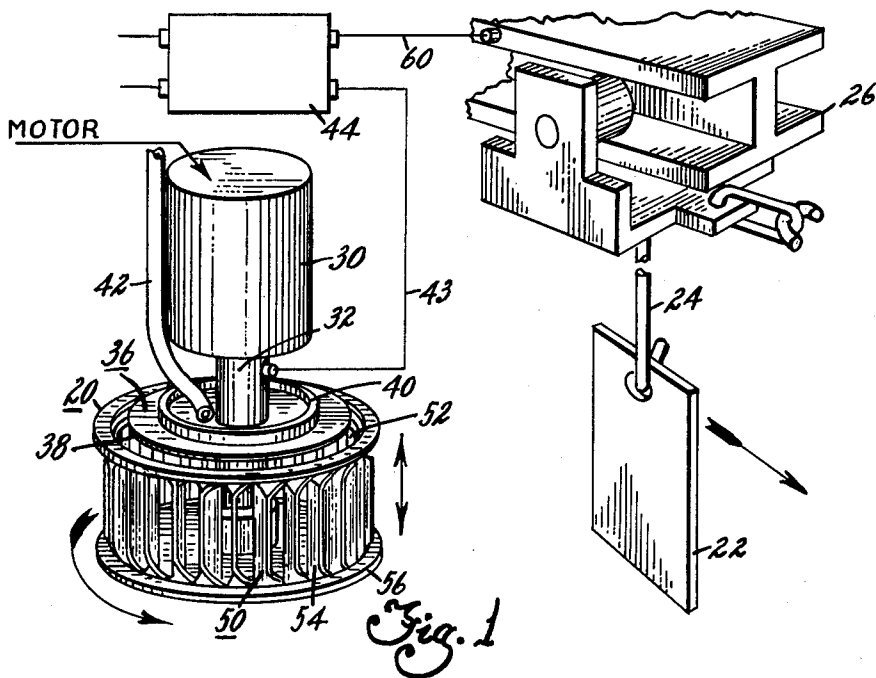
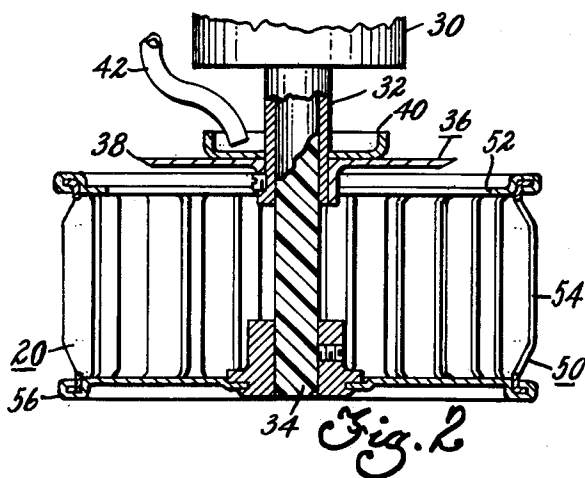
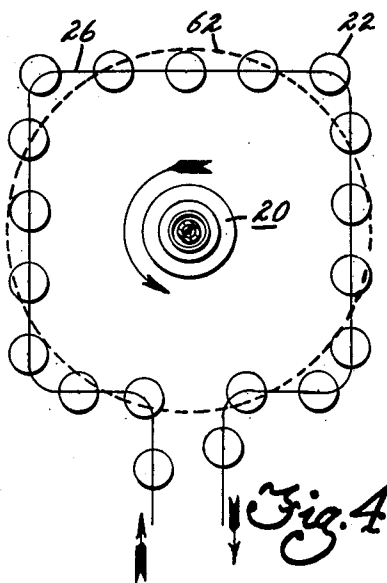
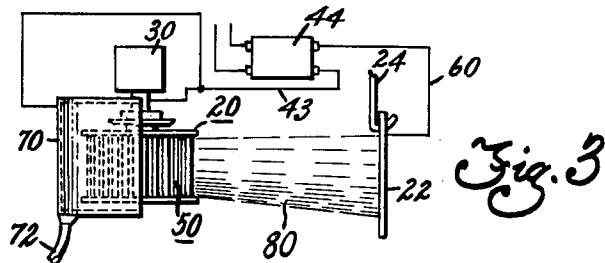


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METHOD AND APPARATUS FOR COATING ELECTROSTATICALLY
AND MECHANICALLY
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1

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METHOD AND APPARATUS FOR COATING ELECTROSTATICALLY AND MECHANICALLY

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The invention relates to methods and apparatus for electrostatically depositing coating material on objects to be coated.

It is the main object of the invention to provide an improved method and apparatus for electrostatically depositing coating material wherein the coating material is first charged and electrostatically atomized and dispersed and is subsequently mechanically distributed onto the part to be coated.

Another object of the invention is to provide an apparatus comprising a stationary plate and a stationary tube for supplying coating material thereto, said plate being connected to one side of an electrostatic circuit whereby coating material deposited thereon becomes charged and is atomized and dispersed electrostatically thereof, means being provided adjacent the plate for imparting mechanical movement to the dispersed particles and for directing said particles mechanically to the part to be coated.

In carrying out the above object, it is a further object to position a squirrel-cage rotor directly beneath the plate wherein the ingress side thereof is in proximity to the plate whereby charged and dispersed particles from the plate are drawn into the rotor and are mechanically distributed therethrough onto the part to be coated.

Another object of the invention is to provide an electrostatic coating apparatus wherein the pattern of painting may be predetermined and controlled both as to width and direction.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

Figure 1 is a diagrammatic view in perspective showing an electrostatic coating apparatus together with a conveyor carrying an article to be coated thereon.

Figure 2 is a cross-sectional view of the electrostatic coating apparatus shown in Figure 1.

Figure 3 is a diagrammatic side view of the coating apparatus shown in Figure 1 demonstrating the coating pattern and also showing an optional shield in place for directing the coating operation in one direction.

Figure 4 is a diagrammatic view of the coating apparatus shown in Figure 1 in conjunction with a conveyor for conveying a plurality of articles into the coating field.

In copending applications, S.N.'s 687,107, filed Sept. 30, 1957, and 696,777, now Patent No. 2,899,136, assigned to the assignee of the present invention, I have disclosed electrostatic coating apparatus which may be used in connection with electrostatic painting operations wherein centrifugal distributing means are provided and wherein the paint is charged and dispersed both electrostatically and centrifugally simultaneously onto the articles to be coated. In connection with application S.N. 687,107, due to the shape of the centrifugal distributor,

2

the paint is distributed non-uniformly in an expanding pattern of generally circular shape wherein the density of deposition of paint particles will fluctuate due to the nonuniform character of the distributor. In both of these applications, however, the paint is distributed electrostatically and centrifugally from a moving device.

In the present invention, the concept of distribution is different in that the paint is supplied to a stationary, electrically-charged plate and the distribution of the paint on the plate is through gravity alone whereby the paint, as it is supplied adjacent the center of the plate, flows outwardly thereon to the edges thereof whereupon, due to the charge on the plate, the film or layer of paint, as it drips from the edge of the plate, is electrostatically charged and disseminated. Immediately beneath the plate and providing an annular entry therearound is a squirrel-cage rotor. The annular restricted entry to the rotor creates a downwardly moving forced draft when the rotor is rotating which draws the electrostatically dispersed paint particles therein and which immediately disperses mechanically these paint particles in their charged condition through the louvers and outwardly from the rotor. This forms an annular paint pattern of expanding shape wherein the paint distribution is substantially uniform since the rotor is moving at a uniform speed and since the paint distribution therein is substantially uniform. Thus, in the present invention, the paint is charged and atomized solely by the electrostatic charge carried by the stationary plate and is dispersed and directed solely by the squirrel-cage rotor onto the article to be coated which obviously should carry a charge opposite to the charge carried by the particles of coating material.

Referring specifically to the drawings, Figure 1 shows a diagrammatic view of an electrostatic painting apparatus at 20 together with an article 22 to be painted which is carried by a hook 24 attached to a conveyor 26. The article 22 is moved within the field of painting of the device 20 by the conveyor 26. The device 20 comprises a motor 30 driven electrically or by fluid having a downwardly extending stationary journal 32 attached thereto through which the motor shaft 34 passes. The journal 32 also acts as a support for a circular plate 36 having sharp knife edge 38 therearound. In order to more uniformly distribute the paint on the plate, it is preferable to include an annular cup 40 adjacent the center thereof into which a supply tube 42 exhausts paint either by gravity from a paint source, not shown, or through pumping means, not shown. When the cup 40 fills with paint, the paint overflows the lip of the cup onto the plate 36 whence it flows by gravity in a layer or film of decreasing thickness to the edge 38 thereof. As the paint drips off the edge 38, it is charged due to the fact that the plate 36 is connected to one pole 43 of a power pack 44. Simultaneously, the paint is dispersed electrostatically into an atomized cloud of charged particles of small magnitude.

At the lower end of the shaft 34, there is positioned a squirrel-cage rotor 50 which has its ingress 52 adjacent to and preferably slightly below the edge 38 of the plate 36. The ingress 52 of the rotor 50 is slightly larger in diameter than the diameter of the plate 36 and, in one form, for example, when using a squirrel-cage rotor of six inches in mean diameter and a height of two and one-half inches with an ingress opening of five and three-fourths inches in diameter, the plate should be about four inches in diameter and positioned so that its upper surface is about one-eighth inch above the upper surface of the rotor. If the plate is below the top of the rotor, the width of the pattern is narrowed in accordance with the position thereof. If the plate is positioned too far above the rotor, efficiency is sacrificed since the suction effect is substantially lost.

When the rotor 50 is rotated by motor 30 preferably at speeds in the order of three thousand r.p.m., the charged and dispersed paint particles emanating from the edge 38 of the plate 36 are drawn downwardly by the suction created by the rotor through the ingress 52 thereof and are distributed mechanically through members 54 disposed around the rotor. It will be noted that the bottom of the rotor 50 is closed by a plate 56 which causes all of the air moved by the rotor to be drawn in through the ingress opening 52 thereof.

In this manner, charged paint particles are mechanically dispersed through the rotor and are thrown outwardly and directed toward the article 22 to be painted. If desired, the entire mechanism 20 may be reciprocated vertically within limits to cover a larger field as is well known in the art and this may be accomplished by any suitable reciprocating mechanism.

It is preferable to form the shaft 34 of insulating material such as Bakelite, glass or polytetrafluoroethylene, etc., or other suitable nonconducting material so that the charge is not imposed on the rotor 50 directly. However, it is believed that the paint particles which carry the charge from the plate 36 will charge the rotor 50 by contact during their passage therethrough. It is also preferable to insulate the journal 32 from the motor 30 so that the lead 43 from power pack 44 may be connected directly thereto as shown in Figure 1. This, of course, is not mandatory since the journal 32 may be insulated from the plate 36 and the lead 43 may be attached directly to the plate 36 which is stationary. Any of these modifications come fully within the scope of the invention and will not, in any way, affect the operation thereof, it merely being desirable to insulate the motor per se from the remainder of the apparatus. It is obvious that the other lead from the power pack 44, as indicated at 60, should be attached to the conveyor 26 so that the article 22 to be painted carries the opposite charge thereon to the charge carried by the paint particles whereby the article attracts the particles thereto and causes deposition of the charged particles thereon without waste usually occasioned by overspray.

The conveyor 26 may take any suitable form, that is to say, it may be a straight line conveyor passing on opposite sides of the device 20 or it may be a looped conveyor passing around the device 20 at a uniformly spaced distance from the device 20 or it may be a rectilinear-shaped conveyor as shown in Figure 4 wherein the conveyor takes the form of a square so that articles are conveyed progressively into and out of the field of painting indicated by the dotted line circle 62. This type of conveyor and its advantages are disclosed in my copending application, S.N. 698,490, filed Nov. 25, 1957, and forms no part of this invention.

In Figure 3, a modification of the invention is shown wherein the device 20 includes an annular shield or snail 70 extending around a portion thereof and preferably extending at least half-way around the squirrel-cage rotor 50. This shield 70 is usually metal and is connected to the power pack lead 43 so that it carries the same charge imposed on the plate 36. This causes the shield 70 to repel the charged paint particles whereby the particles are forced outwardly through the rotor at the portions thereof that are outside the shield 70. Any paint which might fall into the shield 70 may be drained outwardly therefrom through a hose drain 72 and returned to the paint supply. The article 22 is shown in Figure 3 as is the paint pattern which is shown at 80 in dotted lines. It will be noted that this pattern is substantially the same width as the rotor 50 and, therefore, the dimensions of the pattern may be varied by changing the width of the rotor to provide any desired width of pattern. The pattern in the other direction, as mentioned before, will be annular in shape when no shield is used and this general shape may be varied at will by utilizing shields, as noted

at 70, so that the annular pattern may be attenuated into any desired segment thereof.

The device as disclosed herein is particularly useful in electrostatic spray painting operations since it provides a very concentrated paint pattern which reduces tendencies toward overspray and which directs the charged particles directly to the article to be painted. Furthermore, the width of the pattern provides uniform density of paint throughout where such conditions are desirable.

The device utilizes the novel principle of first charging the paint and atomizing the same electrostatically and subsequently directing and distributing the paint mechanically after it has been charged. In the past, the mechanical direction of the paint has frequently been attempted prior to the charging thereof. However, in this instance, fouling of the apparatus is inevitable and the direction of the painting operation is difficult to control. In other devices, as noted in the aforementioned applications assigned to the assignee of this invention, charging and directing have been accomplished simultaneously wherein the electrostatic forces control the direction of painting to a substantial degree. In the present instant, however, the electrostatic forces are over-ridden by the mechanical directing means whereby more accurate control is accomplished while utilizing the full benefit of electrostatic painting for eliminating waste and overspray.

The present device is not fouled by paint since the rotor 50 assumes the same charge as the plate 36 whereby the particles are actually repelled by the rotor while they are being mechanically drawn therein due to the stream of air passing therethrough. Thus, the rotor is not fouled by the paint and very little paint will be apparent thereon after the device has been stopped and the charge removed therefrom. In this connection, however, it is an easy matter to clean the device by merely supplying solvent to the cup 40 or onto the plate 36 while the rotor is rotating which solvent passes through the rotor and cleans the louvers 54 thereof by removing all vestiges of paint therefrom.

One other advantage is apparent in this device, namely, since the paint used is generally a solvent containing paint, the paint particles, in solvent, as they are dispersed from the plate 36 are picked up by the draft of air being drawn through the rotor 50. This causes a rapid evaporation of the solvent whereby the paint or coating material upon deposition on the article 22 is partially dried whereby heavier coatings may be applied due to the rapid evaporation of solvent during the mechanical distribution of the paint particles. This does not mean that the paint particles are dry when they are applied to the part and this condition can be easily controlled by addition of solvent to the paint. However, by proper evaluation of the operation, it is possible to maintain the paint at a minimum condition of solvent content at the moment that it is deposited on the article 22 whereby runs and tears are controlled.

Several modifications of the device may be used for obtaining specific results. For example, the louvers 54 of the rotor 50 may be slanted to vary the pattern of spray. In general, if the louvers are slanted about 15° from the vertical, the desired results will be accomplished. Also, some louvers may be slanted one way and other louvers may be slanted in the opposite direction. This condition widens the pattern and helps control the throwing power of the rotor 50.

In the device as shown in Figure 2, there is a tendency toward throwing a somewhat greater density of paint from the bottom of the rotor than from the top due to gravity. This can be compensated by angling the louvers 54 from the bottom of the rotor outwardly about 15° from the vertical at the top thereof. This makes it easier for the paint at the bottom to flow up the louvers by centrifugal force to produce a substantially uniform density pattern. Thus, I contemplate the use of angled louvers wherein the angling is carried out to produce

the desired result. In this connection, the louvers may even be of "herringbone" design, angling in one direction from the top and the other direction from the bottom wherein the center line of the junctions of the angles may be in one plane or may undulate around the rotor.

While the embodiments of the present invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In a method for coating the surface of an article with particles of a liquid coating material, the steps comprising; establishing an electrostatic field between an atomizing head and the article to be coated, supplying liquid coating material to the atomizing head, electrostatically atomizing said material from said head while maintaining the electrostatic field between the article and the head, and then subsequently concentrating and mechanically distributing said electrostatically atomized particles with a force sufficient to span the distance between the head and the article whereby particles are mechanically and electrostatically deposited on the article.

2. In a method for distributing liquid as a coating onto a surface wherein liquid is supplied at a controlled rate to an electrostatic atomizing head and is subsequently deposited in dispersed condition as a finished coating on said surface which is spaced a substantial distance from the head, the steps of; electrostatically atomizing the liquid coating material from the head and then subsequently concentrating and mechanically effecting disposition of said coating material onto said surface wherein the distance between the head and the surface is greater than the distance normally spanned by electrostatic forces alone.

3. A method of depositing liquid as a coating on an article, comprising the steps of; supplying liquid at a controlled rate to a stationary atomizing zone, electrostatically atomizing finely divided discrete charged particles of said liquid from said zone, and immediately thereafter concentrating and mechanically directing and depositing said electrostatically charged particles on the article, the distance between the atomizing zone and the article being materially greater than the distance normally bridged by particles under the influence of electrostatic forces alone.

4. A method of depositing paint as a paint coating onto an article, the steps comprising; supplying paint at a controlled rate to a stationary atomizing zone, electrostatically atomizing finely divided discrete charged particles of said paint from said zone, then immediately thereafter drawing said particles into a confined mechanical distributing means from which they are mechanically impelled toward said article with sufficient force to bridge the space between the directing means and the article wherein the article is positioned a distance from the atomizing zone materially greater than the distance normally bridged by said particles under the influence of electrostatic forces alone.

5. A method of depositing paint as a coating onto an article, the steps comprising; supplying paint at a controlled rate to a stationary electrostatic atomizing zone, electrostatically atomizing finely divided discrete charged particles of said paint from said zone, and thereafter immediately concentrating the atomized charged particles, and then directing said particles toward the article to be coated with a force sufficient to bridge the distance between the atomizing zone and the article.

6. A method of depositing paint as a coating onto an article, the steps comprising; supplying paint at a controlled rate to an atomizing zone, atomizing finely divided discrete particles of said paint electrostatically from said zone, producing a suction zone adjacent said atomizing zone, concentrating said charged particles by drawing them into said suction zone, and then subsequently mechanically directing said particles toward the article with

sufficient force to bridge the space between the mechanical directing means and the article.

7. A method of depositing electrostatically charged paint particles as a coating onto an article, the steps comprising; supplying paint at a controlled rate to an electrostatic atomizing zone, atomizing finely divided discrete particles of said paint electrostatically from said zone, producing a flow of air adjacent said atomizing zone for changing the direction of said particles and for concentrating said particles and then mechanically directing the concentrated particles toward the article, said flow being of sufficient velocity to carry the atomized particles through the space between the atomizing zone and the article.

8. An apparatus for electrostatically depositing paint on an article to be painted, comprising in combination; a source of electrostatic power having one pole thereof attached to the article to be painted, a stationary paint distributor attached to the other pole of said power source, means for supplying paint to said distributor whereby the paint is subsequently atomized from the distributor by electrostatic forces, and air moving and suction means positioned below said distributor so as to pick up the atomized charged particles of paint from the distributor and direct the paint particles toward the article to be painted.

9. An apparatus for electrostatically depositing paint on an article to be painted, comprising in combination; a source of electrostatic power having one pole thereof attached to the article to be painted, a stationary paint distributor attached to the other pole of said power source, means for supplying paint to said distributor whereby the paint moves solely by gravity over said distributor and is subsequently atomized from the distributor solely by electrostatic forces, and air moving and suction means positioned below said distributor so as to pick up the atomized charged particles of paint from the distributor and direct mechanically the paint particles toward the article to be painted.

10. An apparatus for electrostatically depositing paint on an article to be painted, comprising in combination; a source of electrostatic power having one pole thereof attached to the article to be painted, a stationary paint distributor attached to the other pole of said power source, means for supplying paint to said distributor whereby the paint moves solely by gravity over said distributor and is subsequently atomized from the distributor solely by electrostatic forces, and air moving and suction means positioned below said distributor so as to pick up the atomized charged particles of paint from the distributor and direct the paint particles toward the article to be painted.

11. Apparatus for electrostatically depositing coating material onto an article, comprising in combination; a stationary plate adapted to be connected to one side of an electrostatic field and having a sharp edge therearound, means for supplying coating material to said plate for gravity flow off the edges of said plate, a squirrel-cage rotor positioned immediately below said plate and concentric therewith and having an ingress opening at its top of greater diameter than the diameter of the plate and means for rotating the rotor.

12. An apparatus for electrostatically depositing paint on an article to be painted, comprising in combination; a source of electrostatic power having one pole thereof attached to the article to be painted, a stationary horizontal distributing plate attached to the other pole of said power source, means for supplying solvent containing paint to said distributing plate and a motor-driven squirrel-cage rotor positioned below and concentric with said plate and having an ingress opening at its top of greater diameter than the diameter of said plate whereby charged particles of paint atomized from the edge of said plate are drawn into said rotor and dispersed therefrom mechanically from the article to be painted.

13. The apparatus as claimed in claim 12 wherein the rotor includes louvers angled from the vertical.

14. The apparatus as claimed in claim 12 wherein a concentric cup is provided upon said distributing plate having a diameter less than the diameter of the plate wherein the paint is supplied directly to the cup for overflow supply therefrom onto the distributing plate.

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