

[54] **ELECTROSTATIC SPRAY GUN NOZZLE AND AIR CAP**

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[58] Field of Search **239/3, 15**

[56] **References Cited**

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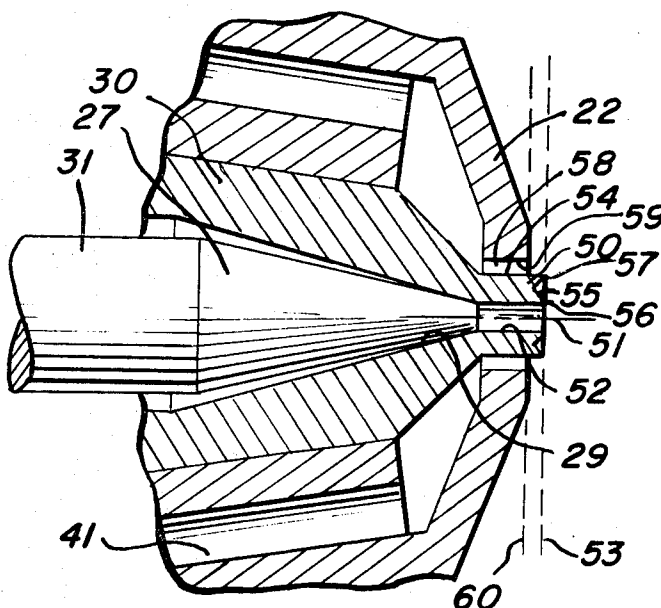
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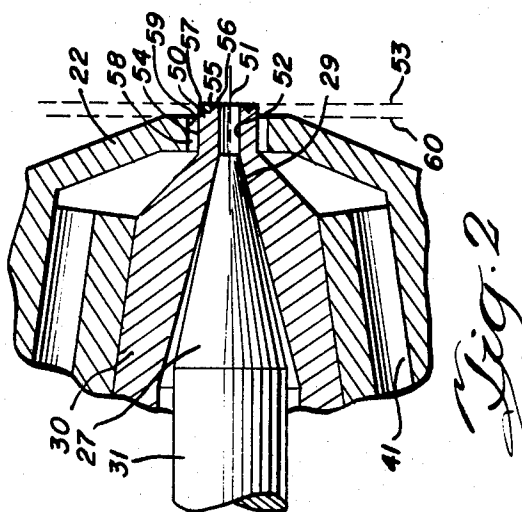
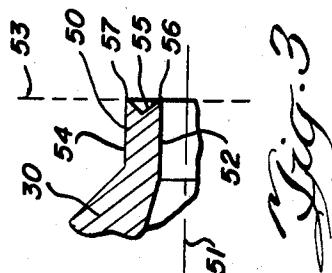
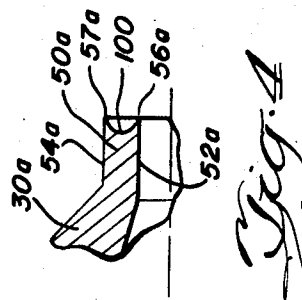
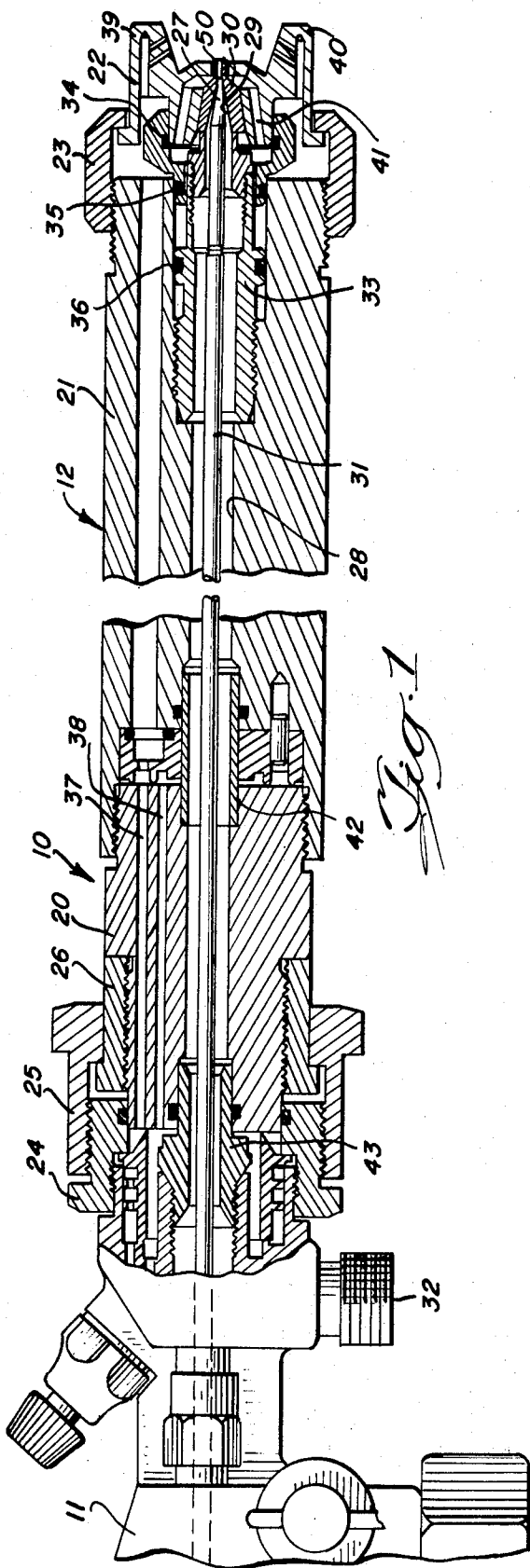
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ABSTRACT

In an electrostatic spray gun, the nozzle serves as the electrostatic charging electrode with a recessed forwardly facing surface that joins a first sharp annular edge adjacent the coating material ejected from the nozzle and a second annular sharp edge adjacent the ejected atomizing air. An air cap surrounding the nozzle provides an annular parallel air ejection passage. Preferably, the sharp edges of the nozzle protrude slightly forwardly of the termination of the air ejection passage formed by the air cap.

12 Claims, 4 Drawing Figures





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ELECTROSTATIC SPRAY GUN NOZZLE AND AIR CAP

This invention relates to electrostatic coating systems and more particularly to nozzles for ejecting coating material wherein the nozzle structure also serves as the electrostatic ionizing electrode.

In the past entire metal spray guns have been charged as the ionizing electrode in electrostatic deposition coating systems. Many other electrostatic deposition coating systems utilized separate sharp pointed ionizing electrodes which were either physically removed from the spray guns or were mounted on the spray gun structure. In air atomizing electrostatic deposition systems it has been preferable to have the nozzle for ejecting coating material also serve as the charging electrode. Such constructions are disclosed in U.S. Pat. No. 3,056,557 issued Oct. 2, 1962, U.S. Pat. No. 3,251,551 issued May 17, 1966 and U.S. Pat. No. 3,268,171 issued Aug. 23, 1966. The first of these patents disclosed a nozzle having a right angle sharp edge between the internal orifice surface and a flat forwardly facing surface and a further sharp edge between the forward facing surface and an outer surface of the nozzle. The last two patents disclosed a sharp edge formed at the termination of the inner orifice surface by an acute angle with an outer nozzle surface. A co-pending U.S. application Ser. No. 665,104 filed Sept. 1, 1967, now U.S. Pat. No. 3,641,971 discloses a sharp edge orifice electrode wherein the sharp edge is not in direct contact with coating material as it is ejected from the orifice. In conventional non-electrostatic coating systems utilizing air atomization, it has been found desirable to eject air from an annular passage which is parallel to a coating material ejection passage surrounded by the air passage. The sudden expansion of the air upon ejection from the passage running parallel to the coating material ejection passage efficiently atomizes the ejected coating material. The present invention provides for an ionizing sharp edge adjacent the flow of ejected coating material and a second sharp edge immediately adjacent the ejected and rapidly expanding atomizing air. These two sharp annular edges are provided by recessing the forwardly facing surface of the nozzle between the termination of the coating material ejection passage and the termination of the air ejection passage.

It is therefore an object of the present invention to provide new and improved nozzles and air caps for electrostatic coating systems.

A principal object of the present invention is to provide a nozzle for an electrostatic spray gun which has a sharp edge formed at the terminus of the coating material ejection passage and a second sharp edge formed at the terminus of the air ejection passage with both sharp edges lying substantially in the same plane which is perpendicular to a center line of the nozzle.

A further object of the present invention is to provide an air cap for the nozzle described in the previous paragraph wherein air is ejected in a direction substantially parallel to the direction of flow of the ejected coating material and the terminus of that passage determined by the position of the air cap is in a second plane perpendicular to the center line of the nozzle with the sharp edges of the nozzle protruding slightly forwardly of the second plane.

Further objects and advantages will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a sectional elevational view of a preferred embodiment of the invention;

FIG. 2 is an enlarged sectional elevational view of the forward portion of the preferred embodiment illustrated in FIG. 1;

FIG. 3 is a further enlarged portion of the nozzle of the preferred embodiments of the invention illustrated in FIGS. 1 and 2; and

FIG. 4 is an enlarged sectional drawing of a modified form of the nozzle portion illustrated in FIG. 3.

Although this invention is susceptible of embodiment of many different forms there is shown in the drawings and will

herein be described in detail, embodiments of the invention with the understanding that the present disclosures are to be considered as exemplifications of the principles of the invention and are not intended to limit the invention to the embodiments illustrated. The scope of the invention will be pointed out in the appended claims.

Referring now to FIGS. 1 and 2, a spray gun 10 comprises a metallic rear housing 11 and a barrel portion of nylon insulating material, generally indicated at 12, which comprises a first barrel section 20 threaded to a second barrel section 21 and an air cap 22 secured to the second barrel section 21 by a threaded annular retainer 23. The barrel section 20 is secured to section 11 by an annular fitting 24 to which an annular retainer 25 is secured by threads, and an annular cylinder 26 which is threaded onto section 20 and has an annular edge which contacts an annular edge of the retainer 25. A stainless steel valve 27 closes a passage 28 through the barrel portion 12 and the rear housing 11 when it engages an annular tapering valve seat 29 in a fluid tip 30. The valve 27 is connected to a stainless steel operating shaft 31. Shaft 31 is connected to an adjustable needle plunger (not shown) which has a spring urging it towards the forward portion of the spray gun. Coating material from a source (not shown) enters an aperture 32 that connects with the passage 28 containing the shaft 31 in order that coating material may flow around the shaft to the fluid tip 30. Thus, the coating material is conducted directly around the shafts which operate the valve in the front of the gun to the valve 27 within the fluid tip 30. The fluid tip 30 is secured between the air cap 22 and a fluid tip housing 33. Sealing rings 34, 35 and 36 prevent fluid from the passage 28 from leaking past the fluid tip housing 33. The fluid tip 30 and the fluid tip housing 33 are constructed of steel. A high voltage electric lead (not shown) is connected to metallic rear housing 11. The air hose (not shown) is connected to rear housing 11 to supply air to the passages generally indicated at 37 and 38. The passage 37 supplies air to two air horns 39 and 40 which form part of the air cap 22, and the passage 38 supplies air to an annular air passage 41 in the fluid tip 30. A nozzle 50 which forms the forward portion of the fluid tip 30 forms an electrode.

The length of the overall barrel 12 is normally of the order of 18 inches which prevents any substantial electrostatic field from existing between the charged rear housing 11 and a grounded product. The strongest electrostatic field exists between nozzle 50 toward a grounded product.

A pilot bushing 42 aids in completing the passage 28 across the junction barrel sections 20 and 21 and a cylinder adapter 43 aids in completing this passage across the junction of the rear housing 11 and the barrel section 20.

Referring now to the enlarged nozzle and air cap sections of the embodiment illustrated in FIGS. 2 and 3, the nozzle 50 has a center line 51. An internal orifice surface 52 is symmetrically positioned around the orifice center line 51. The internal orifice 52 terminates forwardly at a plane 53 perpendicular to the center line 51. An outer surface 54 of the nozzle 50 is symmetrically positioned above the nozzle center line 51 and terminates at the plane 53. A recessed forward facing surface 55 joins the internal orifice surface 52 and the nozzle outer surface 54 to form two sharp annular edges 56 and 57. In the embodiment illustrated in FIGS. 1-3, the recessed forward facing surface 55 is a V-shaped groove.

The nozzle 50 which is a portion of fluid tip 30, housing 33 and shaft 31, being constructed of electrically conductive material, electrically connect the source of electrical potential to the sharp edges 56 and 57 to provide the ionizing electrode.

Atomizing gas, which is in most instances air, is ejected by an annular passage 58 formed by the nozzle outer surface 54 and an internal orifice surface 59 of the air cap 22. The air cap internal orifice surface 59 surrounds the nozzle 50 and is parallel to the center line 51. It terminates at a second plane 60 perpendicular to the center line 51.

The air cap 22 may be made of electrically conductive material, but it is preferably constructed of electrically non-

conductive material to make the nozzle 50 essentially an ionizing point source as is more fully disclosed in the U.S. Pat. No. 3,251,551 issued May 17, 1960.

The sharp edges 56 and 57 protrude slightly forward of the end of the air (gas) passage 58 at plane 60. This protrusion of the sharp edges 56 and 57 at plane 53 beyond plane 60 should be at least 0.003 inch. The sharp edges could be in the same plane 60 as the termination of the passage 58 which is the point of rapid expansion of the ejected air, but if they do not project at least 0.003 inch the pressure of the expanding air creates a back pressure against the pressure of the coating material being ejected from the nozzle 50.

The sharp edges 56 and 57 are preferably located in the plane 53 rather than having one slightly project forwardly of the other in order to provide a recessed forwardly facing surface 55 which is equivalent to a flat surface for atomization. The expanding air expands across the forward facing surface 55 in essentially the same manner as if the surface was not recessed. Such a spacing is necessary to allow for efficient expansion of the air before the molecules of expanding air impinge upon the molecules of the solid stream of ejected coating material from the nozzle 50. However, from an ionizing standpoint the expanding air passes over the sharp ionizing edge 57 while the fluid being ejected passes over the sharp ionizing edge 56. Although it is not absolutely necessary that both sharp edges terminate in the exact same plane, it is preferable that both project forwardly of the plane 60.

The edges 56 and 57 may project substantially beyond the terminus of the air passage 58 at plane 60 and provide an efficiently operating spray gun. However, it has been found to be desirable to limit the distance between the sharp edges 56 and 57 to 0.010 inch beyond the terminus of the air passage 58 at plane 60. Thus the most preferred range of projection of the edges 56 and 57, that is, the spacing between plane 53 and plane 60 is between three thousands and ten thousands of an inch. However, as aforementioned, the edges 56 and 57 may be flush with the air cap 22 or may protrude far beyond ten thousands of an inch without departing from the basic principle of the present invention.

Referring now to FIG. 4 a portion of a fluid tip, 30a is illustrated which has the exact construction of the fluid tip 30 except that a forward facing surface 100 is concave rather than being V-shaped. The corresponding elements of the fluid tip 30a in FIG. 4 have the same numerals applied as are used in FIGS. 1-3 with the addition of a subscript a. The fluid tip 30a with its nozzle 50a is completely interchangeable in the spray gun 10 with the fluid tip 30 having its nozzle 50. The V-shaped groove 55 is simpler to produce from a manufacturing standpoint, but the concave shaped groove 100, has the advantage of producing sharper edges 56a and 57a than the corresponding sharp edges 56 and 57.

We claim:

1. An electrostatic spray gun comprising:
an electrically conductive nozzle having a center line through which coating material is ejected, said nozzle

having an internal orifice surface symmetrically positioned around the nozzle center line and terminating at a first plane perpendicular to said center line, an outer surface symmetrically positioned around the nozzle center line and terminating substantially at said perpendicular plane, and a recessed forward facing surface joining said internal orifice surface and joining said outer surface to form inner and outer sharp edges therebetween, and

an air cap through which gas is ejected having an internal orifice surface surrounding said nozzle and substantially parallel to said center line, said surface terminating in a second plane perpendicular to said center line.

2. An electrostatic spray gun as specified in claim 1, wherein said nozzle outer sharp edge protrudes forwardly of said second plane.

3. An electrostatic spray gun as specified in claim 1, wherein said nozzle inner sharp edge protrudes forwardly of said second plane.

4. An electrostatic spray gun as specific in claim 1, wherein said first plane is positioned at least three thousands of an inch forwardly of said second plane.

5. An electrostatic spray gun as specified in claim 1, wherein said first plane is positioned not more than ten thousands of an inch forwardly of said second plane.

6. An electrostatic spray gun as specified in claim 1, wherein said air cap is composed of electrically non-conductive material.

7. An electrostatic spray gun comprising:

an electrically conductive nozzle having a center line through which coating material is ejected, said nozzle having an internal orifice surface symmetrically positioned around the nozzle center line and terminating at a first ionizing means, an outer surface symmetrically positioned around the nozzle center line and terminating at a second ionizing means, and a recessed forward facing surface formed by joining said internal and external surfaces, and

an air cap through which gas is ejected having an internal orifice surrounding said nozzle and substantially parallel to said center line, said surface terminating in a plane perpendicular to said center line.

8. The electrostatic spray gun of claim 7, wherein the first and second ionizing means are sharp edges.

9. The electrostatic spray gun of claim 8, wherein both of the sharp-edged ionizing means protrude forward of the air cap.

10. The electrostatic spray gun of claim 8, wherein the air cap is composed of electrically non-conductive material.

11. The electrostatic spray gun of claim 9, wherein the protruding sharp edges extend at least three-thousandths of an inch forward of the air cap.

12. The electrostatic spray gun of claim 9, wherein the protruding sharp edges extend not more than ten-thousandths of an inch forward of the air cap.

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