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ROTATABLE SPRAY APPARATUS

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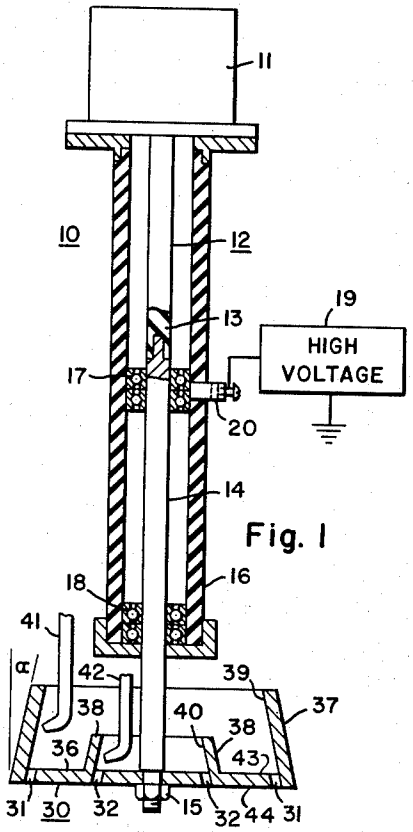

Fig. 1

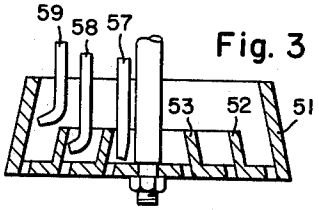

Fig. 3

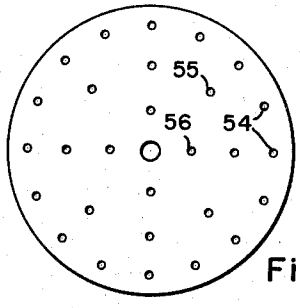

Fig. 4

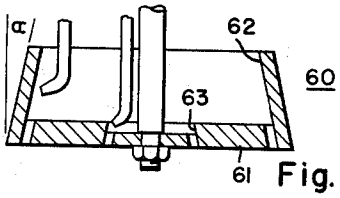

Fig. 5

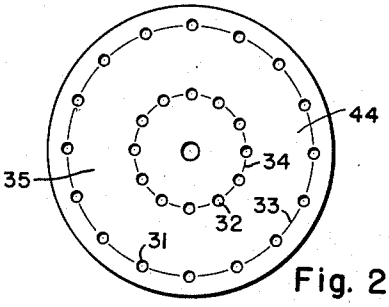

Fig. 2

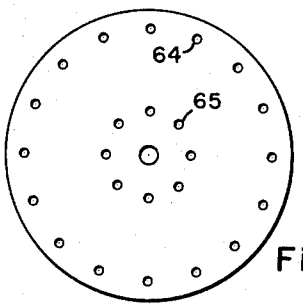

Fig. 6

WITNESSES

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ROTATABLE SPRAY APPARATUS

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This invention relates in general to a rotatable spray head, a spray apparatus and method of spraying liquid coating materials therewith. More particularly, it relates to a rotatable foraminous spray head and associated apparatus adapted for the simultaneous centrifugal spraying and electrostatic deposition of a plurality of liquid coating materials.

Heretofore, the simultaneous centrifugal spraying of multiple colored or incompatible coating materials has required a separate spray apparatus for each material. With a single spray head or apparatus, on the other hand, the deposition of multiple colored or incompatible coating materials could only be accomplished by a separate coating operation for each material. Obviously, a single apparatus would have to be taken apart, cleaned and reassembled between each use of a different coating composition. Frequent changes of this nature are not only inconvenient, time consuming, but are expensive as well. Similarly, the provision of more than one spray head or apparatus multiplies the initial investment for equipment.

Accordingly, it is an object of this invention to provide a single spray head adapted to spray simultaneously a plurality of coating materials.

It is a further object of this invention to provide a single spray head, electrostatic paint apparatus and method adapted to simultaneously deposit a plurality of multicolored or incompatible materials upon an object.

Briefly, this invention accomplishes the foregoing objects with a rotatable spray head having a series of discharge holes located on a plurality of concentric circles. A plurality of radially located circular flanges extend rearwardly from the discharge holes so that they provide a feed surface for each series of holes. Feeding of the dissimilar coating materials is accomplished by providing separate feed means for each flange feed surface. Speckled or multi-colored finishes are applied by appropriately selecting the size, number, location and angle of the discharge holes and the speed of rotation to provide a spray that preserves the individual characteristics of each material without the homogenization and loss of identity inherent in complete atomization. The efficiency of deposition is increased by electrically charging the spray head with a high voltage and grounding the article to be coated.

Further objects and advantages of the invention will become apparent as the following description proceeds and features of novelty which characterize the invention will be pointed out in particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the invention, reference may be had to the accompanying drawing, in which:

FIGURE 1 is a view in elevation, partly in section, of a spray apparatus,

FIG. 2 is an end view of the rotatable spray head illustrated in FIG. 1,

FIG. 3 is a view in elevation, partly in section illustrating a portion of the apparatus of FIG. 1 with another type of rotatable spray head,

FIG. 4 is an end view of the spray head illustrated in FIG. 3,

FIG. 5 is a view in elevation, partly in section, illustrating a portion of the apparatus of FIG. 1, with another type of rotatable spray head, and,

FIG. 6 is an end view of the spray head illustrated in FIG. 5.

Referring now to FIG. 1, there is illustrated the electrostatic spray apparatus **10**, embodying the rotatable spray head **30** of this invention, adapted for centrifugally and simultaneously spraying a plurality of coating materials and adapted to apply an electrical charge to the sprayed particles.

An accurately regulated driving means **11**, which may, for example, be an air motor, is connected to a rotatable shaft **12**, formed of two sections, an electrical insulating section **13** and an electrical conducting section **14**. The spray head **30** is rigidly fixed to the conducting section **14** and held in place by the cap nut **15**. The electrical insulating section **13** may be a solid shaft member prepared from convolutely wound sheets of kraft paper impregnated and bonded together with a cured thermoset phenolic resin. Such insulating materials are available commercially under the proprietary name Micarta.

A stationary sleeve or tube **16**, prepared from electrical insulating material, encloses at least a major portion of the shaft **12** so that the apparatus may be handled and held without danger of electrical shock. The tube **16** may be prepared from the phenolic impregnated kraft paper described heretofore for making the shaft section **13**. The rotatable shaft **12** is supported within the tube **16** by bearings **17** and **18**.

One side of a high voltage source **19** is electrically connected to the terminal **20** when employed for electrostatic spraying applications. The terminal **20** is electrically connected to bearing **17** and to the spray head **30** through the conductive shaft section **14**. The spray head **30** is made from an electrically conductive material such as steel, aluminum, brass, copper or the like so that the discharged sprayed coating particles are negatively charged. The other side of the high voltage source **19** is connected to ground.

When energized the high voltage source establishes an electric field between the rotatable spray head **30** and the surface of an article (not shown) to be coated. Appropriate electrical controls (not shown) permit application of the high-voltage from a remote position by an operator at ground potential. The articles, the surfaces of which are to be coated, are preferably maintained at ground potential, and can be passed into and through a zone where the coating material is applied thereto by well known conveyor means.

Referring now to FIGS. 1 and 2, there is illustrated two series of discharge holes or apertures **31**, **32** located on concentric circles **33**, **34** and extending directly through the forward plate or disc **36** from the rearward surface or side **43** of the rotatable spray head **30** to the exterior side or external forward surface or side **44**. A plurality of circular flanges **37**, **38** extend rearwardly from the forward plate and are flared inwardly toward the axis of rotation of the shaft and spray head. Radially, the flanges are located so that they each enclose a series of discharge holes. Each flange **37**, **38** provides an annular feed surface **39**, **40**. The annular feed surfaces **39**, **40** are sloped inwardly toward the axis of rotation at an angle of from about 15° to about 45° to the axis of rotation to provide a uniform flow of liquid coating material to the discharge holes **31**, **32** and to prevent the possible undesirable discharge of liquid coatings from the back side of the spray head.

To prevent a buildup of solids in the interior corners of the spray head, it is preferred to locate the discharge holes as close as possible to the inner flange feed surface. It is preferred, therefore to locate the discharge holes so that the outermost edge of the hole coincides with the feed surface. If the holes are circular, for example, it is preferred that they be tangent to the feed surface. For descriptive purposes, it may be said that the annular surface is junctured or connected to the forward plate. The

discharge holes may then be described as bordered by the annular surface or it may be said that the juncture of the annular surface to the forward plate and the discharge holes are juxtaposed.

It is also preferred, to assure a smooth, uniform flow of material, that the center line of the discharge holes be parallel to the feed surface. It will be understood, of course, that the spray head is operable with the holes located a short distance from the feed surface and with the center line of the holes not parallel to the inner feed surface. The individual series of holes need not be exactly located in a circular pattern, although such an arrangement is preferred.

The liquid coating materials to be sprayed are supplied to the annular feed surfaces **39**, **40** of the circular flanges **38**, **39** at a controlled rate by means of feed tubes **41** and **42**, respectively. The tubes **41**, **42** are preferably rigid and may be constructed, for example, from steel tubing. The coating materials can be supplied through the feed tubes by an convenient means such as a pump, pressure pot or merely by gravity. It is preferred to position the feed tubes to point in the direction of rotation of the head to minimize splashing or loss of coating material. Dissimilar materials may be supplied to different feed tubes. The structure of the head provides separate annular compartments or channels for each material and prevents mixing of the individual coating materials.

By altering the size, number, angle and location of the holes various decorative end results can be attained. In order to indicate more specifically the advantages and capabilities of the present invention, the following specific example is set forth.

Example I

A spray head with a forward plate about six inches in diameter is constructed from aluminum. The exterior circular flange has an axial dimension of two inches, the interior circular flange has an axial dimension of one inch. A series of 16 equally spaced 1/64 inch holes is drilled through the forward plate so that the center lines of the holes are parallel to the annular feed surface of the outer circular flange and so that the annular feed surface is tangent to the holes. Similarly, a series of 8 equally spaced 1/16 inch holes in drilled adjacent to the interior circular flange. Distance between the flanges is approximately 2 inches. Both flanges flare inwardly toward the axis at an angle of about 30°. The feed tubes are located adjacent the inner feed surfaces of the flanges, as illustrated in FIG. 1.

To apply a decorative multi-colored spackled finish to an object, two contrasting colored paints are individually supplied through the feed tubes at a rate of ½ to 4 ozs. of paint per minute, depending on conveyor speed, to the rotating head. The paint viscosity is from 25 to 35 seconds in a Zahn No. 2 cup. The spray head is rotated at a speed of about 300 to about 600 r.p.m. Speeds greater than 600 r.p.m. will atomize the paints to such a degree that the speckled multi-color effect is not visible to the naked eye. The article to be coated is located 10 to 14 inches from the spray head. The voltage impressed on the spray head is in the order of 60,000 to 90,000 volts. The article is grounded. A discontinuous multi-colored speckled finish is satisfactorily attained.

Another version of the spray head is illustrated in FIGS. 3 and 4. With the three circular flanges **51**, **52** and **53**, the three concentric series of discharge holes **54**, **55** and **56** and the three feed tubes **57**, **58** and **59**, three dissimilar coating materials may be applied simultaneously.

Another mode of constructing a spray head according to this invention is illustrated in FIGS. 5 and 6. Referring to those figures, we have shown a spray head **60** with a relatively thick forward plate **61**. The outer circular flange **62** is similar to the flanges illustrated heretofore. The inner circular flange **63** may, however, be easily formed by machining or cutting away a portion of the forward plate **61**. The feed holes **64**, **65** are similar to those previously described.

It will be understood that a spray head with any practical number of flanges, annular feed surfaces, discharge holes and feed tubes may be constructed according to this invention. Incompatible or immiscible coating materials, such as lacquer and enamel may be simultaneously sprayed and deposited. While the spray head is especially adapted for the application of a plurality of different materials, it will also be understood that a single coating material may be sprayed from each head flange and deposited according to this invention.

It will be understood that certain changes may be made to the foregoing examples and particular descriptions, without departing from the true scope or spirit of the invention.

I claim as my invention:

1. A rotatable spray head adapted for rotation about an axis comprising a plate having a rearward surface and an external forward surface and at least one series of discharge holes extending through the plate from said rearward to said forward surface, at least one circular flange having an annular feed surface, the annular surface joining said rearward surface to form a juncture therewith, the annular surface flaring inwardly from said juncture at an angle of from about 15° to about 45° to the axis of rotation, a series of the discharge holes being disposed radially inwardly from said juncture.

2. A rotatable spray head adapted for rotation about an axis comprising a forward plate having a rearward surface and an external forward surface and a plural series of discharge holes extending through the plate from said rearward to said forward surface, a plurality of circular flanges extending from said rearward surface, each flange having an annular surface joined to said plate to form a juncture therewith, the annular surfaces flaring inwardly from said junctures at an angle of from about 15° to about 45° to the axis of rotation, each series of said discharge holes located so that said holes are disposed radially inwardly from said juncture.

3. A rotatable spray head adapted for rotation about an axis comprising a forward plate having a first and second series of discharge holes projecting therethrough from one side to an exterior side of the plate, first and second circular flanges extending from said plate, each flange having an annular feed surface joined to said plate to form first and second junctures therewith, the annular surfaces flaring inwardly from said junctures at an angle of about 15° to 45° to the axis of rotation, the discharge holes being so located that the first series and said first juncture are juxtaposed and so that the second series and said second juncture are juxtaposed.

4. In electrostatic liquid coating apparatus, a rotatable spray head adapted for rotation about an axis comprising a forward plate having a rearward surface and an external forward surface and at least one series of discharge holes extending through the plate from said rearward to said forward surface, at least one circular flange having an annular feed surface, the annular surface joining said rearward surface to form a juncture therewith, the annular surface flaring inwardly from said juncture at an angle of from about 15° to about 45° to the axis of rotation, the series of discharge holes being located so that said holes and said juncture are juxtaposed, means for supplying liquid coating material to said annular surface, means for rotating the head to cause the liquid to form a film on said annular surface and to flow to and through said discharge holes and means including a high voltage source electrically connected to said head to electrically charge the discharged liquid.

5. In electrostatic liquid coating apparatus, a rotatable spray head adapted for rotation about an axis comprising a forward plate having a plural series of discharge holes extending therethrough from one side to an exterior side of the plate, a plurality of circular flanges extending from

said plate, each flange having an annular surface joined to said plate to form a juncture therewith, the annular surfaces flaring inwardly from said junctures at an angle of from about 15° to about 45° to the axis of rotation, each series of said discharge holes located so that said holes and said junctures are juxtaposed, means for supplying a liquid coating material to each of said annular surfaces, means for rotating the head to cause the materials to form a film on said annular surfaces and to flow to and through said discharge holes and means including a high voltage source electrically connected to said head to electrically charge the discharged liquids.

6. In electrostatic liquid coating apparatus, a rotatable spray head adapted for rotation about an axis comprising a forward plate having a first and a second series of discharge holes projecting therethrough from one side to an exterior side, first and second circular flanges extending from said plate, each flange having an annular feed surface joined to said plate to form first and second junctures therewith, the annular surfaces flaring inwardly from said junctures at an angle of about 15° to 45° to the axis of rotation, the discharge holes being so located that the first series and said first juncture are juxtaposed and so that the second series and said second juncture are juxtaposed, means for simultaneously supplying liquid coating materials to each of said annular surfaces, means for rotating the head to cause the materials to form a film on each of said annular surfaces and to flow to and through said discharge holes and means including a high voltage source electrically connected to said head to electrically charge the discharged liquids.

7. A rotatable spray head for simultaneously spraying a plurality of liquids comprising, in combination, a disc having an internal rearward surface and an external forward surface, means cooperating with said rearward surface to define a plurality of annular feed surfaces, discharge apertures extending directly through said disc and adapted to provide liquid communication between each annular feed surface and the external forward face of

said disc and means for simultaneously supplying a liquid to each annular feed surface.

8. A rotatable spray head adapted for rotation about an axis comprising a disc having an internal rearward surface and an external forward surface, a plural series of apertures extending directly through said disc from the rearward to the forward surface, means providing an annular feed surface for each series of apertures, the annular feed surfaces being flared inwardly toward the axis and adapted to supply liquid to each of said series of apertures and means for simultaneously supplying liquid to each annular feed surface.

9. In electrostatic liquid coating apparatus, a rotatable spray head adapted for rotation about an axis comprising a disc having an internal rearward surface and an external forward surface, plural series of apertures extending directly through said disc from the rearward to the forward surface, means providing an annular feed surface for each series of apertures, the annular feed surfaces being flared inwardly toward the axis and adapted to supply liquid to each of said series of apertures, means for simultaneously supplying liquid to each annular feed surface, means for rotating the head to cause the liquid to form a film on said annular surface and to flow to and through said apertures and means including a high voltage source electrically connected to said head to electrically charge the discharged liquid.

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