United States Patent [19]
Williams et al.
[11] 3,858,812
[45] Jan. 7, 1975

[54] SPRAY NOZZLE FOR LOW PRESSURE SPRAY AND UNIFORM SPRAY PATTERN

[75] Inventors: Robert P. Williams; Ted Lee Butterfield, both of Naperville; Lyle J. Emory, Darien, all of Ill.
[73] Assignee: Spraying Systems Co., Wheaton, Ill.

[22] Filed: Nov. 23, 1973
[21] Appl. No.: 418,728
[52] U.S. Cl. 239/599, 239/601
[51] Int. Cl. B05b 1/00
[58] Field of Search .... 239/601, 599, DIG. 1, 592

[56] **References Cited**

UNITED STATES PATENTS

2,683,626 7/1954 Wahlin 239/599
2,701,412 2/1955 Wahlin 239/599
3,045,932 7/1962 Steinen 239/601
3,754,710 8/1973 Chimara 239/601

FOREIGN PATENTS OR APPLICATIONS

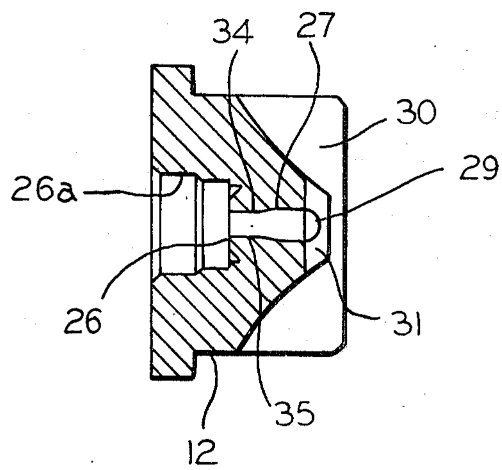
717,464 10/1954 Great Britain 239/592

Primary Examiner—Lloyd L. King
Attorney, Agent, or Firm—Mann, Brown, McWilliams & Bradway

[57] **ABSTRACT**

A spray nozzle with spaced projections at the entrance end of the nozzle passage leading to the orifice to promote uniformity of spray.

6 Claims, 11 Drawing Figures



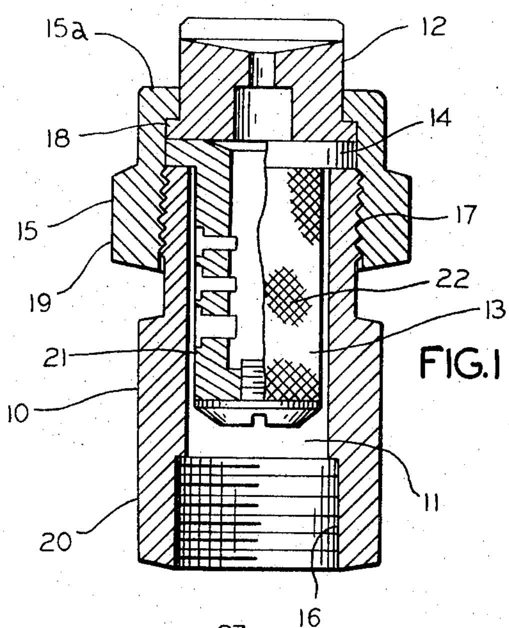


FIG.1

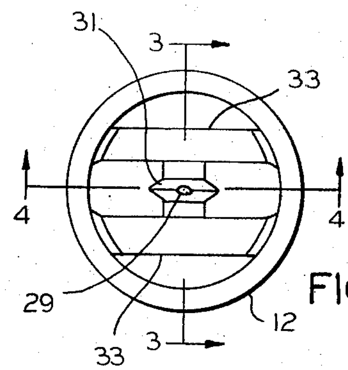


FIG.2

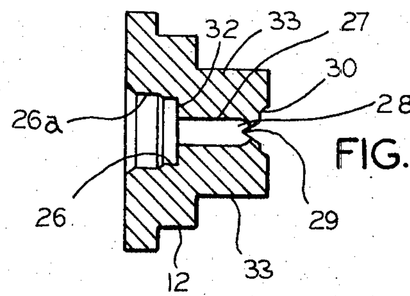


FIG.3

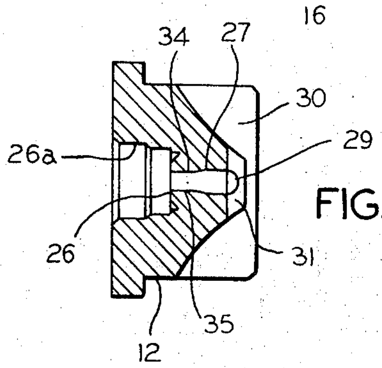


FIG.4

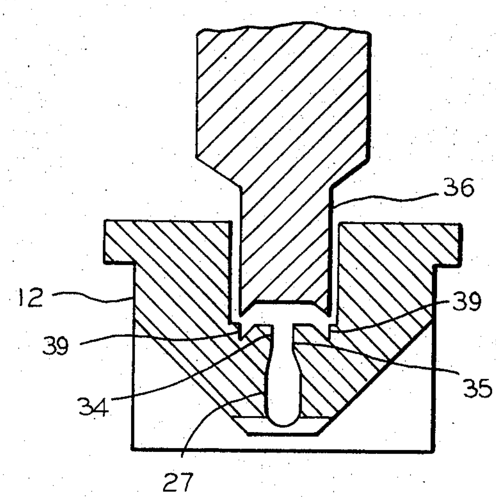


FIG.6

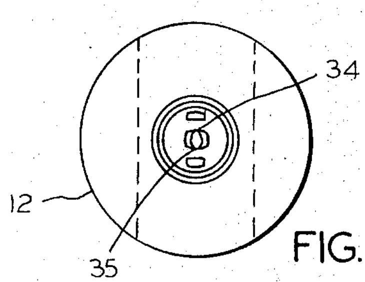


FIG.5

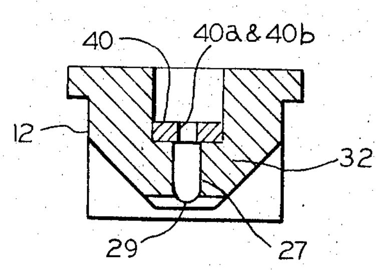


FIG.7

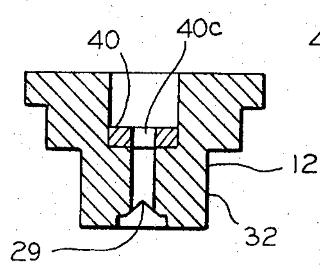


FIG.8

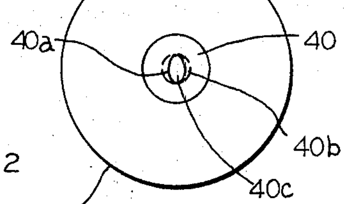


FIG.9

SWEDGED ORIFICE

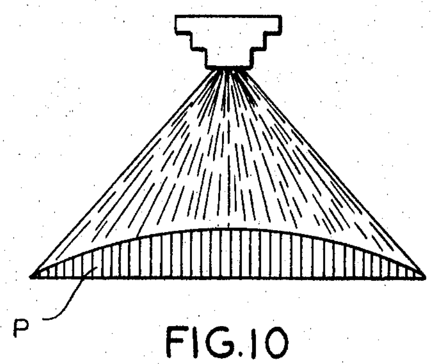


FIG.10

UNSWEDGED ORIFICE

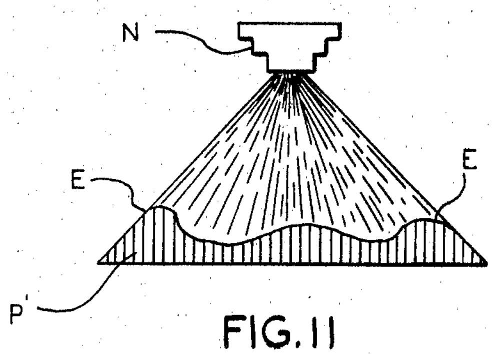


FIG.11

SPRAY NOZZLE FOR LOW PRESSURE SPRAY AND UNIFORM SPRAY PATTERN

The present invention is directed to improvements in spray nozzles and is particularly concerned with improvements in nozzles intended for low pressure spraying.

There are a number of advantages to low pressure spraying operations. For example, nozzle wear is directly related to spraying pressures. Use of relatively low pressure spraying increases the useful life of a nozzle by slowing the eroding effects of fluid on the nozzle passages. In this respect, wear is undesirable because a relatively small amount of nozzle wear can result in an undesirable increase in nozzle capacity. Increase in nozzle capacity is especially harmful when the nozzle is used for spraying chemicals, where an undesirable increase in the quantity of chemicals sprayed results in a waste of chemical and may result in damage to crops, etc. Also, low pressure spraying provides further advantage in that it enables a larger particle size in the sprayed fluid. The larger particle size is highly desirable in certain types of spraying as, for example, agricultural spraying wherein larger particle sizes reduce drifting of sprayed chemicals. Particle size is dependent upon the degree of atomization of fluid and this is directly related to operating pressures utilized with a nozzle. As operating pressures are reduced, the degree of atomization is reduced while fluid particle size in the sprayed fluid is increased. Particle size decreases as spraying pressures are increased.

While the advantages of low pressure spraying have been evident, previous nozzles have not been suitable at low spraying pressures because previous nozzles tended to produce heavy edges (undesirable and relatively large amounts of fluid) at the ends of the spray patterns. Attempts have been made to reduce the tendency to produce the heavy edge patterns as, for example, in Wahlin U.S. Pat. Nos. 2,745,701, and Levey patent 3,000,576. The Wahlin patent utilizes a circular bead at the entrance end of the nozzle passage and, while nozzles formed in this manner produce a substantially uniform distribution of spraying at the edges at relatively high operating pressures, this effect is not as well defined at relatively low operating pressures as, for example, 10–20 p.s.i.g. Generally speaking, the present day operating pressures for agricultural purposes range from 30–60 p.s.i.g., and even higher in some cases. Levey et al. U.S. Pat. No. 3,000,576 uses a special passage configuration having a restricted orifice between the liquid supply and the nozzle passage for purposes of enabling high velocity, but low pressure flow. This arrangement produces a relatively high degree of particle atomization and does not produce the large particle size desired as aforementioned.

With the foregoing in mind, the major purposes of the present invention are to form spray nozzles in such a manner that relatively large particle size is achieved at relatively low operating pressures while the spray pattern formed by the nozzle at the low operating pressures produces a more nearly uniform distribution of the spray pattern without the characteristic heavy edges found in prior nozzles, and at the same time enable these objects with simple and inexpensive structure.

These and other purposes of the invention will become more apparent in the course of the ensuing speci-

fication and claims, when taken with the accompanying drawings, in which:

FIG. 1 is a cross-sectional view of a typical nozzle assembly in which the present invention may be used;

FIG. 2 is an end view of the nozzle illustrated in FIG. 1;

FIG. 3 is a cross-sectional view of a nozzle utilizing the principle of the present invention and taken along section lines 3—3 of FIG. 2;

FIG. 4 is a cross-sectional view of the nozzle of FIG. 3 but taken along section lines 4—4 of FIG. 2 and at right angles to the section illustrated in FIG. 3;

FIG. 5 is an end view of the nozzle of FIGS. 3 and 4 when looking at the entrance end of the nozzle passage and opposite to the direction of the view illustrated in FIG. 2;

FIG. 6 is a sectional view illustrating a method of forming the nozzle of FIGS. 3, 4 and 5;

FIG. 7 is a sectional view of another nozzle embodiment incorporating the principles of the present invention;

FIG. 8 is a cross-sectional view of the nozzle illustrated in FIG. 7, with the section being taken on a plane extending at right angles to the section shown in FIG. 7;

FIG. 9 is an end view of the nozzle of FIGS. 7 and 8 when looking at the entrance end of the nozzle orifice passage;

FIG. 10 is a diagram of a spray pattern produced with the present invention; and

FIG. 11 is a diagram of a spray pattern having the undesirable heavy edges.

Like elements are described by like characters throughout the specification and claims.

Referring specifically now to the drawing, a nozzle assembly like that of Wahlin U.S. Pat. No. 2,745,701 is illustrated. The assembly includes a body **10** having a large cylindrical opening **11** therethrough, a flat sided nozzle tip **12** which is made as a separate part and secured to the outer end of the body **10**, a strainer **13** in the cylindrical opening **11** of the body and having an annular flange **14** at the outer end thereof interposed between the nozzle tip **12** and the outer end of the body **10**, and a coupling **15** by which the nozzle tip **12** is secured to the body **10**.

The body **10** is internally threaded at **16** at its end remote from the tip **12** for connection to a pipe or other means through which liquid is supplied to the nozzle and the other end of the body is externally threaded at **17** for threaded connection therewith of the coupling **15**. Coupling **15** is of a collar nut type with the outer end of the collar turned in as at **15*a*** to engage over an annular flange **18** at the base of the nozzle tip for clamping the latter against the outer end of the strainer **13** and the strainer flange **14** against the outer end of the nozzle body. The coupling **15** and body **10** each have a portion of the length thereof of external hexagonal form as indicated at **19** and **20** respectively, or of other suitable form for engagement with a wrench for coupling and uncoupling the parts.

The illustrated strainer **13** has a hollow cylindrical body **21** surrounded by a cylindrical screen **22**. The strainer body **21** has a series of transverse slots **24** through its wall, preferably at several places therearound, for example at diametrically opposed sides thereof, so that the liquid introduced through the lower end of the nozzle passes through the screen into the interior of the strainer body **21.**

The nozzle tip **12** has a large bored out cavity or counterbore **26** communicating with the interior of the strainer body **21** and leading to a relatively small diameter bore or cylindrical passage **27** with convex or dome shaped outer end **28** through which the spray orifice **29** is formed.

The orifice **29** is preferably recessed in the end of the nozzle at the bottom of a channel or groove **30** which extends in a direction across the nozzle end, and at its bottom, this groove **30** is provided with a small groove **31** usually of V-shape as shown, which cuts through and intersects the dome shaped outer end **28** of the bore or passage **27** to form the orifice opening **29** which is of long narrow shape and of an arcuate contour from end to end corresponding to the rounded end **28** of the bore **27** at the place where the orifice extends thereacross.

Thus the nozzle body opening **11,** the relatively large nozzle tip cavity **26,** and the small diameter bore **27,** conjointly provide a passageway through which liquid is supplied to the orifice **29,** and because of the small diameter of the bore **27,** the liquid flows therethrough to the orifice **29** at a highly accelerated rate.

Generally the bore **27** is made with an abrupt shoulder around the entrance, substantially as shown at **32** in FIGS. **4** and **7,** and is of a considerable length relative to the diameter thereof to insure a long straight path of accelerated flow of liquid before it reaches the orifice **29.**

Nozzles of this type may have a stepped bore configuration leading to the nozzle orifice passage as illustrated by the inner bore **26** and counterbore **26*a*** in FIGS. 3 and 4.

The depth of the counterbore may vary and may in some instances be omitted as is illustrated in the showing of the nozzle in FIG. **1.**

In accordance with the present invention, the entrance end of the nozzle orifice passage is restricted on opposite sides thereof by forming spaced and generally parallel protuberances therein. This is illustrated at **34** and **35** in FIGS. **4, 5** and **6.** This produces a generally oval cross-sectional configuration at the entrance end of the nozzle orifice passage **27,** while the remainder of the nozzle orifice passage leading to the orifice is of uniform circular cross-sectional shape. The length of this restriction should be on the order of approximately one-third of the length of the nozzle orifice passage.

The restriction at the entrance end of the nozzle orifice passage may be conveniently accomplished through use of a staking tool **36** which, as illustrated in FIG. **6,** is inserted into the bore **26** of the nozzle body leading to the orifice passage. Diametrically spaced, staking tips **37** and **38** of the staking tool **36** are then forced into the wall or shoulder of the bore surrounding the nozzle orifice passage **27.** This results in the formation of diametrically spaced and generally parallel V-shaped depressions **39** as viewed in cross-section in FIG. **6.** This staking operation deforms or upsets the metal surrounding the nozzle orifice passage so as to force the metal toward the axis of the passage **27** to thereby form the protuberances **34** and **35.**

The result of this upsetting operation which provides a noncircular entrance end of the nozzle orifice passage is to break up the flow direction through the orifice passage and produce a turbulent condition.

The effect of this operation is to enable a liquid flow pattern as is illustrated in FIG. **10.**

In FIG. **10** the nozzle body is illustrated at **12,** and the spray pattern is designated at P. The pattern is shown as having a tapered form indicating generally uniform distribution throughout the pattern and with generally uniform distribution from end to end of the pattern. This is the pattern desired with low pressure spraying operation as accomplished by use of nozzles embodying the present invention. This is distinguished from spray patterns as illustrated in FIG. **11** wherein a prior nozzle is designated at N, while the spray pattern resulting from use of the nozzles at relatively low spraying pressures is designated at P'. The heavy edges referred to are diagrammatically shown at the ends of the pattern and designated by the letter E. It is this heavy distribution at the ends of the pattern defined by the nozzle that is undesirable in prior nozzles at low spraying pressures.

It is preferred that the staking actions and thus the protuberances produced thereby be aligned along a plane extending perpendicular to the major axis of the elongated orifice **27** in the nozzle.

The result of the protuberances is to produce a spray pattern having a pattern of distribution of the form illustrated in FIG. **10** wherein the pattern is more or less tapered and shaped during low pressure operation as distinguished from the relatively heavy edges to the pattern produced with other nozzles as illustrated in FIg. **11.**

FIG. 7 illustrates a modified form of the invention. In this figure the nozzle body is designated at **12** and is formed with an orifice passage **27** and outlet orifice in a manner similar to that illustrated in FIGS. **1–3.** In FIG. **7,** protuberances at the entrance end of the orifice passage are defined in a separate insert disc **40** which is positioned in the passage of larger diameter adjoining the nozzle orifice passage **27.** The insert abuts the shoulder **32.** This may be conveniently formed by molding or otherwise forming the protuberances **40*a*** and **40*b*** which define the more or less oval-like cross-sectional shape (FIG. **9**) for the passage **40*c*** therethrough to the orifice passage in a disposition similar to that illustrated in FIGS. **1–5.**

We claim:

1. A spray nozzle suitable for use at relatively low spraying pressures and for defining a spray pattern of oval-shaped form and with a tapered distribution of the spray pattern at the edges thereof, comprising a nozzle body having a cylindrical passage therein, said passage having an open entrance end and a discharge end terminating at a wall extending across the passage, an orifice in said wall and extending across the axis of said passage, said orifice being disposed symmetrically relative to the axis of said passage and being oval in form, said passage having a plurality of spaced protuberances formed in the wall thereof adjacent the entrance end of the passage whereby the entrance end of the passage has a generally oval cross-sectional shape, said protuberances extending from the entrance end of said passage toward said discharge end by a short distance.

2. A nozzle as defined in claim **1** wherein said protuberances are formed by upsetting the wall defining the approach area of the nozzle passage.

3. A nozzle as defined in claim **1** wherein said protuberances are aligned with a line perpendicular to the major axis of said orifice.

4. A nozzle as defined in claim 1 wherein the nozzle is defined by a single body of material.

5. A nozzle as defined in claim 1 wherein said body is defined by a multi-piece assembly of material, at least two of said pieces defining said cylindrical passage, one of said pieces being disposed at the entrance end of said passage and having said protuberances therein.

6. A nozzle as defined in claim 1 wherein said body has a counterbore defining a shoulder around the entrance end of said cylindrical passage, said shoulder having grooves therein adjacent the material defining said protuberances.

* * * * *