

Sept. 9, 1952

W. B. THOMPSON
SPRAY DISCHARGE NOZZLE

2,610,092

Filed Oct. 26, 1950

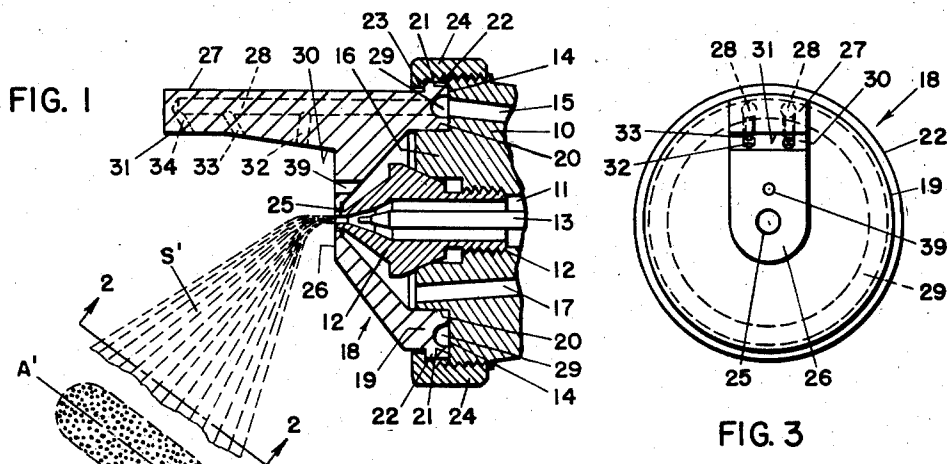


FIG. 2

FIG. 4

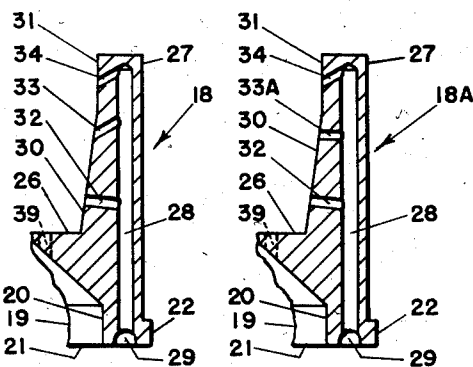
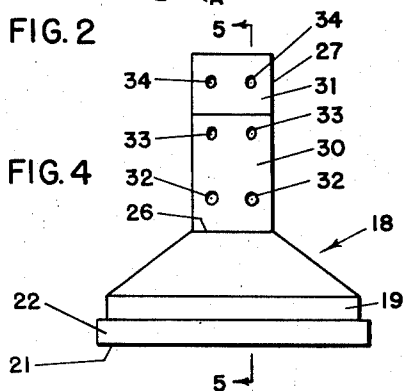


FIG. 5

FIG. 6

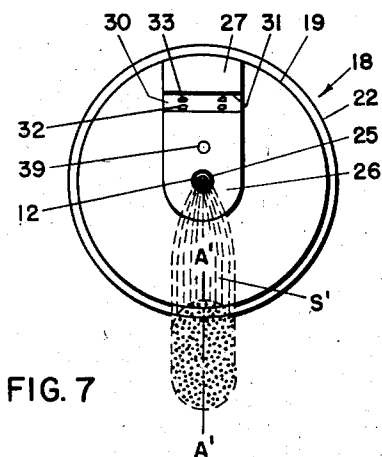
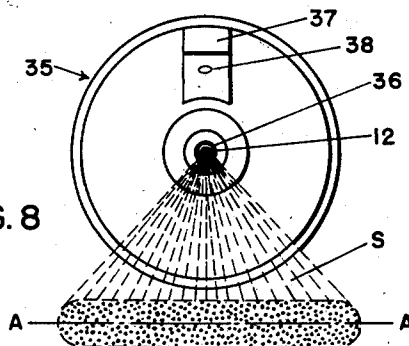


FIG. 8



INVENTOR

WAYNE B. THOMPSON

BY *Robert G. Enterbridge*
HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,610,092

SPRAY DISCHARGE NOZZLE

Wayne B. Thompson, Winchester, Mass., assignor
to Spray Engineering Company, Somerville,
Mass., a corporation of Massachusetts

Application October 26, 1950, Serial No. 192,236

7 Claims. (Cl. 299—140.1)

1

The present invention relates broadly to spraying apparatus for applying liquid coating material to the interior wall surfaces of hollow articles. More particularly, the present invention relates to spray discharge nozzles which are used with such apparatus and which are characterized by the fact that air is directed supplementally to flatten the main discharge of coating material to produce an elongated spray pattern.

It has been proposed heretofore to spray-coat the interior wall surfaces of hollow articles such as cylinders, tubes, pipes, cans, and the like by apparatus which transforms to a flattened or fan shape, with elongated spray pattern, a main discharge of coating material which is initially circular in cross section, the means of accomplishment involving the discharge of air supplementally in the direction of only one side of the main discharge. The action of this supplemental air causes the main discharge to have a fan shape with an elongated spray pattern and it also causes deflection of the spray discharge as a whole so that it is tilted to the axis of the main discharge orifice. But this action also has the further effect of causing the major axis of the spray pattern to be at 90° to the axis of discharge of the supplemental jet, i. e., at 90° to the plane which intersects the supplemental jet orifice axis and the main discharge orifice axis. Stating this differently, the major axis of the spray pattern remains transverse to the axis of the main discharge orifice, as in the case of conventional supplemental jet spray heads or spray guns having two opposed supplemental jets which strike the main discharge at opposite sides to flatten it, but the location of the major axis of the pattern of the deflected spray is such that said major axis and the axis of the main discharge are not coplanar, in contrast to such conventional supplemental jet constructions.

In coating apparatus such as referred to in the preceding paragraph, there is relative longitudinal movement between the article to be interiorly coated and the head of the spraying apparatus, so that the coating is applied interiorly along the length of the article, and there is also relative rotative movement between the article and the spray head so that coating is applied interiorly of the article circumferentially. But since the axis of relative longitudinal movement is coaxial with the main discharge orifice of the spray head, it necessarily follows that the major axis of the elongated spray pattern is transverse also to the longitudinal axis of the article to be coated. As a consequence, there is a very prac-

2

tical disadvantage in using such apparatus for coating the interior wall surfaces of hollow articles. Coating material is applied to the article interior in a narrow stripe because the relative rotative movement is along the major axis of the flattened spray pattern, as it were, in analogy to using a manual paint brush with the applying end moving along its major axis and so producing a narrow stripe regardless of the width of the brush. From this it follows that there is a relatively large time duration for coating the article interior from one end to the other or along a given part of its length, and as a result there is a minimum machine output per minute, i. e., per time unit.

If, however, the major axis of the pattern of the deflected spray is not transverse to the axis of the main discharge orifice and consequently to the longitudinal axis of the article to be coated, but instead is coplanar with the axis of the main discharge orifice, it necessarily follows that said major axis is also coplanar with the longitudinal axis of the article to be coated. As a consequence, the flattened spray discharge is applied to the article interior in a wide band because the relative rotative movement is along the minor axis of the flattened spray pattern, as it were, in analogy to using a manual paint brush with the applying end moving at 90° to its major axis and so making a band as wide as the brush. From this it follows that there is a relatively small time duration for coating the article interior from one end to the other or along a given part of its length, and as a result there is a maximum machine output per minute, i. e., per time unit.

It is therefore the principal object of the present invention to provide for use with article interior coating apparatus a spray discharge nozzle characterized by the fact that although air is discharged supplementally in the direction of only one side of the main discharge of coating material, with consequent flattening and deflection of the spray as a whole, the major axis of the flattened spray pattern thus produced is coplanar with the axis of the main discharge orifice and hence coplanar with the longitudinal axis of the interior of the article to be coated.

To the accomplishment of this object and of such others as will appear hereinafter, the various features of the present invention reside in certain constructions, combinations, and formations of parts which are all fully described hereafter in this specification and are then set forth in the appended claims the subject matters of

which possess advantages which will be readily apparent to those skilled in the art.

The various features of the present invention will be readily understood from reading this specification in connection with the accompanying drawing which illustrates the best physical embodiments of the invention at present known to the inventor and in which:

Fig. 1 is a detail view in side sectional elevation showing a nozzle constructed in accordance with the present invention mounted on the forward end of a spray head body with which the nozzle may be used, the bulk of this body being cut away and the embodiment being shown in operation producing the deflected and fan-shaped spray which it is the principal object of the present invention to achieve. Fig. 1 may be considered as taken along the axis line A'-A' of Fig. 7, looking toward the left of that figure;

Fig. 2 is a view in cross section of the fan-shaped spray discharge, taken along the line 2-2 of Fig. 1, which line 2-2 is perpendicular to the axis of the Fig. 1 spray discharge as a whole;

Fig. 3 is a view in front elevation of the nozzle illustrated in Fig. 1;

Fig. 4 is a view in side elevation of the nozzle illustrated in Figs. 1 and 3;

Fig. 5 is a detail view in sectional elevation taken along the line 5-5 of Fig. 4;

Fig. 6 is a detail view corresponding to Fig. 5 but showing a modified embodiment of the present invention;

Fig. 7 is a detail view in front elevation of the Fig. 1 nozzle showing the location of the major axis of the elongated spray pattern produced by an embodiment of the present invention and also showing the coplanarity of that major axis with the axis of the main discharge orifice, the spray being shown cut off by the plane which produces Fig. 2; and

Fig. 8 is a detail view in front elevation of a supplemental jet spray nozzle having only one conventional jet, this view showing the deflection of the spray as a whole and the location of the major axis of the elongated spray pattern when supplemental air is discharged conventionally in the direction of only one side of the main discharge and also showing the lack of coplanarity of that major axis with the axis of the main discharge orifice. In Fig. 8 the spray is shown cut off by a plane which is perpendicular to the axis of the spray as a whole.

With reference to the drawings, there is shown in Fig. 1 an embodiment of the present invention mounted upon the forward end of a spray head or spray gun body. Those familiar with the spraying art will recognize in Fig. 1 the front end of a gun body 10 having a central passage 11 for liquid coating material and in which there is threaded the rear portion of a liquid nozzle 12. A needle 13 located in the passage 11 seats at its forward end in the nozzle 12 to shut off the flow of liquid, but in Fig. 1 the needle 13 is shown in retracted position to permit liquid flow through the nozzle 12. The body 10 is provided with an annular forward face 14 which communicates with a compressed air passage 15 extending rearwardly in the body 10, and forwardly of the annular face 14 the body 10 has a cylindrical portion 16 of reduced diameter the front face of which communicates with a compressed air passage 17 which also extends rearwardly in the body 10. Further body structure is not disclosed because gun body structure per se forms no part of the present in-

vention. The above-named parts are well understood in the art and are sufficient to give a locus of mounting of embodiments of the present invention. It may be added, however, that the body 10 showing in Fig. 1 is to be considered as only the forward end portion of an elongated structure capable of being moved into and out of hollow articles so that their interiors may be coated.

With particular reference to Figs. 1 and 3-5, the spray discharge nozzle 18 there shown and which illustrates one embodiment of the invention claimed herein is provided with a cylindrical base 19 having an inner cylindrical surface 20 which fits over the body forward portion 16 of reduced diameter so as to be rotatable thereon. Rearwardly the cylindrical base 19 is provided with an annular face 21 which seats against the annular face 14 on the body 10, and to hold the cylindrical base 19, and therefore the nozzle 18 as a whole, seated in any desired rotative position, the base 19 is provided with an annular boss 22 which is engaged by the inturned lip 23 (Fig. 1) of a locking ring 24 threaded on the body 10, as is well understood. Forwardly of the cylindrical base 19 the nozzle 18 is shown as having a frusto-conical construction, both internally and externally, and at the center of the smaller base or front of this construction there is formed a circular orifice 25 in which the forward end of the liquid nozzle 12 is located, as shown in Fig. 1. Compressed air from the body passage 17 passes into the space between the body 10 and the interior frusto-conical surface of the nozzle 18, and the orifice 25 thus forms the main discharge orifice for the emission of liquid coating material and compressed air for atomizing it. As is well understood, the spray discharge of atomized coating material which such a construction produces is cone-shaped as a whole and is circular in cross section in the absence of influences which would alter the cross sectional shape. As is also well understood, in the absence of such influences the spray as a whole is coaxial with the main discharge orifice, i. e., the spray is discharged along the axis of the main discharge orifice. The front face 26 of the nozzle 18 is planar at 90° to this axis.

As indicated above, it is intended that in the use of an embodiment of the present invention this spray discharge which is initially circular in cross section be flattened to form an elongated spray pattern and also be deflected so that the axis of the spray as a whole is tilted away from the axis of the discharge orifice 25. But it is also intended that concurrently the major axis of the elongated spray pattern thus produced be coplanar with the axis of the main discharge orifice, and not transverse to that orifice axis. To achieve this result, the present invention contemplates that the nozzle 18 be provided with a horn or projection 27 which extends forwardly from one side only of the exterior frusto-conical surface of the nozzle and which has a closed forward end. The projection 27 is provided interiorly lengthwise with a pair of parallel passages 28 for compressed air, and communication between these passages 28 and the air passage 15 in the body 10 is afforded by an annular air passage 29 formed in the cylindrical base 19 of the nozzle 18. The side of the projection 27 which is shown facing the main discharge orifice 25 is illustrated as made up of a planar face portion 30 which slopes away from the nozzle front face 26 at a slight angle and of a face portion 31 which merges with the face portion 30 and is in a plane

5

parallel with the axis of the discharge orifice 25 and at 90° to the planar front face 26 of the nozzle 18. The precise structure of the face portions 30 and 31 illustrated and described is not essential to embodiments of the present invention, but is suggested because of mechanical facility in manufacture of the nozzle as a whole.

Adjacent the nozzle front face 26 the projection face portion 30 is provided transversely with a pair of spaced ports 32 which extend into the projection 27 in communication with the air passages 28, respectively. These ports 32 lie in a plane, which may be called their axes plane, and this plane is perpendicular to the face portion 30, with the result that the axes of the ports 32 are tipped forwardly at a slight angle away from the nozzle front face 26 and hence at an angle slightly greater than 90° to the axis of the discharge orifice 25, as indicated best in Fig. 1. The axes plane of the ports 32 intersects the axis of the discharge orifice 25 and is tipped away from that orifice, and while the ports 32 are shown with their axes parallel, these axes may diverge or converge, if desired.

Spaced outwardly from the ports 32, the projection face portion 30 is shown as provided transversely with a second or intermediate pair of ports 33 which also extend into the projection 27 in communication with the air passages 28, respectively. These ports 33 also lie in a plane, which may be called their axes plane, but this plane is preferably tipped rearwardly, i. e., in the direction of the front face 26 of the nozzle 18 and angularly to the plane of the ports 32, with the result that the axes of the ports 33 are also thus tipped rearwardly. The axes plane of the ports 33 intersects the axis of the discharge orifice 25 and is tipped toward that orifice, and while the ports 33 are shown with their axes parallel, these axes may diverge or converge, if desired.

The paired port structure in the illustrated projection 27 is completed by a transverse third or outermost pair of ports 34 which are formed in the projection face portion 31 and which also extend into the projection 27 in communication with the air passages 28, respectively. These ports 34 also lie in a plane, which may be called their axes plane, and these ports 34 are shown with said plane tipped rearwardly, i. e., in the direction of the nozzle front face 26, at the same angle as is the axes plane of the intermediate ports 33, with the result that the axes of the ports 34 are also thus tipped rearwardly. The axes plane of the ports 34 intersects the axis of the discharge orifice 25 and is tipped toward that orifice, and while the ports 34 are shown with their axes parallel, these axes may diverge or converge, if desired.

With further reference to the port structure above described and with particular reference to Fig. 4, the individual ports 32, 33, and 34 extending in a row at each side of the longitudinal median line of the projection 27 are shown with their axes lying in a plane at 90° to the front face 26 of the nozzle 18. These two planes, which may be called the axes planes of the two rows, are parallel and equally spaced laterally from the opposite sides of the axis of the discharge orifice 25 and thus straddle that axis. In a given construction, however, these two axes planes could diverge or converge, if desired. Moreover, the axes of each pair of the ports 32, 33, and 34 illustrated are spaced apart transversely of the projection 27 a distance greater than the diameter

6

of the discharge orifice 25, and it is preferred that each pair of these ports themselves be so spaced apart a distance greater than the diameter of the discharge orifice 25. If the axes of each pair of ports 32, 33, and 34 diverge, these axes and port spacings would also be the case, while if the axes of each pair of ports 32, 33, and 34 converge, the amount of convergence should not be great enough to cause the axes to intersect the axis of the discharge orifice 25 or even to be tangential to the orifice itself. Stating the foregoing differently, whether the axes of each pair of ports 32, 33, and 34 are parallel, or diverge, or converge, the space between these axes along a line diametric of the main discharge orifice 25 is greater than the diameter of said orifice.

While the angularities of the axes of the ports 32, 33, and 34 to the nozzle front face 26 and to the axis of the discharge orifice 25 may vary to suit different conditions of use, and while it is within the contemplation of the present invention that there be less or more than three pairs of ports along the projection 27, it is preferred that in the embodiment shown in Figs. 1-5 and 7 the planes through the axes of the ports 33 and 34 be each tipped rearwardly at 30° to a line perpendicular to the axis of the main discharge orifice 25 and that the axes plane of the ports 32 be thus tipped forwardly at 7°, this last being easily achieved by giving the projection face portion 30 a 7° slope and drilling the ports 32 perpendicularly thereto, as above indicated. The pairs of ports 33 and 34 may each have a diameter of .035" and the ports 32 may have the slightly greater diameter of .040". The space between the axes of each pair of ports may preferably be .156" where the axes of these ports are parallel, and for use with these dimensions the diameter of the discharge orifice 25 may be .070". It is to be understood that none of the dimensions and angularities stated in this paragraph is critical, but they are set forth as practical examples because nozzles exhibiting them have achieved the object of the present invention in commercial use.

In Fig. 8 there is illustrated a spray discharge nozzle 35 which may be considered as mountable on the body 10 for disclosure purposes so that from the central orifice 36 there may be discharged the usual conical spray of atomized liquid coating material coaxial with the discharge orifice 36. In order to flatten this discharge to transform it to a fan shape, as indicated at S, the nozzle is provided at one side only with a projection 37 in which a conventional supplemental air port 38 is formed with its axis coplanar with the axis of the discharge orifice 36, as is well understood. Since there is only one port 38, the spray is deflected downwardly, viewing Fig. 8, with the result that the axis of the spray as a whole is tilted downwardly and forwardly from the axis of the discharge orifice 36, and the major axis A-A of the elongated spray pattern produced is transversely at 90° to the axis of the discharge orifice 36. Fig. 8 illustrates the condition described in the second paragraph of this specification, and from this it follows that with the Fig. 8 nozzle in use on the body 10 for coating the interior of hollow articles, there will result the undesirable operation which is set forth in the third paragraph of this specification. Stating the foregoing differently, Fig. 8 illustrates the very condition which it is the principal object of the present invention to avoid.

Referring now to Figs. 1-5 and 7, it will be seen that while air is discharged supplementally from the pairs of ports 32, 33, and 34 in the direction of the main discharge, indicated at S', that supplemental air is not discharged in a plane coaxial with the discharge orifice 25 but instead in spaced planes located at opposite sides of, or straddling, the axis of that orifice. The result of this operation is to provide a wall of air along each of opposite sides of the main discharge S' so that it is flattened laterally to a fan shape by a wiping action, as it were, and the elongated spray pattern thus produced, as indicated in Figs. 2 and 7, has its major axis A'-A' in a vertical plane with which the axis of the discharge orifice 25 is coplanar. Simultaneously with this flattening of the main discharge, it is deflected downwardly and forwardly as a whole, as indicated in Figs. 1 and 7, because the ports 32, 33, and 34 are located at one side only of the main discharge orifice 25, and as a result the flattened discharge S' is applied to the interior of hollow articles in the desirable manner set forth in the fourth paragraph of this specification.

Air discharged supplementally from the pairs of ports 32, 33, and 34 thus serves the double purpose of flattening the main discharge along its sides so that the major axis A'-A' of the spray pattern produced is coplanar with the axis of the discharge orifice 25 and of deflecting the spray as a whole so that the spray is not coaxial with the discharge orifice 25 but is projected in the general direction of the surface to be coated instead of being projected along an axis parallel thereto. Air supplementally discharged from the ports 32 initiates the deflection of the spray discharge along with its flattening, and this deflection is further carried out by the air discharged supplementally from the ports 33 and 34. If these ports have the angularities above described for them and illustrated in Figs. 1 and 5, for examples, the flattened spray S' as a whole will have substantially the angle of deflection shown in Fig. 1, but if it be desired that this angularity from the axis of the discharge orifice 25 be less than shown, a spray nozzle 13A (Fig. 6) may be provided which is in all respects identical with the nozzle 13 and to this extent has been given the same reference numerals, except that the intermediate pair of ports 33A, otherwise identical with the ports 33, have their axes parallel with the planar front face 26 of the nozzle instead of 30° there-toward, as described above. It will be noted, however, that even with this modification the axes plane of the ports 33A, i. e., the plane through these two ports, is disposed angularly to the axes plane of the innermost ports 32.

Depending upon the nature of the liquid coating material with which a given embodiment of the present invention may be used, and also depending upon eddy currents which may be set up in a given environment where the nozzle may be in operation, there may occur a building up of the material on the front face 26 of the nozzle. If the nature of the material is such that particles thereof have no tendency to fly off the front face 26, or if such flying off does not have an adverse effect upon the success of the spraying operation, nozzles made as above described produce commercially successful results. If, however, the material builds up at such a rate as to necessitate frequent cleaning and hence lowered machine output, or if particles which may fly off the front face 26 render inferior the coating op-

eration performed, it is desirable that the deflected spray S' as a whole have a locus which is spaced outwardly from the nozzle front face 26 a greater distance than would otherwise be the case. To this end the front of the nozzle 13 may be provided with a supplemental air port 39 the axis of which is shown as parallel with that of the discharge orifice 25, as indicated in Figs. 1, 3, and 7. This port 39 extends rearwardly in the nozzle 13 to its inner frusto-conical surface so as to be in communication with the air from the body passage 17, and the port 39 is located between the projection 27 and the discharge orifice 25. The axis of the port 39 is also parallel to and equally spaced from the planes in which lie the axes of the individual ports 32, 33, and 34 at each side of the longitudinal median line of the projection 27, as indicated in Fig. 7, with the result that air supplementally discharged from the port 39 is directed between the air walls formed by the discharges from the ports 32, 33, and 34 in addition to being directed axially parallel with the axis of the main discharge orifice 25. It is to be understood, however, that in a given construction the port 39 may be angularly disposed so that its axis is tipped out of parallelism with the axis of the discharge orifice 25. In keeping with the exemplary diameters stated above for the discharge orifice 25 and the pairs of ports 32, 33, and 34, the diameter of the port 39 may be .040".

Nothing herein set forth is to be interpreted as limiting the various features of the present invention in the scope of their application to use in connection with the particular structural details or the particular mode of operation selected for purposes of illustration and explanation. While the particulars of construction herein set forth are well suited to one mechanical embodiment of the invention, to the use to which it is put, and to the mode of operation disclosed, the invention is not limited thereto nor to the disclosed details of construction nor to the conjoint use of all the disclosed features. It is not to be understood that these particulars or details are essential since they may be variously modified within the skill of the artisan without departing from the true scope of the actual invention, the characteristic features of which are set forth in the following claims which intentionally use generic terms and expressions that are inclusive in meaning of various physical modifications.

What is claimed as new is:

1. A spray discharge nozzle having a main orifice for the discharge along an axis of liquid coating material and air under pressure to atomize the liquid; a projection extending from the front of the nozzle to one side of the main discharge orifice and provided with air passage means; and a plurality of ports disposed in pairs along said projection in communication with said air passage means for the discharge of air supplementally along opposite sides of the main discharge to form an air wall at each of said opposite sides, the axes of each pair of ports lying in a plane which intersects the main discharge axis, the axis of each individual port being laterally spaced from the main discharge axis, the space between the axes of each pair of ports along a line diametric of the main discharge orifice being greater than the diameter of said orifice, and the supplemental discharges from said ports being unopposed by corresponding supplemental discharges directed from the opposite side

of the main discharge, whereby the axis of the main discharge is deflected from the axis of the main discharge orifice.

2. Structure such as set forth in claim 1 characterized by the presence of an additional supplemental air port located between the main discharge orifice and the projection.

3. A spray discharge nozzle having a main orifice for the discharge along an axis of liquid coating material and air under pressure to atomize the liquid; a projection extending from the front of the nozzle to one side of the main discharge orifice and provided with air passage means; and a plurality of ports disposed in pairs along said projection in communication with said air passage means for the discharge of air supplementally along opposite sides of the main discharge to form an air wall at each of said opposite sides, the axes of each pair of ports lying in a plane which intersects the main discharge axis, the axes plane of the outermost pair of ports being angularly disposed toward the main discharge orifice, the axes plane of the innermost pair of ports being angularly disposed away from the main discharge orifice, the axis of each individual port being laterally spaced from the main discharge axis, the space between the axes of each pair of ports along a line diametric of the main discharge orifice being greater than the diameter of said orifice, and the supplemental discharges from said ports being unopposed by corresponding supplemental discharges directed from the opposite side of the main discharge, whereby the axis of the main discharge is deflected from the axis of the main discharge orifice.

4. Structure such as set forth in claim 3 characterized by the presence of an additional supplemental air port located between the main discharge orifice and the projection.

5. A spray discharge nozzle having a main orifice for the discharge along an axis of liquid coating material and air under pressure to atomize the liquid; a projection extending from the front of the nozzle to one side of the main discharge orifice and provided with air passage means; a plurality of ports located in said projection in communication with said air passage means for the discharge of air supplementally along opposite sides of the main discharge to form an air wall at each of said opposite sides, the supplemental discharges from said ports being unopposed by corresponding supplemental discharges directed from the opposite side of the main discharge, whereby the axis of the main discharge is deflected from the axis of the main discharge

orifice; and an additional air port located between the main discharge orifice and the projection and adapted to discharge air supplementally between said air walls.

6. A spray discharge nozzle having a main orifice for the discharge along an axis of liquid coating material and air under pressure to atomize the liquid; a projection extending from the front of the nozzle to one side of the main discharge orifice and provided with air passage means; and three pairs of ports disposed along the projection in communication with said air passage means for the discharge of air supplementally along opposite sides of the main discharge to form an air wall at each of said opposite sides, the axes of each pair of ports lying in a plane which intersects the main discharge axis, the axes plane of the outermost pair of ports being angularly disposed toward the main discharge orifice, the axes plane of the innermost pair of ports being angularly disposed away from the main discharge orifice, the axes plane of the intermediate pair of ports being angularly disposed to the axes plane of the innermost pair of ports, the axis of each individual port being laterally spaced from the main discharge axis, the space between the axes of each pair of ports along a line diametric of the main discharge orifice being greater than the diameter of said orifice, and the supplemental discharges from said ports being unopposed by corresponding supplemental discharges directed from the opposite side of the main discharge, whereby the axis of the main discharge is deflected from the axis of the main discharge orifice.

7. Structure such as set forth in claim 6 characterized by the presence of an additional supplemental air port located between the main discharge orifice and the projection.

WAYNE B. THOMPSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,717,086	Binks -----	June 11, 1929
1,751,787	Binks -----	Mar. 25, 1930
1,752,922	Mueller -----	Apr. 1, 1930
2,070,696	Tracy -----	Feb. 16, 1937
2,139,133	Paasche -----	Dec. 6, 1938

FOREIGN PATENTS

Number	Country	Date
585,239	Germany -----	Sept. 30, 1933