are preferably knurled to facilitate the longitudinal movement of the outer sleeve with respect to the inner sleeve.

In the use of the nozzle, arranged as shown in Fig. 1, a stream of water flowing from a hose line will enter the coupling member 12 and inner sleeve 10 from which a portion of the fluid stream will flow through the ports 29 into the chamber 28 of the deflector head 25. As the water is forced from the chamber 28 through the annular passage between the head 37 and lip 30 it will strike the grooves 39 and serrated surface 31 where it will be broken up and ejected in the form of minute globules possessing all the characteristics and appearances of a dense cloud of mist or vapor. The remaining portion of the stream impinges the rear wall 26 and flows along the concaved surface thereof finally entering the passage between the deflector head 25 and the outer sleeve 40. The stream flowing between the head 25 and sleeve 40 will strike the serrated surface 43 and grooves 44 and be broken up into minute water particles and deflected out of the conical discharge opening 42 in the form of a dense cloud of mist or vapor of a cross sectional area greater than that of the cloud of mist discharged from the recess or chamber 28.

The contour of the outer cone of mist or vapor ejected from the nozzle is determined by the position of the outer sleeve 40 with respect to the deflector head 25, while the contour of the inner cone is determined by the position of the head 37 with respect to the annular bead or lip 30 of the deflector head 25. As shown in Fig. 1, the sleeve 40 and head 37 are so arranged with respect to the deflector head 25 that a stream of water is discharged from the nozzle in the form of straight streams of minute particles, with the

particles of the inner stream being caught up and carried along by the outer stream to increase the volume thereof. As the outer sleeve 40 is retracted upon the inner sleeve 10 the annular passage between the deflector head 25 and the sleeve 40 will be enlarged as shown in Fig. 2, thus changing the contour of the outer cone of mist or vapor in order to meet varying conditions as might occur in the case of a spreading fire.

As shown in Fig. 3, the head 37 and rod 33 have been advanced beyond the annular bead 30 formed on the deflector head 25 in order to enlarge the inner cone of mist or vapor produced by the nozzle. The head 37 is susceptible of movement either forwardly or rearwardly in order to enlarge or restrict the size of the inner cone of mist or vapor. As shown in Fig. 4, the head 37 and rod 33 have been moved inwardly, against the action of the spring 22, in which position any foreign particles lodged within the recess 28 may be ejected therefrom by the stream flowing therethrough. The outward movement of the head 37 and rod 33 due to the action of the spring 22 will be limited by the collar 34 striking the inner end of the deflector stem 24. The head 37 may be moved axially by first removing the sleeve 10, adjusting the rod 33 then tightening the nut 35 into locking engagement with the member 29.

In the modified form of the nozzle shown in Figs. 7 through 11 the tubular inner sleeve 50 is provided with an enlarged end portion 51 which is threaded internally to facilitate the connection of a hose line thereto in the usual manner. A resilient washer 52 is disposed within the enlarged end 51 for sealing the connection between the nozzle and hose. An outer sleeve or body member 53 is threaded upon the inner sleeve 50 for axial movement with respect thereto. A packing ring 54 disposed between the inner end of the outer sleeve 53 and the inner sleeve 50 is retained in place by a jam nut 55 threaded within the inner end of the outer sleeve.

Th forward end of the outer sleeve 53 is provided with an inwardly extending annular shoulder 57 having conical seats 58 and 59 formed on opposite sides. The forward end portion of the outer sleeve 53 is counterbored adjacent the conical seat 59 to provide an annular recess or ledge 60, which is formed with a threaded or grooved surface 61. The portion of the sleeve 53 beyond the ledge 60 is flared outwardly to provide an enlarged conical discharge opening 62. Secured within the inner end of the sleeve 50 there is a spider 64 having one end of a stem 65 threaded therein coaxial with the inner sleeve 50. The outer end of the stem 65 is provided with an enlarged head 66, the forward surface of which is configured for engagement with the conical seat 58, Fig. 7, to completely shut off the passage of water through the nozzle.

Secured to the enlarged head 66 of the stem 65 there is a deflector head 68 of a diameter greater than that of the restricted passage 57 but less than that of the annular recess 60 so as to form an outer annular passage with the recess 60. The rear wall 69 of the deflector head 68 is substantially concave with a portion thereof adapted to engage the seat 59 to shut off the passage of water between the deflector head 68 and the outer sleeve 53. The portion of the deflector head 68 complemental to the recess or ledge 60 is provided with a plurality of diagonal grooves 70, Fig. 9, which are substantially normal to and adapted to cooperate with the threaded surface 61 to effect the ejection of a stream in the form of a dense cloud of vapor or mist. A chamber or recess 72 is formed in the deflector head 68 and is in direct communication with the interior of sleeve 50 through ports 73 provided in the rear wall 69. Secured within the deflector head 68 there is a member 75 the outer end of which is spaced from the edge of the opening into the recess or chamber 72. The said edge is provided with a serrated surface 76, while the peripheral surface of the member 75 is formed with a plurality of grooves 78 which are substantially normal to and adapted to coact with the serrated surface 76 to effect the discharge of an inner stream in the form of a dense cloud of mist or vapor. The contour of the member 75 is such as to facilitate the ejection of the inner stream in the form of a cone.

With the several parts of the nozzle assembled in the manner as shown in Fig. 7, the nozzle is completely shut off to the passage of a stream of water therethrough. Upon the rotative movement of the outer sleeve 53 with respect to the inner sleeve 50 the conical seat 58 will be moved beyond the enlarged end portion 66 of the stem 65, Fig. 9, permitting a stream to flow through the inner and outer annular passages defined by the outer sleeve 53, deflector head 68 and member 75. As the outer sleeve 53 is moved forwardly the threaded surface 61 of the recess 60 will be moved into close proximity to the grooves 70 formed on the deflector head 68 to facilitate the breaking up of the outer stream into a dense cloud of mist or vapor. The portion of the stream flowing through the ports 73 into the internal chamber or recess 72 of the deflector head 68 will be impinged against the irregular surfaces formed on the member 75 and the deflector head to effect the ejection of the inner stream in the form of an inner cone of mist of minute particles.

Upon the continued forward movement of the outer sleeve 53 the contour of the outer cone of mist or vapor will be changed. With the outer sleeve 53 advanced to the position shown in Fig. 11, the rear wall 69 of the deflector head will be disposed upon the conical seat 59 for completely shutting off the outer stream of water. Prior to the seating of the deflector head upon the conical seat 59 the contour of the outer cone of mist or vapor ejected through the outer annular discharge outlet will be narrowed to such an extent as to produce a straight stream of mist or vapor which will tend to envelope the inner cone of vapor, thereby adding to the volume of the ejected vapor or mist. With the deflector head supported upon the seat 59, as shown in Fig. 11, the stream flowing through the nozzle will pass through the ports 73 into the chamber 72 so that only the inner cone of mist or vapor will be ejected from the nozzle.

Another modified form of the nozzle is shown in the Figs. 12 and 13 wherein the portion of the outer sleeve 80 defining a restricted passageway through the nozzle is provided with a serrated or threaded surface 81. The portion of the outer sleeve 80 rearwardly of the surface 81 is adapted to be engaged by the enlarged head 82 of the stem 83 for closing the valve against the passage of a stream therethrough.

As shown in Fig. 13, the peripheral surface 85 of the deflector head 84 is formed with knurled grooves which are disposed at a slight angle to the threaded surface 81 to produce a dense cloud of vapor or mist. Mounted within the stem 83

and extending through the deflector head 84 there is a rod 86 having a head or knob 87 formed on the outer end thereof which is adapted to coact with the deflector head 84 in the same manner as the nozzle shown in Fig. 2 to effect the ejection of an inner cone of vapor or mist. The head 87 is capable of threaded adjustment with respect to the deflector head 84 in order to vary the contour of the inner cone of vapor or mist. As shown in Figs. 12 and 13 the discharge end of the outer sleeve 80 is provided with a convex surface 89 to insure the ejection of an outer cone of mist or vapor at all times.

In the use of the nozzle, shown in Figs. 12 and 13, the forward face of the enlarged head 82 is adapted to engage the rear surface of the portion 81 for sealing the nozzle against the passage of a stream therethrough. Upon the forward movement of the outer sleeve 80 the fluid flowing through the nozzle will pass through the ports 88 formed in the rear wall of the deflector head 84 and be ejected from the nozzle in the form of an inner cone of vapor or mist. The remaining portion of the fluid flowing through the nozzle will pass between the deflector head 84 and the outer sleeve 80 impinging the irregular surfaces 81 and 85 to produce an outer cone of vapor or mist.

As the outer sleeve 80 is moved forwardly beyond the deflector head 84 the contour of the outer cone of mist will not be narrowed or restricted in the manner of the nozzle disclosed in Figs. 2 and 7, but will continue to be ejected in the form of a cone due to the stream flowing over the convex surface 89. The seating of the deflector head 84 upon the conical seat 90, Fig. 13, will completely shut off the outer cone of mist and permit the stream to flow through the deflector head 84 and be ejected therefrom in the form of an inner cone of minute particles.

By providing the discharge ports of the nozzle with irregular surfaces the cones of mist or vapor may be produced at extremely low pressure. This constitutes a material advantage over nozzles of the prior art in that the present nozzle is susceptible of use in many restricted low pressure areas.

Although the foregoing description is necessarily of a detailed character, in order that the invention may be completely set forth, it is to be understood that the specific terminology is not intended to be restrictive or confining, and that various rearrangements of parts and modifications of detail may be resorted to without departing from the scope or spirit of the invention as herein claimed.

I claim:

1. A nozzle comprising a tubular inner sleeve, and outer sleeve axially adjustable upon the inner sleeve and having grooves upon its inner surface, a stem secured in the inner sleeve coaxial therewith, a deflector head mounted thereon and spaced from the outer sleeve to define an outer annular discharge passage, said deflector head provided with a recess in the outer end thereof in communication with said inner sleeve, a member in the recess in said deflector head and spaced from the edge of the opening into said recess to form an inner annular discharge passageway, the edge of the opening into said recess having grooves formed thereon, said member and deflector head having grooves formed upon the peripheral surface substantially normal to the grooves on said sleeve and deflector head for producing a dense cloud of vapor.

2. A nozzle comprising inner and outer sleeves with the outer sleeve telescopically engaging the inner sleeve and movable longitudinally thereon, a stem secured in the inner sleeve coaxial therewith, a deflector head mounted thereon and arranged to coact with a portion of said outer sleeve to define an outer annular discharge passage, the portions of said deflector head and outer sleeve which define the outer passage having grooves formed thereon substantially normal to one another to effect the ejection of a dense cloud of mist, a recess in said deflector head, a member mounted in said recess so as to form an inner annular discharge passage communicating with the inner sleeve, the edge of the opening into said recess, and the edge of the said member cooperating to define said passage, said passage walls having grooves formed thereon, the grooves on the deflector being substantially normal to those on the member for intercepting and breaking up a stream into extremely fine minute particles of mist.

3. A nozzle comprising an inner sleeve having a tubular member secured therein coaxial therewith, a deflector head affixed to the tubular member and extending beyond the end of the inner sleeve, a plurality of grooves formed on the peripheral surface of the head, said deflector head formed with a recess communicating with the inner sleeve, a rod extending through the deflector head and tubular member, an enlarged end formed on the outer end of the rod and spaced from the edge of the opening into said recess to form an inner discharge port, said enlarged end and deflector head having grooves formed thereon with the grooves of said enlarged end being substantially normal to the grooves of said deflector head to effect the ejection of a dense cloud of vapor, said rod being adjustable longitudinally of the deflector head to vary the contour of the inner cloud of vapor, an outer sleeve mounted upon the inner sleeve and having a portion thereof spaced from the periphery of the deflector head to define an outer annular discharge port, said outer sleeve having annular grooves formed therein substantially normal to the peripheral grooves of said head and arranged to coact with the peripheral grooves on the deflector head for intercepting and breaking up a stream into a dense cloud of mist, said outer sleeve being susceptible of adjustment longitudinally of the inner sleeve to vary the contour of the outer cloud of mist.

4. A nozzle comprising an inner tubular sleeve, an outer sleeve movable longitudinally thereon and having an inwardly extending shoulder, a stem secured within the inner sleeve coaxial therewith, an enlarged end formed thereon engageable with said shoulder upon the movement of the outer sleeve for sealing said nozzle, said outer sleeve having a cylindrical counterbored portion therein adjacent its outer end with internal grooves formed thereon, a deflector head affixed to said enlarged end and having grooves formed on the periphery thereof substantially normal to the grooves of said sleeve; the grooves on said head being arranged to coact with the grooves of the counterbored portion for intercepting and breaking up a stream into minute globules, a recess communicating with the inner sleeve, a member positioned within said recess and cooperating with the walls of the recess to form a discharge passage, grooves formed on the said walls and on the said member, with the grooves on the walls disposed at an angle to the

grooves on the member to effect the ejection of a dense inner cloud of vapor.

5. A nozzle comprising inner and outer sleeves with the outer sleeve movable longitudinally upon the inner sleeve, an inwardly extending annular shoulder formed on the outer sleeve, and having grooves formed thereon, a stem secured within the inner sleeve coaxial therewith and terminating in an enlarged end for engaging the rear surface of the shoulder to seal the nozzle, an outwardly flared convex surface formed in the discharge end of the outer sleeve, a deflector head disposed on the forward side of said shoulder and secured to said enlarged end, said deflector head having grooves formed on the periphery thereof substantially normal to the grooves of said shoulder for ejecting a conical stream of minute globules of vapor, said deflector head provided with a recess communicating with the said inner sleeve, a rod extending through said head and secured within said stem, a head formed on the rod and spaced from the portion of the deflector head defining said recess to form an inner annular discharge port, said head and deflector head having grooves formed thereon with the grooves of said head being substantially normal to the grooves of said deflector head for ejecting a dense cloud of vapor, said rod being adjustably mounted in said stem for varying the contour of the inner cloud of vapor.

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