

Sept. 15, 1959

R. W. TATE ET AL

2,904,263

LIQUID SPRAY NOZZLE

Filed Aug. 30, 1956

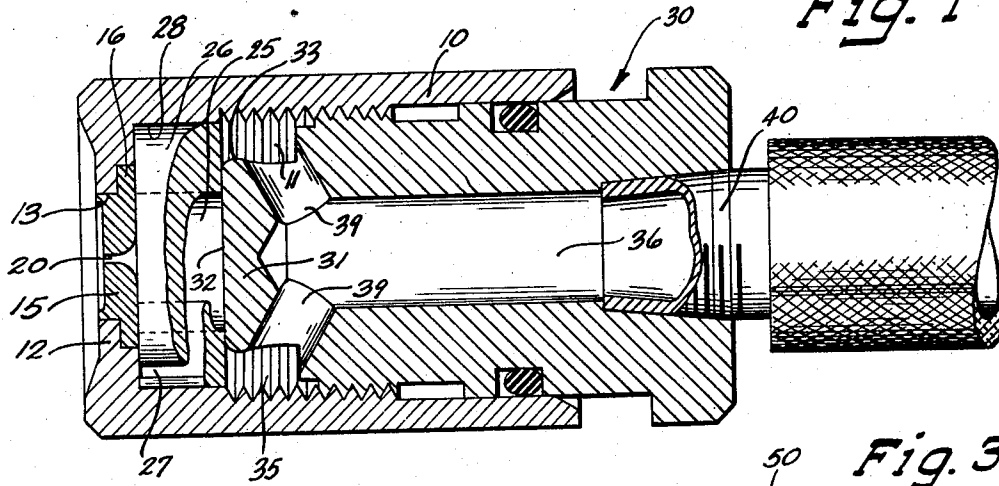
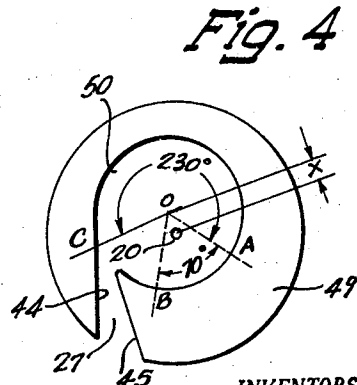
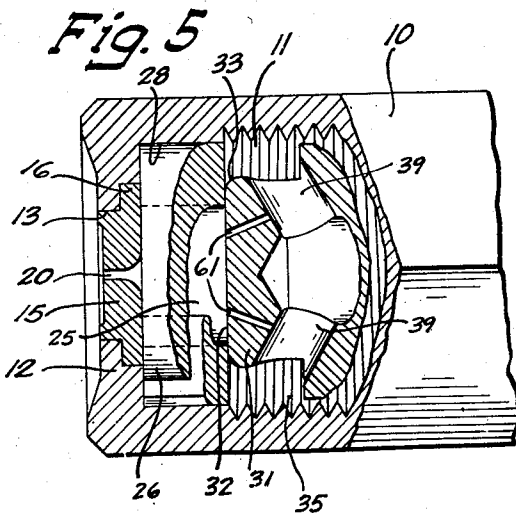
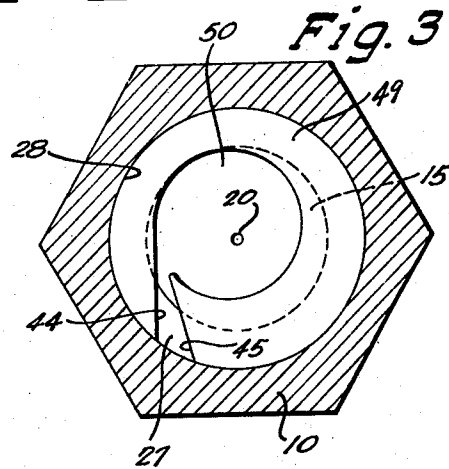
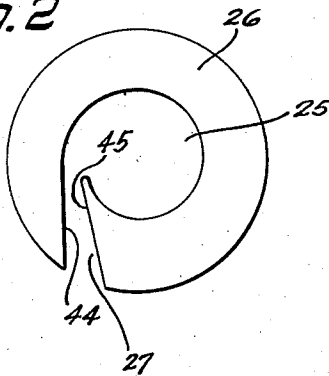


Fig. 2



INVENTORS.
 Roger W. Tate +
 Ronald J. Volkmann
 BY
 Emory J. Wutschel
 Attorney

1

2,904,263

LIQUID SPRAY NOZZLE

Roger W. Tate, Pewaukee, and Ronald J. Volkmann, Milwaukee, Wis., assignors, by mesne assignments, to Delavan Manufacturing Company, a corporation of Iowa

Application August 30, 1956, Serial No. 607,225

3 Claims. (Cl. 239—494)

This invention relates generally to spray nozzles and more particularly to an improved spray nozzle for atomizing liquid into fine droplets that are disposed to form a conical spray for distributing the atomized liquid in a uniform pattern.

It is a general object of the present invention to provide an improved liquid spray nozzle for atomizing a liquid and discharging the atomized liquid so that it is uniformly distributed in a conical spray.

Frequently, when fine atomization of a liquid is required, it is the practice to employ nozzles having swirl chambers in which the liquid to be atomized is formed into a tubular stream that is directed by the configuration of the swirl chamber into a spiral path and then discharged through an orifice that serves as an outlet for the swirl chamber. As the swirling liquid is discharged through the orifice it is finely divided into minute droplets, and if the nozzle is properly constructed the droplets will be uniformly distributed in the spray. For maximum efficiency the swirl chamber comprises an opening that is formed by a wall which follows a spiral path and has an inlet for admitting the fluid into the swirl chamber. A closure is required for one end of the swirl chamber while the opposite end is positioned to register with the discharge orifice which is provided in the nozzle body. In order to achieve a uniform pattern of distribution of the minute droplets that comprise the spray, it is essential that the interior surfaces of the swirl chamber be provided with an extremely smooth finish to reduce its frictional resistance to a minimum and avoid agitation of the liquid in the tubular stream as it is flowing in the swirl chamber at a high velocity.

By reason of the construction of previous spray nozzles employing a swirl chamber, the fabrication of the swirl chamber has presented a serious problem because it is necessary for the closure to be attached to the chamber wall to seal one end of it. This can be accomplished by forming the closure integrally with the chamber wall or by forming it separately and performing an additional operation of soldering the closure to the chamber wall. In order to form the closure integrally with the chamber wall it is necessary to perform a routing operation for forming the swirl chamber. In such an operation the routing tool is operating simultaneously on the side wall and closure surfaces causing its excessive flexure in different directions and rendering it impractical to obtain the proper finish on the interior surfaces of the swirl chamber. Therefore, one of the purposes of the present invention is to provide an improved spray nozzle construction having a swirl chamber structure of improved efficiency that may be readily fabricated to relieve the difficulties that have been encountered in producing this member.

Another object of the present invention is to provide a spray nozzle with a replaceable swirl chamber and a replaceable outlet orifice so that the configuration as well as the depth of the swirl chamber may be varied along with the size of the outlet orifice to enable maxi-

2

imum efficiency of operation to be obtained under substantially all conditions.

Another object is to provide a spray nozzle that will form the usual hollow conical spray or may be adapted to form a solid conical spray when required.

Another object is to provide a spray nozzle that may be equipped with a swirl chamber having its axis offset from the axis of the outlet orifice and constructed so that the inlet to the swirl chamber will be in the same position relative to the axis of the outlet orifice regardless of the angle that the inlet is placed about the axis of the nozzle.

A further object is to provide a spray nozzle which is of simple but sturdy construction and efficient in operation.

According to this invention the improved spray nozzle comprises a bored plug adapted to be threaded into a nozzle body. The inner end of the plug is of reduced diameter and arranged to bear upon one of the two open ends of a replaceable swirl chamber body to close the end of the swirl chamber and thereby serve as a closure for the swirl chamber even though it is entirely independent of the swirl chamber body. The opposite end of the swirl chamber is in communication with an outlet orifice through which the liquid is discharged in an atomized spray, the orifice being preferably formed in a replaceable disk located in juxtaposition with the swirl chamber body. The liquid to be sprayed is introduced into the bore of the plug under pressure and is discharged therefrom into an annular passage formed by the reduced end of the plug and the wall of the nozzle body. From the annular passage the liquid flows into the replaceable swirl chamber through an inlet opening formed in the swirl chamber body in position to be in communication with the annular passage. The swirl chamber directs the fluid into a spiral stream before it is discharged from the nozzle through the outlet orifice in an atomized conical spray. The replaceable swirl chamber enables a variety of configuration and construction of swirl chambers to be employed with the nozzle to render it extremely versatile and capable of operating at maximum efficiency under a variety of conditions.

The foregoing and other objects of this invention, which will become more fully apparent from the following detailed description, may be achieved by the particular embodiment depicted in and described in connection with the accompanying drawings, in which:

Figure 1 is a view substantially in longitudinal section taken through the center of a spray nozzle embodying the features of the present invention;

Fig. 2 is a detail plan view illustrating the swirl chamber body shown assembled in the nozzle in Fig. 1;

Fig. 3 is a view in transverse section taken through the nozzle illustrated in Fig. 1 but illustrating a modified swirl chamber body assembled in the nozzle having a circular swirl chamber in lieu of a spiral swirl chamber, and having its axis offset from the axis of the nozzle and its concentric outlet orifice;

Fig. 4 is a detail plan view of the swirl chamber body illustrated in Fig. 3; and,

Fig. 5 is a fragmentary view in longitudinal section taken through the center of the spray nozzle shown in Fig. 1 but modified to produce a solid cone spray in lieu of the hollow cone spray that is produced by the nozzle as depicted in Fig. 1.

Reference is now made more specifically to the drawings and particularly to Fig. 1 thereof which illustrates a liquid spray nozzle constructed in accordance with the teachings of the present invention and comprising a cylindrical nozzle body 10 having a female thread 11 formed along a portion of its inner diameter. The left end of the nozzle body 10 as viewed in Fig. 1 is provided

with an inwardly extending annular flange 12 to form a concentric opening 13 of reduced diameter for receiving an orifice disk 15. The opening 13 is counter-bored on its interior side for receiving a peripheral flange 16 formed on the disk 15 to properly locate the disk 15 within the opening 13. The liquid to be sprayed is discharged from the nozzle through an outlet orifice 20 which is concentrically formed in the disk 15. The disk 15 is tightly fitted within the opening 13 to prevent leakage about the periphery of the disk but it may be readily forced out of the opening 13 toward the interior of the nozzle body 10 for the purpose of replacing it with another disk 15. With this arrangement, a plurality of disks 15 having different size orifices 20 may be made available to accommodate varying conditions.

The liquid that is being sprayed is discharged through the outlet orifice 20 from a swirl chamber 25 formed within a swirl chamber body 26. The swirl chamber body 26 includes an inlet passage 27 for admitting the fluid into the swirl chamber as clearly shown in Figs. 1 and 2. Both ends of the swirl chamber 25, as formed in the swirl chamber body 26, are open and one of these open ends overlies the outlet orifice 20 to establish communication between the swirl chamber 25 and the outlet orifice 20.

The periphery of the swirl chamber body 26 is of circular configuration and of a diameter to accommodate the diameter of the cylindrical wall 28 formed within the nozzle body 10 to the left of the female thread 11 as viewed in Fig. 1. The swirl chamber body 26 is fitted within the cylindrical opening 28 and retained therein by a plug that is generally identified in Fig. 1 by the reference numeral 30.

The plug 30 includes a reduced end portion 31 which bears against one face of the swirl chamber body 26 as the plug 30 is threaded into the body 10. The reduced end portion 31 therefore serves to retain the swirl chamber body 26 in position within the nozzle body 10. It is apparent that the height of the swirl chamber body 26 may be varied to suit the particular conditions and the plug 30 will accommodate the different heights of the swirl chamber body 26, it only being necessary to thread the plug 30 into the nozzle body 10 until the reduced end portion 31 engages the face of the swirl chamber body 26.

The end portion 31 of the plug 30 is of sufficient diameter so that its end face 32 completely overlies the end opening of the swirl chamber 25 to serve as a closure therefor. However, the diameter of the reduced end portion 31 is substantially less than the outer diameter of the swirl chamber body 26 and the inner diameter of the nozzle body 10 so that it forms an annular channel 35 within the body 10. The liquid to be sprayed is admitted into the annular channel 35 from a concentric longitudinal bore 36 formed in the plug 30 which extends from one end of the plug through a major portion of its length, and is in communication with the channel 35 by means of a pair of radial openings 39 which register at one end with the bottom of the bore 36 and at their opposite ends with the annular channel 35. The opposite end of the bore 36 is provided with a tapered pipe thread for receiving a fitting 40 for connecting the bore 36 to the source of the liquid to be sprayed which is introduced into the bore 36 under pressure.

It is therefore apparent that the liquid which is admitted into the nozzle proceeds through the bore 36 and thence through the radial passages 39 into the annular channel 35. Since the inlet passage 27 of the swirl chamber 25 extends to the periphery of the swirl chamber body 26, it communicates with the annular channel 35 so that the liquid flows from the channel 35 through the inlet passage 27 into the swirl chamber 25. The liquid is discharged from the swirl chamber 25 through the outlet orifice 20 from which it emerges in a conical spray of finely atomized liquid. The structure of the plug 30 is especially well adapted to receive a cartridge

type filter in the bore 36 to filter the liquid that is to be sprayed if desired.

The inlet passage 27 is defined by two walls 44 and 45 which establish a passage of rectangular cross-section. The wall 44 is tangent to the wall of the swirl chamber 25 and the latter wall proceeds from its point of tangency with the wall 44 in a spiral path with its radius reducing gradually to its juncture with the interior end of the wall 45. The liquid is therefore admitted into the swirl chamber 25 in a tubular stream of rectangular cross-section, and the stream is directed by the wall of the swirl chamber 25 into a spiral path to form a vortex within the swirl chamber 25. The stream of liquid within the swirl chamber 25 proceeds in the spiral path until it approaches the center of the swirl chamber 25 and is discharged therefrom through the outlet orifice 20.

If the tubular stream of liquid flowing within the swirl chamber 25 is not disturbed and the liquid which composes the stream is not agitated out of its spiral path of travel, the swirling liquid will be discharged from the orifice 20 and atomized into minute droplets which will be uniformly distributed to form a conical shaped spray. However, the slightest irregularity within the swirl chamber 25 or rough finish on the walls defining the swirl chamber 25 will disturb the stream of fluid within the swirl chamber 25 and agitate it with the result that the minute droplets will not be uniformly distributed in the spray that emerges from the outlet orifice 20 so that an entirely unsatisfactory spray pattern is obtained which in many applications cannot be tolerated. For this reason, it is extremely important that the swirl chamber 25 be accurately formed and that the walls which define the swirl chamber 25 be provided with a very smooth finish.

For the same reason, it is imperative that the peripheral edge of the reduced end portion 31 adjacent to its end face 32 be provided with the radius 33 to assure a smooth flow of the liquid. It has been found that if a sharp edge is substituted for the radius 33, the liquid tends to be agitated as it enters the inlet passage 27 causing it to deviate from a uniform tubular stream within the swirl chamber 25 so that a uniform pattern of distribution of the minute droplets in the spray cannot be obtained.

It is apparent from the above description that it is a fundamental requirement that a closure be provided to seal the end of the swirl chamber 25 opposite the end that is in registration with the outlet orifice 20. Prior art spray nozzles which employ a spirally shaped swirl chamber have been constructed in such a manner that it is necessary to secure the closure member directly to the swirl chamber body. This is accomplished by forming the closure member integrally with the swirl chamber body or by brazing a separate member to the swirl chamber body to provide the proper closure for the chamber. The brazing of an independent member to the swirl chamber body involves an additional expensive operation, while on the other hand, if the closure is formed integrally with the swirl chamber body, a serious machining problem results inasmuch as it is necessary to machine both the spiral wall surface and the interior surface of the closure member simultaneously with the result that it is extremely difficult to obtain the proper surface finish on the walls which define the swirl chamber because of the forces that are set up in the cutter.

The construction of the spray nozzle in accordance with the teachings of the present invention solves these fabrication problems by reason of the fact that the swirl chamber body and the closure member for the swirl chamber are independent elements which may be machined separately with the reduced end portion 31 of the plug 30 serving as the closure member for an infinitely variable height of the swirl chamber 25 within the limits of the nozzle body 10. With this arrangement, the spirally shaped wall of the swirl chamber 25 and the end

face 32 of the closure member 31 are machined separately to enable a smooth finish to be readily obtained on both surfaces to alleviate the fabrication problem which has existed in producing these members for previous spray nozzle constructions. Furthermore, the swirl chamber body 26 may be placed within the cylindrical opening 28 with either face in contact with the face 32 of the reduced end portion 31 without affecting the spray pattern. A reversal of the placement of the swirl chamber body 26 within the cylindrical opening 28 will, of course, reverse the direction of travel of the stream of fluid within the swirl chamber 25, but this will not affect the quality of the spray.

It has been previously ascertained by others skilled in the spray nozzle art that a spray pattern suitable for some spray nozzle applications may be obtained by substituting a circular swirl chamber in lieu of the spiral swirl chamber 25 if the outlet orifice 20 is offset from the axis of the circular swirl chamber. Such swirl chamber construction is illustrated in Figs. 3 and 4 where a swirl chamber body 49 having a circular swirl chamber 50 is substituted for the spiral swirl chamber body 26. However, in order to obtain a satisfactory spray pattern with a circular swirl chamber 50, it is essential that the outlet orifice 20 be accurately located with respect to the inlet passage 27 to obtain the desired effect.

It has been found that in order to obtain a satisfactory spray pattern with a circular swirl chamber, the orifice 20 must lie within a segment defined by two radii located 230° and 300° respectively in a clockwise direction from a line drawn from the center of the circular swirl chamber 50 to a point midway between the interior end of the wall 45 and the point of tangency of the wall 44 with the wall of the circular swirl chamber 50 as represented by the line OC in Fig. 4. As illustrated in Fig. 4, the line OC extends from the center of the circular swirl chamber 50 to a point midway between the point of tangency of the line 44 with the wall of the swirl chamber 50 and the interior end of the wall 45. The radius OA is drawn 230° from the line OC in a clockwise direction, and the line OB is 300° from the line OC in a clockwise direction. The orifice 20 therefore, must lie within the segment AOB, and the particular location of the orifice 20 within this segment will vary depending upon the existing conditions, so that its proper location in this segment must be ascertained for each set of circumstances.

In the past, the nozzles employing circular swirl chambers with an offset outlet orifice were constructed on the premise that it was necessary to locate the axis of the swirl chamber concentrically within the nozzle body and offset the orifice therefrom. Since it is essential in this construction that the outlet orifice 20 be accurately located with respect to the inlet passage 27 of the swirl chamber as described above, it was impractical to provide such nozzles with either replaceable outlet orifices or replaceable swirl chambers because of the difficulty in aligning the position of the outlet orifice with respect to the inlet passage of the swirl chamber. For this reason, such nozzles have been constructed with fixed outlet orifices and fixed swirl chambers, which severely limits their application.

On the other hand, it has been found that the unique nozzle construction of the present invention is very well adapted for employing a circular swirl chamber 50 with an offset outlet orifice 20, and the problem of properly locating the outlet orifice 20 with respect to the inlet passage 27 in conjunction with replaceable outlet orifices and swirl chambers is solved by offsetting the circular swirl chamber 50 in the swirl chamber body 49 and retaining the concentric location of the outlet orifice 20 with respect to the nozzle body 10. With this arrangement, the axis of the circular swirl chamber 50 is offset from the axis of the nozzle body 10 as well as from the axis of the outlet orifice 20 by the distance X as indicated in Fig. 4, and it is offset in the desired direction and de-

gree with respect to the inlet passage 27. With this arrangement, regardless of what angular position about the axis of the nozzle body 10 that the swirl chamber body 49 is placed within the nozzle body 10, the inlet passage 27 will always be in the same relationship to the outlet orifice 20 to obtain the desired results.

Therefore, the operator may place the circular swirl chamber body 49 within the nozzle body 10 with the assurance that its inlet passage 27 will be in the proper location with respect to the outlet orifice 20, and without the requirement of carefully aligning the inlet passage 27 with the outlet orifice 20 everytime that the swirl chamber body 49 is placed within the nozzle body 10. Thus, by the simple expedient of offsetting the swirl chamber 50 rather than offsetting the outlet orifice 20 in the nozzle body 10, the applicant has solved a problem which has hampered the use of the circular swirl chamber in spite of the fact that its use is frequently desirable because it will produce satisfactory results for certain conditions and is much less expensive to produce than the spirally shaped swirl chamber.

The conical sprays produced by the swirl chambers 25 and 50 described above are hollow with the atomized liquid being distributed at the periphery of the cone. Such spray form fully satisfies the great majority of spray applications, but there are a few applications where a solid cone spray is preferable. A solid cone spray may be conveniently obtained with the nozzle construction illustrated in Fig. 1 by the simple expedient of modifying the plug 30 by drilling one or more diagonal holes 61 in its end portion 31 in the manner shown in Fig. 5 where two such holes 61 are provided. Although only two holes 61 are depicted in Fig. 5, additional holes 61 may be formed in the end portion 31 if desired.

Each of the holes 61 extends from one of the passages 39 to the face 32 of the end portion 31 where they register with the swirl chamber 25 to establish direct communication between the passages 39 and the swirl chamber 25. This path of fluid flow from the passage 39 to the swirl chamber 25 is in addition to the normal path previously described in which the fluid flows from the passages 39 into the annular channel 35 and thence through the inlet 27 into the swirl chamber 25. The holes 61 are inclined from the passages 39 toward the axis of the end portion 31.

With this arrangement, a portion of the fluid flowing under pressure in the radial passages 39 will flow through the holes 61 and discharge in streams into the swirl chamber 25. The holes 61 are located so that the streams of fluid they produce intercept the circulating stream of fluid that enters the swirl chamber 25 through the inlet 27 and serve to force fluid into the central portion of the vortex in the swirl chamber 25 which would otherwise be void of fluid. By thus forcing fluid into the central portion of the vortex, a solid stream of swirling fluid enters the outlet orifice 20, and the fluid is discharged from the orifice in a spray that takes the form of a solid cone with atomized liquid occupying the interior of the cone as well as its periphery. It is therefore apparent that by simply replacing the plug 30 shown in Fig. 1 with a plug having the holes 61 formed in its end portion 31, the spray form created by the nozzle may be changed from the usual hollow cone spray to a solid cone spray when the latter form is preferred for a particular application.

From the foregoing and detailed description and explanation of the operation of the exemplifying liquid spray nozzle herein set forth as a practical embodiment of the present invention, it will be apparent that there has been provided an improved nozzle of simple and inexpensive construction but possessing extreme versatility for meeting the requirements of an infinite variety of applications.

Although the illustrative embodiment of the invention has been described in considerable detail for the purpose

of disclosing a practical operative structure whereby the invention may be practiced advantageously, it is to be understood that the particular apparatus described is intended to be illustrative only and that various novel characteristics of the invention may be incorporated in other structural forms without departing from the spirit and scope of the invention as defined in the subjoined claims.

The principles of this invention having now been fully explained in connection with the foregoing description, we hereby claim as our invention:

1. In a spray nozzle; a nozzle body having a cylindrical bore with an outlet orifice at one end; a replaceable swirl chamber body fitted in the cylindrical bore of said nozzle body and having a swirl chamber open at both ends with one open end in registration with the outlet orifice of said nozzle body, said swirl chamber body having an inlet passage to serve as an inlet for fluid entering the swirl chamber; a plug threaded into said nozzle body, said plug having a longitudinal bore extending through a portion of its length so that its interior end is closed; and a reduced end portion on the interior end of said plug in position to bear against the face of said swirl chamber body when said plug is threaded into said nozzle body and being of sufficient diameter to form a closure for the adjacent open end of the swirl chamber but being of lesser diameter than the inner diameter of said nozzle body to form an annular channel between its periphery and the inner diameter of said nozzle body, the annular channel being in registration with the inlet passage of said swirl chamber body, said reduced end portion having passages extending from the bore of said plug to the annular channel and diagonal holes extending from the passages in the reduced end portion to the end of the reduced end portion to open into the swirl chamber through its open end that is closed by the end of said plug, the diagonal holes being inclined inwardly from the passages in reduced end portion toward the axis of the reduced end portion with their converging ends opening into the swirl chamber; whereby a portion of the fluid to be sprayed will flow from the longitudinal bore through the passages in said plug into the annular channel and enter the swirl chamber through its inlet passage while the other portion of the fluid to be sprayed will flow from the passages through the diagonal holes to enter the open end of the swirl chamber in streams which unite with the fluid entering the swirl chamber from its inlet passage to form a solid cone spray having atomized liquid at its interior as well as at its periphery.

2. In a spray nozzle; a hollow nozzle body having an outlet orifice at one end and presenting a smooth interior cylindrical wall portion at its end adjacent to the outlet orifice and a female thread beyond the cylindrical wall portion; a replaceable swirl chamber body fitted in the opening formed by said cylindrical wall portion, said swirl chamber body having a swirl chamber open at both ends with one open end being in registration with the outlet orifice and having an inlet passage opening into the swirl chamber to provide an inlet for fluid to enter the swirl chamber; and a plug threaded into said nozzle body and having a longitudinal bore through a portion of its length with its closed end bearing against the face of said swirl chamber body to serve as a closure for the open end of the swirl chamber opposite the open end that is in registration with the outlet orifice, said plug having one or more passages connecting the longitudinal bore of said plug with the inlet passage of said swirl chamber body for admitting fluid from the bore of said plug into the swirl chamber, said plug also having diagonal holes formed through its closed end, the diagonal holes being inclined inwardly toward the axis of said plug, converging toward the end of said plug with the converging ends of the diagonal holes opening into the swirl chamber through the open end of the swirl chamber that is closed

by the end of said plug to provide passages for fluid flowing through the nozzle to enter the swirl chamber through one of its open ends; whereby a portion of the fluid to be sprayed will flow from the longitudinal bore through the passages in said plug and into the inlet passage of said swirl chamber body while the other portion of the fluid to be sprayed will flow through the diagonal holes in the end of said plug to enter the swirl chamber through one of its open ends in streams which unite with the fluid entering the swirl chamber from its inlet passages to form a solid cone spray having atomized fluid at its interior as well as at its periphery.

3. In a spray nozzle; a hollow nozzle body having an outlet orifice at one end and presenting a smooth interior cylindrical wall portion at its end adjacent to the outlet orifice and a female thread beyond the cylindrical wall portion; a replaceable rigid swirl chamber body of nonresilient construction fitted in the opening formed by said cylindrical wall portion, said swirl chamber body having an eccentric bore of constant size which constitutes a swirl chamber open at both ends with one open end in registration with the outlet orifice and having a single inlet passage of a size that remains constant regardless of the value of the fluid pressure or the volume of fluid flowing therethrough, the inlet passage thereby serving to admit fluid into the swirl chamber so that the fluid enters the swirl chamber immediately upon the application of fluid pressure to the inlet passage regardless of the value of the fluid pressure applied, causing the nozzle to function and form the desired spray pattern while a fluid pressure of minimum value flows through the nozzle, and to provide a nozzle of constant capacity, the inlet passage extending from the periphery of the swirl chamber body to the swirl chamber and being of rectangular cross section extending through the entire height of said swirl chamber body with a maximum cross sectional area at the periphery of said swirl chamber body and constantly decreasing therefrom to a minimum cross sectional area at its opening into the swirl chamber, one wall of the inlet passage being tangent to the wall of said swirl chamber body that defines the swirl chamber, said swirl chamber body having a circular periphery with the thickness of said body surrounding the swirl chamber being at a minimum at its point of tangency with the wall of the inlet passage and increasing therefrom progressively about the swirl chamber to a maximum thickness at the wall of the inlet passage which is opposite the tangential wall of the inlet passage to form the eccentrically located swirl chamber; and a plug threaded into said nozzle body, said plug having a longitudinal bore extending through a portion of its length to form a closed end which bears against the face of said swirl chamber body to serve as a closure for the open end of the swirl chamber opposite the open end that is in registration with the outlet orifice, said plug having one or more passages in communication with the bore of said plug and with the inlet passage of said swirl chamber body; whereby fluid introduced into the bore of said plug under any pressure will flow through the passages in said plug and the inlet passage in said swirl chamber body to enter the swirl chamber for discharge through the outlet orifice to accurately produce the desired spray pattern with a minimum of fluid pressure flowing through the nozzle.

References Cited in the file of this patent

UNITED STATES PATENTS

2,306,141	Richardson	Dec. 22, 1942
2,428,748	Barz	Oct. 7, 1947
2,572,606	Fisher	Oct. 23, 1951

FOREIGN PATENTS

344,897	Great Britain	Mar. 13, 1931
1,035,991	France	Apr. 22, 1953