Dec. 16, 1958 E. J. O'BRIEN ET AL 2,864,652

WIDE SPREAD FAN SHAPED SPRAY DISCHARGE NOZZLE

Filed Sept. 16, 1955

Fig. 1.

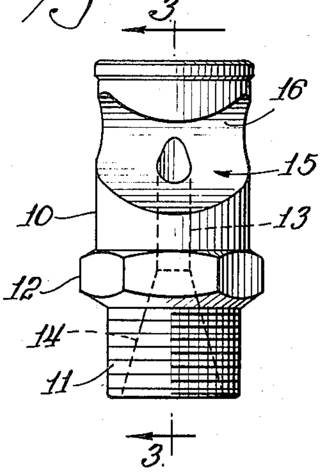


Fig. 2.

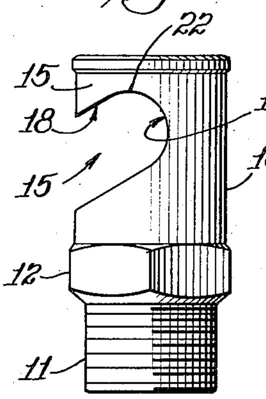


Fig. 3.

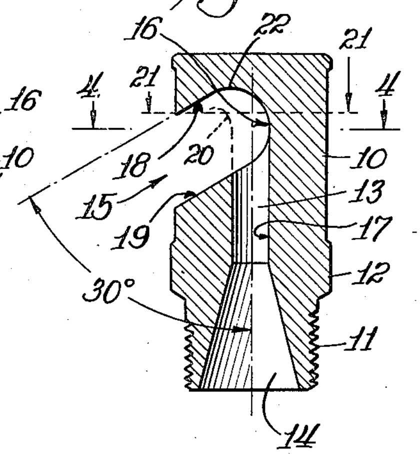


Fig. 8.

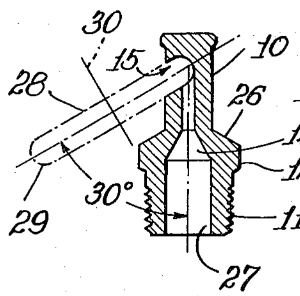
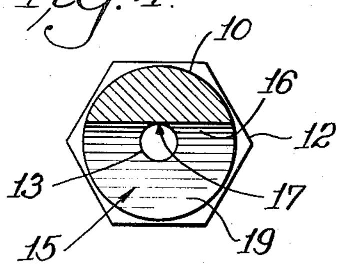


Fig. 4.



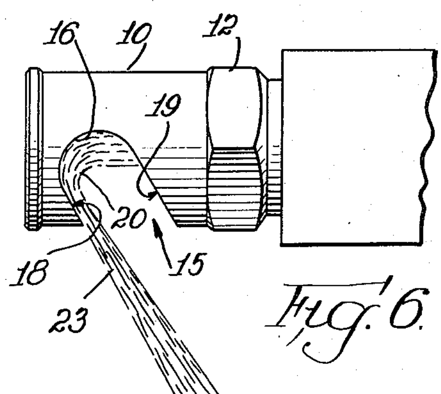
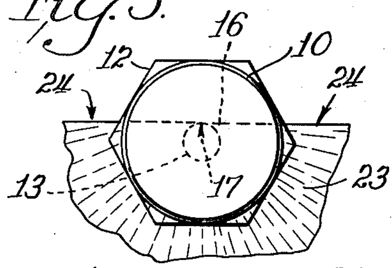


Fig. 6.

Fig. 5.



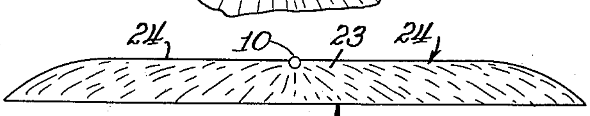


Fig. 7.

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WIDE SPREAD FAN SHAPED SPRAY DISCHARGE NOZZLE

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4 Claims. (Cl. 299—121)

This invention relates to spray nozzles for producing a spray of wide spread flat fan shape, and has reference more particularly to a nozzle and a method of making such nozzle with a deflector which redirects the discharge from the nozzle orifice througout an arcuate fan shaped range of such extent that at the opposite limits thereof the spray is discharged substantially in opposite directions respectively.

Moreover the invention includes an arrangement of deflector surface by which uniform distribution of spray deposit through the range of spray coverage is provided.

In many spraying operations, as for example, in field spraying and the like, it is desirable to project the spray throughout as wide a range as possible and it is also important that the spray deposit be uniform throughout that range.

Such uniformity of spray deposit does not depend on uniformity of volume of discharge throughout the fan shaped extent of the discharging spray, as the portions of the spray which are projected sidewise to the far flung places of deposit necessarily cover a greater length of the range of spray deposit and accordingly require proportionately greater volume of spray than the portions of the spray which are discharged downwardly or more nearly downwardly from the place of spray discharge, and therefore the volume of spray discharge throughout the fan shaped extent of the discharging spray must be varied according to its sidewise remoteness of deposit from the place where the spray discharge occurs.

Generally it is preferred in such spraying operations to project the spray in opposite directions from the nozzle location and it has been customary for this purpose to utilize two nozzles which are paired together and one of which discharges at one side of the nozzle location and the other of which discharges at the other side of the nozzle location so that the total extent of spray range is the combined fanwise extent of spray discharge of the two nozzles, the orifices of which are shaped and arranged so as to produce corresponding fan shaped sprays which are positioned to meet or overlap at their inner limits of individual spray range and have the spray volume suitably proportioned throughout the fanwise range of each so that the spray deposit is substantially uniform throughout the range from the outer limit of projection of the spray from one nozzle to the outer limit of projection of spray from the other nozzle.

Aside from the fact that two nozzles are required for such paired nozzle spraying, each of the two nozzles is necessarily of smaller capacity and has smaller passages and orifices and is accordingly more susceptible to clogging than a single nozzle employed for the same purpose.

Also it is necessary to carefully adjust the two nozzles relatively to one another to insure the required meeting or overlapping of the spray therefrom for continuity and uniformity of spray deposit at that place.

Moreover the orifices of such paired nozzles are elongated and narrow and must be carefully located and

accurately shaped to produce a spray of the required fan shape, and because of their narrow width are more easily clogged.

Furthermore the orifices thereof are directly exposed and are usually defined by a sharp edge, because of the manner in which the elongated shape is generally produced, and by reason of their direct exposure and the sharp defining edge thereof such orifices are readily damagable by impact and their sharp defining edge eventually becomes worn out of size and shape by the large volume of high pressure liquid passing therethrough.

The principal objects of the invention are to provide an improved nozzle for producing a fan shaped spray and a simple and convenient method of making the nozzle; to simplify the nozzle facilities, and the manufacturing thereof, for producing a fan shaped spray of wide fanwise range; to produce with a single nozzle a fan shaped spray of an extent of fanwise range and uniformity of spray distribution for which several nozzles have been required heretofore; to permit the volume of spray discharge throughout the fanwise extent thereof to be readily varied to insure uniformity of spray deposits; to construct the nozzle so that it is substantially immune to damage and wear; and in general to provide a simple and reliable deflector spray nozzle which produces a fan shaped spray of wide fanwise range with fanwise continuity of spray discharge throughout the range thereof and having appropriate fanwise variation of volume for uniformity of spray deposit, these and other objects being accomplished as pointed out more particularly hereinafter and as shown in the accompanying drawing, in which:

Fig. 1 is a side view of a nozzle made in accordance with the invention hereof, looking at the open side thereof from which the spray is discharged;

Fig. 2 is a view looking at the right side of the nozzle of Fig. 1;

Fig. 3 is a central longitudinal sectional view of the nozzle taken on the line 3—3 of Fig. 1;

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

Fig. 5 is a view of the nozzle of Fig. 1 looking at the outer end thereof and showing the spray issuing therefrom;

Fig. 6 is a view of the nozzle as shown in Fig. 2 arranged in spraying position for spraying on the ground as in field spraying or the like and showing the spray discharging therefrom;

Fig. 7 is a diminutive view of the Fig. 5 nozzle showing the fanwise shape of spray in the ground spraying of Fig. 6, and

Fig. 8 is a view, similar to Fig. 3, of a small capacity nozzle as made in accordance with the present invention.

In the drawing, which illustrates a preferred embodiment of the invention, and referring particularly to Figs. 1 to 7 inclusive thereof, the nozzle comprises an elongated body the outer end portion **10** of which is of cylindrical shape and the inner end portion **11** of which is externally threaded as shown or otherwise formed for convenient attachment to a pipe or other facilities through which liquid is supplied to the nozzle, and the body is provided between the portions **10** and **11** with a hexagonal enlargement **12** for wrench engagement.

The nozzle body has a cylindrical passage **13** therein, preferably concentric with the cylindrical portion **10**, and this passage extends from the inner or rear threaded end **11** of the nozzle toward the outer or forward end thereof and is preferably flared at its entrance end, as indicated at **14**, and the cylindrical portion **10** of the nozzle is deeply notched at one side, hereafter referred to as the discharge side, to form a relatively wide groove **15** which extends across the nozzle portion 10 from side to side thereof and has the passage 13 terminating at its forward end at and opening into the bottom of the groove 15 at one side thereof so as to discharge into the bottom of the groove in a direction crosswise thereof.

The groove 15 extends straight across the nozzle body portion 10, and the passage 13 and the direction of flow of liquid therethrough is perpendicular to the direction of the length of the groove 15, and the place of entry of the passage 13 into the groove 15 is midway of the length of the latter so that there is an equal extent of groove length at each side of the passage 13.

Moreover, as the body portion 10, across which the groove extends, is cylindrical, the outer margins of the groove side walls coincide with the cylindrical surface curvature of the portion 10 and extend a little more than half way around the periphery of the cylindrical portion 10, because of the depth of the groove 15, and the latter is of greatest depth midway between the ends thereof, which is also midway of the discharge side of the nozzle, and the groove 15 progressively decreases in depth at the opposite sides of its midlength in conformity to the peripheral curvature of the nozzle portion 10.

The groove bottom, which is indicated at 16, is rounded in cross section and of the same and aligned rounded cross section throughout its length and the groove 15 is preferably of such depth that a plane tangent to the cylindrical passage 13 at the side extremity 17 of the latter farthest distant from the discharge side of the nozzle is also tangential to the rounded bottom 16 of the groove throughout its length as shown particularly in Fig. 3, although exactitude in this respect is not essential.

The notch or groove 15 is formed so that at the side thereof remote from the rear end of the nozzle, it has a flat wall portion 18 which extends outwardly to the discharge side of the nozzle at an inclination toward the rear end of the nozzle and as the groove 15 of the illustrated nozzle has parallel opposite side walls the groove is arranged in a sidewise tilted manner so that the groove itself and the side 19 thereof nearest to the rear end of the nozzle, as well as the said side 18 thereof remote from the rear end of the nozzle have the same inclination. Also in the illustrated nozzle the bottom 16 of the groove is semi-cylindrical.

Thus as the stream of liquid emerges from the passage 13 it is confined at the side thereof corresponding to the previously referred to side 17 of the passage 13, by the curved or cylindrical bottom 16 which curves from the place of emergence of the stream, forwardly toward the outer end of the nozzle and across the path of the issuing stream to the inner extremity of the flat rearwardly inclined side 18 of the groove 15 so that the stream of liquid issuing from the passage 13 is deflected sidewise substantially as indicated at 20, and flattened against the above mentioned curved and flat deflecting surfaces into a fan shape.

The deflector surfaces 16 and 18 are smooth and continuous so that the liquid flows freely thereover and as the portion of the curved bottom 16 immediately preceding the flat portion 18 forms a return bend and the flat surface 18 provides a continuation thereof, both reverse to the direction of flow of the liquid from the passage 13, a rearwardly facing trough is provided beyond the dotted line 21—21 (see Fig. 3) which extends throughout the length of the groove 15 and is of greatest depth at approximately the place of intermediate width indicated by the reference numeral 22 in Fig. 3, and of less width and more precipitous depth at one side of said place of greatest depth than it is at the other side thereof, and by reason of this rearwardly facing trough shape the liquid is spread so widely against the deflector surface that a spray 23 of fanwise spread of approximately 180 degrees is produced, as indicated in Figs. 5 and 7, the liquid which constitutes the outerwise fanwise limits of the spray being projected at great distances from the opposite ends of the groove as indicated at 24 in Fig. 7.

The volume of spray between the fanwise extremities 24 thereof varies according to the extent of rearward inclination of the flat surface portion 18 of the deflector surface, an increase of the inclination thereof decreasing the volume centrally of the fanwise expanse and progressively increasing the volume from said central place to the outerwise fanwise extremities 24, and accordingly the volume throughout the fanwise range of the spray may be proportioned to provide uniformity of spray deposit according to the purpose for which the nozzle is to be used, by increasing or decreasing the angularity of the flat face 18 of the groove 15 to the longitudinal axis of the passage 13.

This nozzle is particularly advantageous for use in field spraying and the like wherein the nozzle is carried by a vehicle at a relatively low elevation above the ground with the discharge side of the nozzle facing downwardly as shown in Fig. 6, and when so arranged produces a spray substantially as shown in Fig. 7 depositing on the ground which is represented by the line 25 in Fig. 7.

In such case the volume of the fanwise expanse of discharging liquid at the center of the spray where it discharges directly downward onto the ground 25 is distributed along a much shorter portion of the fanwise range of deposit of the spray on the ground 25 than a corresponding fanwise expanse of discharging liquid at the opposite extremities thereof where it is far flung sidewise from the nozzle, and accordingly it is important that the volume of spray discharge for the opposite fanwise extremes of the fanwise spray be greater than the volume thereof midway between the extremes and progressively decrease from the same outer extremes to the midway plane between these extremes, and we have found that a nozzle as described above wherein the flat deflector portion 18 thereof is inclined rearwardly at an included acute angle of 30 degrees to the longitudinal axis of the passage 13, as indicated in Fig. 3, provides a suitable proportioning of volume throughout the fanwise expanse of the spray to provide uniformity of spray deposit for field spraying, such as illustrated in Fig. 7 and for similar purposes.

The groove 15 is not necessarily parallel sided as shown in the illustrated embodiment, as the side 19 thereof nearest to the rear end of the nozzle performs no function in deflecting the spray stream or determining the slope of the spray discharge, and neither is it essential that the bottom of the groove be cylindrical as other cross sectional curvature thereof may be employed. We have found, however, that it is desirable that the groove at the bottom where the liquid stream enters be of substantially greater width than the diameter of the passage 13, the width of the groove at that place being preferably about twice the diameter of the passage 13.

For example, in practice, with a nozzle having a passage 13 of 0.348 inch diameter (No. 5 drill) I have provided a groove 15 having a semi-cylindrical bottom 16 of a 3/8 inch radius, and with a passage 13 of 0.281 diameter (9/32 inch drill) a groove 15 having a semi-cylindrical bottom 16 of 5/16 inch radius is employed, and with a passage 13 of 0.199 inch diameter (No. 8 drill) a groove 15 having a semi-cylindrical bottom 16 of 7/32 inch radius is employed, and with a passage 13 of 0.140 diameter (9/64 inch drill) a groove 15 having a semi-cylindrical bottom 16 of 5/32 inch radius is employed, and with a passage 13 of 0.0995 diameter (No. 39 drill) a groove 15 having a semi-cylindrical bottom of 7/64 inch radius is employed.

Necessarily a sufficient expanse of deflector surface must be provided to impart the desired spread and proportioning of volume throughout the fanwise expanse of the spray, and we have found that a diameter of body portion 10 at least three times as great as the diameter of the passage 13 is desirable.

For example, with the above mentioned diameters of passage, namely 0.348 inch, 0.281 inch, 0.199 inch, 0.140 inch and 0.0995 inch, body portion **10** diameters of 1⅝16 inch, 1⅜16 inch, ¾ inch, ½ inch and ⅜ inch respectively are employed.

Small sizes of nozzles having the portions **10** thereof of small diameter, may be made with the threaded end **11** enlarged as shown in Fig. 8 to connect with a large size supply pipe, and have a similar enlarged portion **12** for wrench engagement and are reduced therebeyond as at **26** to the required small diameter size of the portion **10**. In such case, the portion **11** is preferably bored out as at **27** to a large diameter and the flared entrance **14** of the passage **13** located at the inner end of this large diameter bore **27**.

Nozzles as above described are readily made as the passage **13** is merely bored by a drill of the proper diameter and the entrance end **14** flared with an appropriately tapered rotary cutter.

To produce the grove **15**, a disk shaped rotary milling cutter **28** (see Fig. 8) is preferably employed with half round peripheral cutting edge **29** of the radius of the bottom of the groove **15** with which the nozzle is to be provided, and this rotary cutter is set at the desired angularity of the face **18** to the longitudinal axis of the nozzle body or passage **13** thereof, for example at a 30 degree angle thereto as recommended herein and as shown in Fig. 8, and while this angularity to the nozzle body is maintained, and the cutter is rotated about the axis of rotation thereof, indicated at **30** in Fig. 8, the rotary cutter is passed straight through the cylindrical portion **10** of the nozzle body from side to side thereof at such depth of cut that the bottom of the groove **15** formed thereby will be located in the proper above described relation with respect to the discharge end of the passage **13**.

This groove **15** may be made by several passes of the cutter **28** at succeedingly greater depth until the required depth of groove **15** is obtained, and moreover the groove **15** may be formed either before or after the boring of the passageway **13**.

It will be noted that in the above described nozzle, the nozzle orifice is readily made as it is merely the end of a round drilled passage, and moreover it is protected from damage by impact because it is recessed in the side of the nozzle body and protected against direct impact by the overhanging outer end of the nozzle body.

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

What is claimed is:

1. A side discharge liquid spray nozzle comprising a body with a rear end and a front end and having an external plain groove extending across the body from side to side thereof, the body having a liquid supply passage therein which leads forwardly from the rear end of the body toward the front end thereof to one side of the bottom of the groove and discharges across the bottom of the groove to the opposite side thereof, the groove having the bottom thereof extending transversely of the passage at right angles thereto and of uniform rounded cross section from end to end of the groove and the groove being tilted sidewise with the bottom thereof projecting foremost toward the front end of the body providing at said opposite side of the groove an undercut cavity of plain trough shape extending lengthwise of the groove and facing toward the rear end of the body to receive therein the discharge from the passage, the opposite sides of the trough shaped cavity being plain and uniformly sloped away from one another toward the rear of the body throughout their length in a relation to one another causing liquid discharged from the passage into the trough shaped cavity to emerge from the opposite ends of the trough shaped cavity.

2. A nozzle in accordance with claim 1 wherein the bottom of the groove is at least approximately semi-cylindrical and the opposite sides of the groove are tangential thereto.

3. A nozzle in accordance with claim 1 wherein the bottom of the groove is semi-cylindrical and the opposite sides of the grooves are tangential thereto and parallel.

4. A nozzle in accordance with claim 1 wherein the groove is of decreasing depth from its midlength to its opposite ends and the passage leads to and discharges into the groove at the place of greatest depth of the groove.

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