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D. J. PEEPS

2,271,779

SPRAY NOZZLE

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FIG-1

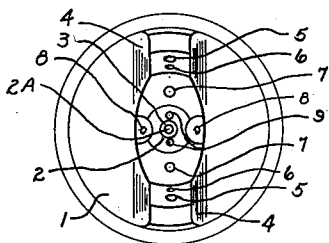


FIG-2

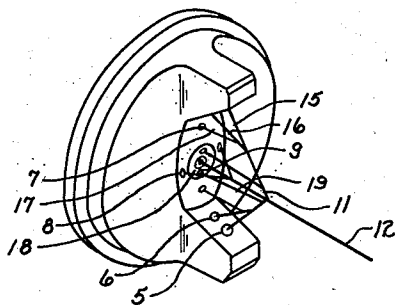


FIG-3

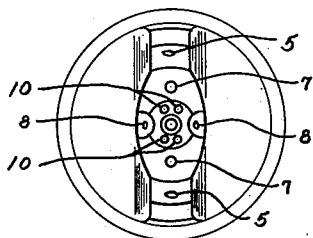


FIG-4

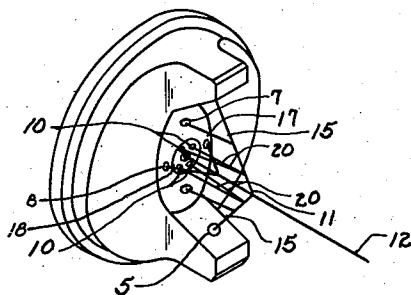


FIG-5

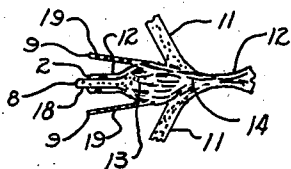
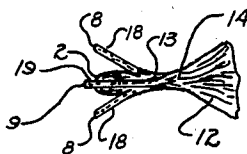


FIG-6



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SPRAY NOZZLE

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5 Claims. (Cl. 299-140.1)

This invention relates to spray nozzles utilizing air for atomization and is particularly directed to such nozzles having a plurality of atomizing air jets directed toward the stream of material discharged by the nozzle to atomize it and to form it into a particular shape.

It is a standard practice to have an annular air jet opening around the spray material outlet. The principal purpose of the air from this opening is the primary atomization of the material. With suction feed equipment it also serves to draw the material out into the atmosphere by lowering the pressure in front of the nozzle. This aspirating action increases the forward velocity of the spray material delivered from force feed equipment.

To form the spray discharge into fan shape (this shape has been found particularly effective for quickly and evenly applying a spray coating) it has long been conventional to have a pair of forwardly converging air jets strike the central air and material stream from opposite sides.

However, various other jets are now used in spray nozzles to alter the characteristics of the spray stream before it is brought by the flattening jets into its final pattern. This last step as well as any preceding shaping of the spray stream usually tends to improve the atomization of it. Its final cross-section is of a general elliptical shape modified to suit the particular coating materials and surfaces involved. For satisfactory results the spray material must be spread uniformly throughout the main body section of the pattern of the spray and also must be confined within the pattern.

The force of an air jet seems to have two principal directional effects on the particles of the paint stream. These are to spread them laterally thereby separating them and secondly to propel them forward from the air nozzle toward the surface to be coated. The first action shapes and atomizes the spray while the second brings the particles to the surface to be coated. The velocity provided by the latter helps keep awayward wisps of spray particles from being carried by the swirl of air currents back upon the face of the spray nozzle.

Air jets act more effectively from an atomizing standpoint upon a stream of material if aimed directly toward it. Such an impingement, however, will ordinarily cause back swirls of spray material. For this reason the air jets are discharged forwardly to strike the stream at acute angles to the axis of the stream. The more ve-

locity the paint stream has, however, the more directly the air jets may be sent toward it.

The movement of each air jet is inclined to draw surrounding air along with it. This suction is stronger near the base of the jet. Wayward swirls of fine spray may thus be drawn near the surface of the spray nozzle and be deposited upon it. This deposit if continued will sooner or later lessen the effectiveness of the air jets by blocking at least a portion of their normal paths.

Such trouble is encountered with some spray nozzles having the type of atomizing jets which issue from the sides 90° about the axis of the spray nozzle from the main flattening or pattern forming jets. These side atomizing jets originate so near the main stream and are discharged at such an acute angle toward the main stream that they disrupt it and spread it quite vigorously. This action while very desirable from an atomizing standpoint is inclined to splash loose wisps of atomized material beyond the confines of the normal spray pattern. If these reach the surface of the article being coated, they may produce an irregular coating. Otherwise if attracted back toward the face of the spray nozzle by the vacuum action of the other air jets they may be deposited upon the spray nozzle.

Fan shaped flattening jets (formed by having two or more jets merge during their movement toward the central stream) are particularly helpful in enveloping the stream after it has been acted upon by such atomizing jets.

The principal nozzle structure shown in R. W. Tracy Patent No. 2,070,696, issued February 16, 1937, provides for broadened flattening jets which work well in gathering together a dispersed central stream and so permit particularly strong side atomizing jets to be used. Even so with certain spray materials and at pressures above certain limits an objectionable amount of spray particles escapes from the main body of the spray material and is deposited upon the face of this nozzle.

This invention comprises the placing of additional jets between the flattening atomizing jets and the central spray stream in nozzles of this general type. These clean up jets are introduced primarily to keep the face of the spray nozzle clean and accomplish this very satisfactorily. However, it has been found that these new jets also improve the atomization, directly, and indirectly by permitting higher pressures to be used. Such higher pressures do not adversely affect the shape of the spray pattern with most materials. These clean up jets also add slightly

to the velocity of the main central stream and thereby allow the side atomizing and flattening jets to be directed more fully toward the stream of material. As indicated an important object of the invention is to provide a spray nozzle which will stay clean during use.

A further object is to provide a spray nozzle which will atomize the spray material more completely.

Other objects and features of novelty will become apparent from the following specification with reference being made to the accompanying drawing in which:

Fig. 1 is a front view of a spray nozzle embodying my invention;

Fig. 2 is a perspective view of the same nozzle with a diagrammatic representation of the paths of the air jets and material stream issuing from the ports of the nozzle;

Fig. 3 is a front view of another spray nozzle embodying a different form of my invention;

Fig. 4 is a perspective view of the spray nozzle shown in Fig. 3 with diagrammatic representation of the paths of the air jets and material stream issuing from the ports of this nozzle;

Fig. 5 is a perspective diagrammatic view of portions of the material stream and air jets discharged from the ports of the spray nozzle shown in Figs. 1 and 2; and

Fig. 6 is a perspective diagrammatic view of portions of the same material stream and air jets taken at 90° about the axis of the central stream from the view shown in Fig. 5.

Referring to the drawing, my invention is shown as applied to a spray nozzle having a main body portion 1 at the center of which is a circular opening 2 for the discharge of the coating material and air. This opening is divided into two sections; the first is the inner circular port 2a at the end of an inner nozzle member commonly referred to as a fluid tip, which is not otherwise shown in the drawing. Around this material discharge port 2a is an annular air outlet opening 3 constituting the second section of the circular opening 2. The central stream of material and air is projected forwardly in the shape of a cone gradually flaring in its direction of travel from the opening 2.

On the horn projections 4 at opposite edges of the nozzle are located ports 5 and 6 from which air for flattening the central stream is discharged. Ports 7 of somewhat similar size are positioned on the face of the nozzle of Fig. 1 between the horns and the central opening. From these, jets issue and combine with the jets discharged from the ports 5 and 6 to cooperate in forming a more or less flattened air stream. Ports 8 are located 90° about the axis of the central stream from the sides where the flattening jets originate. These are close to the central opening and are directed so that their axes converge at a point on the axis of the central main stream. At less distance from the central stream, but between it and the ports for the flattening jets are positioned the comparatively small ports 9. Except for the ports 9 the spray nozzle shown in Fig. 1 of the drawing is similar to the principal nozzle illustrated in Tracy Patent No. 2,070,696, issued February 16, 1937.

The paths of travel of the various jets discharged from the ports of the nozzle shown in Fig. 1 are illustrated in Fig. 2. As may be noted the jets 15 and 16 issuing from ports 5 and 6 are directed to strike the central stream 12 at large acute angles. Jets 17 intercept the lines of travel

of jets 15 and 16 prior to their meeting with the central stream. This convergence spreads the jets laterally and softens their piercing effect upon the central stream. The jet formed from the convergence of the horn jets and jets 17 is marked 11. Jets 18 from the side ports 8 are the first to impinge against the central stream of air and material. The jets 19 pass from ports 9 and are directed more forwardly than are the jets 18 and therefore converge with the expanding central stream 12 at a greater distance from the face of the spray nozzle. This convergence is brought out more clearly in Fig. 5.

In Fig. 5 is shown diagrammatically an enlarged view of certain jets discharged by the spray nozzle of Fig. 1. The main central stream 12 of material and air is shown discharged from the center orifice 2. Atomizing jet 18 from the orifice 8 strikes and spreads the central stream 12 at 13. The clean up jets 19 from ports 9 travel along the edges of the spread portion 13 of the stream 12 until the powerful flattening jets 11 come in to spread the main stream into its final fan shape. The same jets except for jets 11 are shown in Fig. 6 at 90° about the axis of the central stream. The flattening effect of jets 11 on the central stream 12 forward from the impact area 14 is however shown in this view.

The spray nozzle shown in Fig. 3 is similar to that shown in Fig. 1 except that it does not have ports 6. Also, it has double ports 10 on either side of the central port of the spray nozzle in the same relative position as and in place of the single jets 9. As revealed in Fig. 4 the jets 20 issuing from ports 10 travel along paths substantially parallel to the main stream but slightly convergent with each other.

Side jets on the order of jets 18 were first utilized as shown in Buzzard and Tracy Patent No. 2,004,033, issued June 4, 1935, to clean up the narrow ends of the fan shaped spray pattern as brought out in Figs. 5 and 6 of this early patent. For this purpose the jets were directed along lines at a very slight angle to the axis of the central stream 12. The force of their convergence with the central stream was therefore quite light. Later it was found by Tracy that these jets could be turned more directly toward (preferably at an angle of at least 25°) the central stream with a quite different but very desirable result. This was to penetrate and agitate the central stream 12 and thereby increase its atomization. They were so utilized in the spray nozzles shown and described in his Patent No. 2,019,941, issued November 5, 1935, and his Patent No. 2,070,696, issued February 16, 1937.

Meanwhile he had learned that the force of these jets could be so great that it would spread the stream laterally toward the horns to a degree where the single air jets from the horns could not bring the stream back into control. To correct this he provided a fan shaped flattening air jet broadened laterally to catch the scattered particles of the central stream and to retain them in the spray pattern. Such fan shaped jets in conjunction with the troublesome side atomizing jets are illustrated in the principal nozzle in Tracy Patent No. 2,070,696.

These fan shaped flattening jets, however, have certain limits beyond which they are unable to restrict the spread of particles of the main stream caused by the force of the side atomizing jets such as shown at 18 in the accompanying drawing. For this reason ports 8 from which these jets 18 are discharged must not be directed too

fully against the main stream. Any stray particles of the spray that do escape are prone to be attracted back to the spray nozzle by the suction effect of the forward movement of the air jets. These wayward wisps of spray are frequently deposited upon the surface of the spray nozzle, close to the jet ports including those in the horns. If the deposit is continued it may close over the port openings and interfere with the normal travel of the air. This difficulty has been encountered with the spray nozzle shown in Tracy Patent No. 2,070,696 with certain materials and above certain pressures.

This objectionable action, however, is considerably restricted by the addition of ports such as 9 and 10. The jets 19 and 20 from these ports restrain to an appreciable extent the lateral thrust of spray particles caused by the force of jets 18. They also modify to some extent the suction effect of neighboring jets such as jets 17 by creating a slight suction of their own. These clean up jets 19 and 20 are positioned close to the central stream and may be comparatively small in diameter, having an individual capacity of less than half that of one of the jets from the ports 8. However, they may serve their purpose just as efficiently if they have a capacity equal to or greater than that of the atomizing jets. These jets also assist somewhat in spreading out the flattened shaping jets traveling in from the direction of the horns. These shaping jets are considerably larger than the atomizing and clean up jets. A spray nozzle having the single clean up jets illustrated in Fig. 2 which gives particularly satisfactory results is one in which these jet ports are .018" in diameter and in which the air jets from these ports follow paths which meet the axis of the central stream at an angle of 10°. The side atomizing jets 18 for such a nozzle may follow paths at an angle of approximately 33° to the axis of the main stream and may issue from ports of a diameter of approximately .032".

The double jets in the spray nozzle of Fig. 3 are somewhat more effective, as the restraining wall they create is wider at the base. Some distance from the face of the spray nozzle they converge and thereby form a more concentrated jet when acting upon the pattern forming air jets traveling from the direction of the horns. They thus have a stronger effect in piercing and softening the center of these flattening jets and permit more concentrated flattening jets to be used. These double jets 20 would restrict the outward spread of the particles of the main stream no doubt as efficiently if they were parallel instead of being convergent. The double clean up jets may be discharged from ports smaller in diameter than those for the single jets.

These new jets 19 and 20 allow greater pressures to be used in the air jets forming the pattern as there is no appreciable amount of loose spray particles to be attracted to the face of the nozzle by the increased suction attending this increase in pressure. Also the side jets 18 may be impinged against the central stream more directly and with greater force, thereby increasing the atomization arising from their action. It may be seen therefor that the addition of these jets enables atomization to be improved in addition to keeping the face of the spray nozzles clean.

It is obvious that while we have described in detail certain embodiments of the invention the same may be considerably modified without departing materially from the invention. The sizes

of the ports involved, their angles of discharge and their distances from the central stream may vary within wide ranges and still remain within the scope of the invention.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A spray nozzle for forming a fan shaped stream of atomized material having central port means from which material and air are discharged in an atomized stream, ports adjacent to and on opposite sides of the stream positioned to direct a pair of opposed atomizing jets of air against the stream at a substantial acute angle thereto and to strike it at a point sufficiently close to the surface of the spray nozzle to result in a concentrated impingement, secondary ports, as close to but on the two sides of the central stream 90° about its axis from the ports for the atomizing jets, positioned to direct a pair of air jets along paths substantially parallel and contiguous to the axis of the central stream and on opposite sides thereof, and additional ports positioned on the same two sides of the central stream as the secondary ports but farther from it, to direct sets of merging jets of air against opposite sides of the central stream to flatten it into its final fan shape.

2. A spray nozzle having a central port for the discharge of an expanding conical stream of material and air, ports on opposite sides of, but adjacent to, the central port for directing against the stream of material and air near its source a pair of opposed jets converging at an angle of more than 50°, a pair of smaller secondary ports, one on each of the two sides of the central port, 90° about its axis from the positions of the first ports, for directing two jets of air along paths adjacent and substantially parallel to the central stream and on opposite sides thereof, and two sets of larger ports, farther from the central port but on the same two sides as the secondary ports, for discharging opposed sets of converging air jets directed to strike the stream simultaneously from opposite sides to form it into its final fan shape.

3. A spray nozzle having a central port for the discharge of an expanding conical stream of material and air, ports on opposite sides of, but adjacent to, the central port for directing against the stream of material and air a pair of opposed jets converging toward each other at a substantial acute angle, smaller secondary ports, on each of the two sides of the central port 90° about its axis from the positions of the first ports, for directing along paths adjacent to the central stream and on each of the two sides thereof two contiguous jets of air equidistant from and substantially parallel to the central stream, and ports farther from the central port but on the same two sides as the secondary ports for discharging opposed sets of converging air jets directed to strike the stream simultaneously from opposite sides to form it into its final fan shape.

4. A spray nozzle having a central port for the discharge of an expanding conical stream of material and air, ports on opposite sides of, but adjacent to, the central port for directing against the stream of material and air a pair of opposed jets converging toward each other at an angle of more than 50°, smaller secondary ports, on each of the two sides of the central port 90° about its axis from the positions of the first ports, for directing along paths adjacent to the central stream and on each of the two sides thereof two contiguous jets of air inclined slightly toward each

other but equidistant from the central stream, and larger ports farther from the central port but on the same two sides as the secondary ports for discharging opposed sets of converging air jets directed to strike the stream simultaneously from opposite sides to form it into its final fan shape.

5. A method of atomizing and shaping a spray stream comprising the discharging of an expanding conical stream of material and air, vigorously striking the stream near its source upon opposite sides with two opposed atomizing air jets converging at an angle of at least 50°, discharg-

ing restricting air jets no larger than the atomizing air jets along paths contiguous and substantially parallel to the stream on opposite sides thereof 90° about its axis from the sides against which the atomizing air jets are directed, and subsequently directing against the stream on the sides along which the restricting jets travel a pair of opposed sets of converging air jets of considerably greater force than the preceding jets to envelop and form into fan shape the stream of material and air.

DONALD J. PEEPS.