

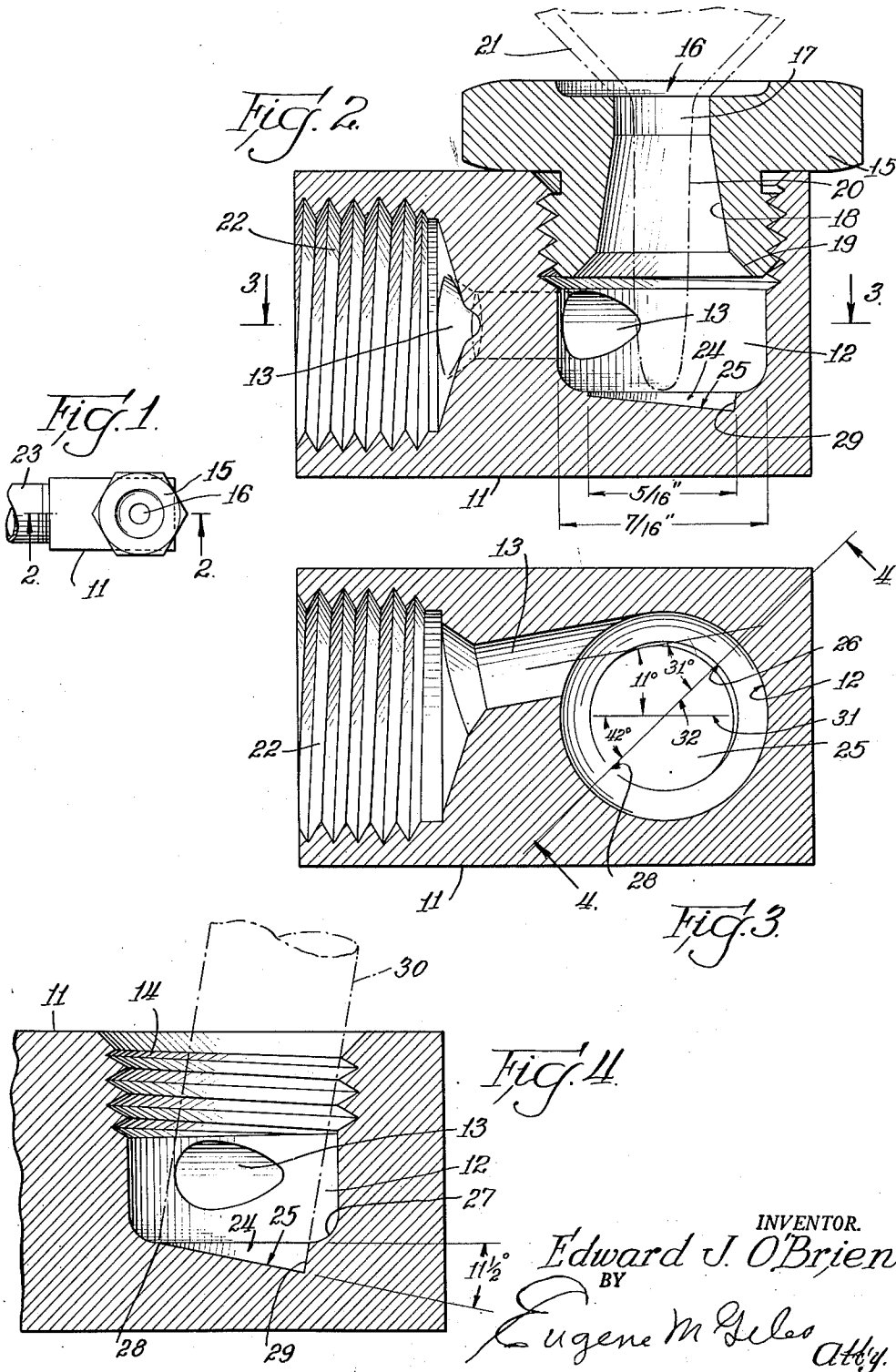
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WHIRL SPRAY NOZZLE

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1

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WHIRL SPRAY NOZZLE

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3 Claims. (Cl. 299—114)

This invention relates to nozzles for spraying liquids in a hollow conical or parasol shaped spray and has reference more particularly to facilities for circumferentially equalizing the liquid passing through the orifice to insure uniformity of distribution, direction and distance of spray discharge.

In such nozzles it is customary to introduce the liquid tangentially into a circular chamber to impart a rapid whirling movement thereto and to discharge this rotating liquid from the chamber through an axially disposed orifice so that the centrifugal force of the liquid as it emerges from the orifice produces a spray of hollow conical or parasol shape.

It is important that the liquid discharges from the orifice in a uniform or balanced hollow cone or parasol form so as to insure equalized and uniform range and distribution of the sprayed liquid at all places around the axis of the orifice. However, the tangential introduction of the liquid into the whirl chamber at one side thereof tends to build up pressures in the chamber which disturb the symmetry of the whirling body of liquid and impart such peripheral inequalities or variations in liquid flow from the orifice that the volume and direction of spray discharge around the orifice is not uniform, and an undesirable unbalanced hollow conical or parasol shaped spray is produced.

To counteract this unbalancing effect of the tangentially introduced liquid, various expedients have been employed, such, for example as constructing the whirl chamber in volute forms or with a spirally rising bottom to compensate for the inequality of pressure and avoid lack of symmetry occasioned by the tangential entry of the liquid into the whirl chamber, but these expedients are not only costly and unadaptable to volume production methods, but introduce undesirable factors of variation of effectiveness depending upon the pressure of the supplied liquid.

It has been found, however, that provision of a shouldered central depression in the bottom of the whirl chamber, as shown in the Wahlin Patent No. 2,247,897 of July 1, 1941, provides a satisfactory solution of the unbalancing effect of tangential entry of liquid into the nozzle whirl chamber, although in some spraying operations objectionable pitting of the bottom of the shouldered central depression has occurred, apparently through what is regarded as cavitation action or effect.

The principal objects of the invention are to provide an improved whirl spray nozzle of the type above described having a depression in the bottom of the whirl chamber thereof to compensate for the unbalancing effect of the tangential entrance of liquid therein; to avoid objectionable pitting of the bottom of the depression which has been experienced heretofore; and to incorporate these improvements in a form adapted for volume production at low cost, these and other objects being accomplished as pointed out more particularly hereafter and as shown in the accompanying drawing in which:

2

Fig. 1 is a top view of a nozzle made in accordance with the present invention;

Fig. 2 is a sectional view greatly enlarged, taken on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2; and

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3.

The nozzle shown herein is of conventional form, except as to the recess in the bottom of the whirl chamber, and comprises a body 11 with a circular whirl chamber 12 therein into which an inlet passageway 13 leads tangentially so as to impart rapid rotation or whirling movement to the liquid in the chamber 12, the body 11 having at one side of the whirl chamber 12 and concentric therewith a threaded opening 14, preferably of the same diameter as the chamber, and having a threaded plug 15 therein which has a nozzle opening 16 therethrough axially aligned with the whirl chamber 12.

The nozzle 16 has a cylindrical mouth portion 17 of a diameter considerably less than that of the chamber 12 and the opening 16 flares inwardly as indicated at 18 and therebeyond has a more pronounced flare 19, to the whirl chamber 12, and as the liquid enters the chamber 12 from the tangential inlet passage 13, it is whirled in the chamber 12 and expelled outwardly from the chamber 12 through the nozzle opening 16 in a centrally open (see dotted lines 20) rapidly rotating annular stream at sufficient axial velocity to form a thin hollow wide conical spray substantially as indicated at 21 in Fig. 2. At the outer end of the inlet passage 13, the body 11 may be formed with any convenient means, such for example as the internal threads 22 for connection of piping 23 or the like through which liquid is supplied to the spray nozzle.

Because of the tangential entry of the liquid into the chamber 12, a rapid whirling impulse is imparted to the liquid in the chamber 12 and as the liquid continues to enter the chamber 12, the liquid is forced upwardly therefrom through the opening of the plug 15 in a hollow annular stream which emerges from the outer reduced end 17 of the opening in a far flung hollow conical spray 21, the uniformity of volume and distance of projection of which depends upon the annular uniformity of volume of the emerging liquid and also the exactitude of coincidence of the axis of rotation of the liquid with the axis of the opening 16.

Because of the tangential entry of the liquid through the passage 13 and the redirecting of this entering liquid into the circular path of rotation in the chamber 12, pressures are built up at the place where the redirecting of the liquid occurs which tend to displace the axis of rotation of the whirling liquid out of concentricity with the axis of the chamber 12 and the opening 16 therefrom and cause non-uniformity of volume and direction of spray from the outer end of the opening 16, and to compensate for this displacement tendency and insure substantial uniformity of volume and direction of spray discharge from the outer end of the opening 16, an auxiliary cavity or depression 24 is provided in the bottom of the chamber 12 of substantially less diameter than and substantially concentric with the chamber 12 and with the bottom or floor 25 thereof tilted as shown particularly in Figs. 2 and 4, so that the depth thereof varies around the periphery and the greatest depth is approximately at a place in front of the entering liquid as indicated at 26.

The chamber 12 is preferably of rounded concave cove shape around the bottom, as indicated at 27, and the bottom or floor 25 of the cavity 24 slopes upwardly, as shown in Fig. 4, from the place 26 of greatest depth to the level or approximately the level of the top of the cavity at the opposite side where the said bottom may be

substantially tangential to the concave curvature of the cove 27, as indicated at 28 in said Fig. 4, the depth of the cavity 24, and also the depth of the peripheral wall 29 thereof progressively increasing from the substantially tangential place 28 to the place 26 of greatest depth.

Thus as the liquid enters the chamber 12 from the passage 13, extra depth of the chamber is provided by the cavity 24 approximately in front of the entering stream and at the place where the liquid is deflected into the circular path of rotation thereof in the chamber 12 to compensate for the normal build-up of distorting pressures at this place, and at the same time the upward inclination of the cavity floor or bottom 25 and the upward directing effect thereof on the liquid as it proceeds from the place 26 of greatest cavity depth around the chamber 12 provides an additional compensating effect at the opposite side of the chamber so that substantial concentricity of the whirling liquid with the axis of the chamber 12 and opening 16 is maintained with the result that there is such uniformity of volume of liquid issuing from the outer end of the opening 16, and such concentricity of rotation of the liquid about the axis of the opening 16 as it emerges therefrom, that a hollow conical or parasol shaped spray of uniform volume, direction and distance of projection is provided.

Moreover, it is an important feature of the invention that a cavity 24, such as shown and described herein, avoids the objectionable pitting of the bottom of the cavity which has occurred with other cavities or depressions heretofore employed to compensate for the displacing effect of tangential entry of the liquid into the whirl chamber of spray nozzles.

It is also an important feature of the invention that the cavity 24 is such that it may be readily provided, and with accuracy by a convenient machining operation adapted for volume production by merely projecting a rotary cutter with flat cutting end face into the chamber 12 of the nozzle body 11 at a suitable inclination and to a suitable depth, as indicated by dotted lines at 30 in Fig. 4.

As a specific example of a cavity 24 and arrangement thereof which satisfactorily accomplishes the purposes of the present invention, a cavity 24 of $\frac{5}{16}$ inch diameter may be employed in a chamber 12 of $\frac{7}{16}$ inch diameter and having the bottom or floor 25 thereof inclined at an angle of $11\frac{1}{2}$ degrees, as indicated in Fig. 4, and with the tangential passage 13 disposed at an angle of 11 degrees to the longitudinal axis 31 of the nozzle body and the cavity diameter 32, which extends between the peripheral points 26 and 28 of greatest and least cavity

depth, disposed at an angle of 42 degrees to the longitudinal axis 31 of the nozzle body and at an angle of 31 degrees to the longitudinal axis of the passage 13, all as shown in Fig. 3.

For convenience in claim terminology, the cavity 24, as it has been described herein, may be said to be in the form of an angularly truncated right cylinder, but it should be recognized that this term is intended to include obvious equivalents and should not be limited to its strict geometrical connotation. For example, but not by way of limitation, it is obvious that a rotary cutting tool such as described above for producing the cavity may produce slightly filleted corners due to wear on the tool.

While I have shown and described my invention in a preferred form, various changes and modifications may be made therein without departing from the spirit of my invention, the scope of which is to be determined by the appended claims.

What is claimed is:

1. A spray nozzle of the type comprising a body having a circular chamber therein, with an inlet passage leading tangentially thereto to inject liquid tangentially into the chamber and impart rotation thereto, the chamber having at one side thereof and axially aligned therewith a discharge outlet through which liquid is discharged from the chamber to the exterior of the nozzle, and the chamber having at the opposite side thereof an auxiliary cavity, the improvement which consists in shaping the cavity substantially in the form of an angularly truncated right cylinder with the bottom of said cavity being substantially flat and positioning said cavity in the chamber such that its greatest depth is adjacent to but forward of the point of tangency between the chamber and the inlet passage.

2. A spray nozzle as set forth in claim 1 in which the cavity has substantially zero depth diametrically opposite to its point of greatest depth.

3. A spray nozzle as set forth in claim 1 in which the longitudinal axis of said right cylinder is inclined with respect to the axis of said chamber by about $11\frac{1}{2}^\circ$.

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