Nov. 28, 1961 J. J. SEDLACSIK 3,010,428

SPRAYING DEVICES

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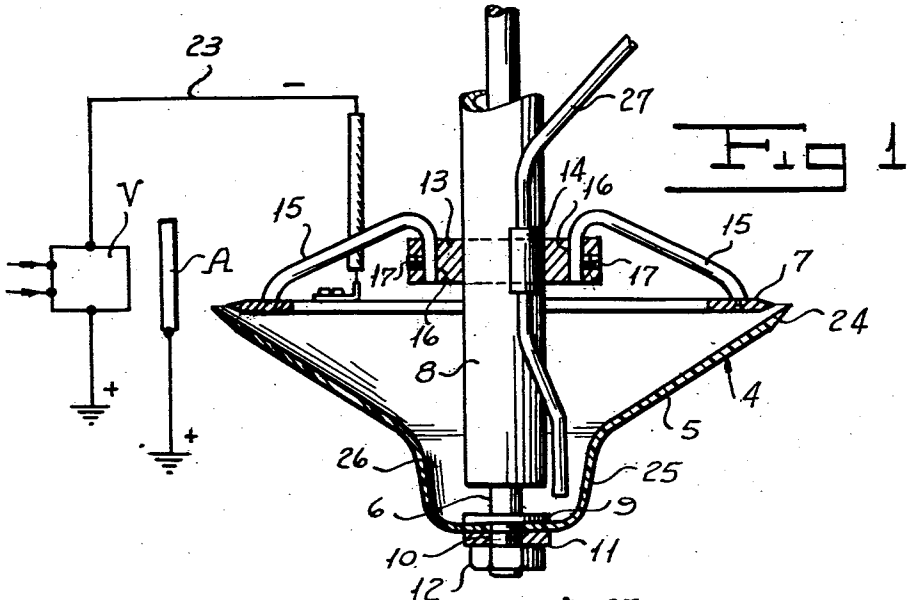

Fig 1

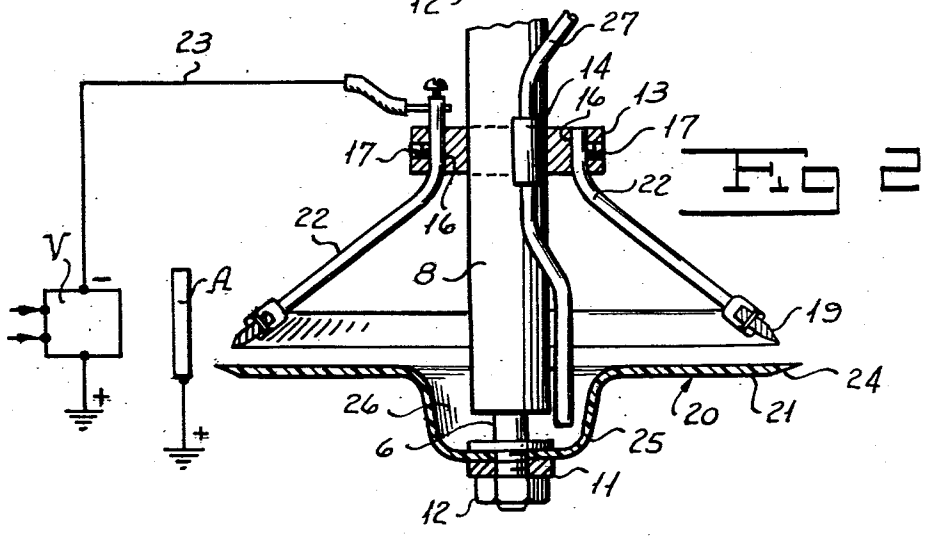

Fig 2

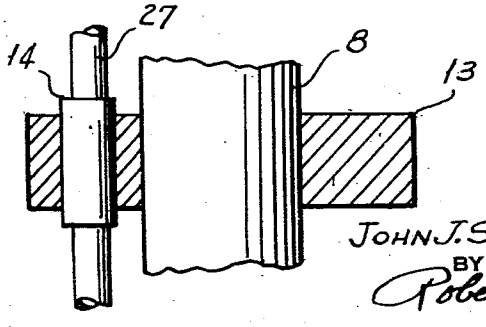

Fig 3

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SPRAYING DEVICES

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This invention relates to the spraying of coating liquids and, more particularly, to a spraying device in which the liquid is dispersed by a rotating member or rotor and then transmitted by an electrostatic field to the object to be sprayed.

Heretofore, the rotating member or rotor was made of metal and charged with a high electric potential so that the liquid would be ionized as it left the rotating member. Much of the electrical energy is lost by this method because the rotary member acts like the plate of a capacitor, causing large leakage losses between the device and the work piece.

An object of this invention is to provide an electrostatic spraying device with only a minimum of electrical energy losses.

Another object of this invention is to obtain, with this type of device, a uniform coating at a high rate of deposition.

The foregoing objects and others ancillary thereto I prefer to accomplish as follows:

According to one embodiment of this invention, the rotating member or rotor is made of a suitable ametallous material having a high electric resistivity. A narrow metallic ring or electrode is mounted coaxially with the rotating member and is located adjacent to the circumference of the rotating member. This ring is attached to the spraying device and to the negative terminal of a high voltage electrical supply.

The article to be coated is attached or grounded to the positive terminal and insulated relative to the ring, thus establishing an electrostatic field between the ring and the article to be coated. Since the area of the ring is small, most of the energy is utilized in the formation of a corona discharge ionizing the air surrounding the ring. As the member rotates, the liquid, which is supplied to the member adjacent the axis of rotation thereof, moves toward the circumferential edge of the member in the form of a film. As the liquid passes between the ring and the rotating member, the particles thereof become negatively charged. This causes a molecular repulsion which disperses the particles of liquid in a fine mist or fog. The article to be coated, being positively charged, attracts and is enveloped by the fog, thus coating all exposed portions of the article.

This preferred embodiment of the invention is set forth in the accompanying drawings, in which:

FIG. 1 is a sectional view of the invention;

FIG. 2 is a sectional view of a modified form of the invention; and

FIG. 3 is a detail sectional view of the ring-supporting collar.

An electrostatic sprayer to overcome the defects hereinbefore mentioned must have an electrically charged member of a small surface area and of such a configuration as to produce the desired corona discharge at the periphery of the rotating member. Accordingly, the invention, as shown in FIG. 1, is constituted by an ametallous member or rotor 4 having a substantially frustum-

shaped outer section 5. The rotor 4 is rotatably mounted on a shaft 6 and with a stationary metallic ring 7 located at the outer edge of the rotor 4 in spaced relation therewith.

A stationary housing or tube 8 constructed of an ametallous material having a high electric resistivity has mounted therein the rotatable shaft 6 journaled in bearings (not shown) in the tube 8, so that the shaft 6 is free to rotate within the tube. The lower end portion of the shaft 6 projects from the tube 8, and said projecting end of the shaft 6 is provided with a flange 9 and a threaded portion 10 therebelow. The rotor or member 4 is affixed to the shaft 6 by means of a washer 11 and a nut 12 cooperating with the flange 9. Thus, when the shaft 6 is rotated by an electric motor, or other suitable means, the rotor 4 will be rotated by the shaft. Suitable insulation may also be provided between the motor shaft and the shaft 6. Furthermore, the housing 8 may be constructed of metal and insulated from the motor or other components to preclude arcing, etc.

The metal ring 7 is mounted on the stationary tube 8 by means of a collar 13 having a sleeve 14 extending therethrough. Several round wire bracket rods 15 are welded at one end to the ring 7, and this assembly is attached to the collar 13 by the rods 15 being inserted at their opposite ends into holes 16 and secured and held therein by set screws 17. The metal ring 7 is positioned in the plane of, and adjacent to, the outer edge of the rotor or member 4.

Referring now to FIG. 2, a modification of the invention, the metal ring 19, which is to carry the electric charge, is in the shape of a frustum of a cone, while the rotating member or rotor 20 is provided with an outer flat discal section 21. The rotor 20 is attached to the shaft 6 by the washer 11 and the nut 12, so that the rotor will rotate with the shaft. The metal ring 19 is attached to the stationary tube 8 by means of the collar 13 and by wire bracket rods 22 having coincident slotted or bifurcated ends receiving the ring 19 and being clamp-riveted to the ring. This assembly is attached to the collar 13 by inserting the other ends of the rods 22 into the holes 16 and securing the same therein by the set screws 17.

A wire 23 from a high voltage supply V, as diagrammatically shown, is attached directly to the metal ring 7, as shown in FIG. 1, or to the supporting rods 22, as shown in FIG. 2. The metal rings 7 and 19 are each provided at its outer circumference with a sharp edge 24 and a rounded edge at its inner circumference. This configuration results in the most efficient electric discharge pattern and concentrates the discharge at the circumferential edge of the rotor to provide the corona discharge.

Both of the rotors 4 and 20 are each provided with a cup-shaped inner or central portion 25 defining a chamber 26 having a side wall with a slight outward slope and having a larger diameter at its mouth than at the bottom of the chamber. This configuration is desirable to allow the coating liquid to flow up the side wall of the chamber in a uniform film by centrifugal force as the rotor turns at high speed.

In operation, the rotor is rotated by the shaft 6, and a high electrical potential is applied to the metal ring 7 or 19 to the extent of producing a corona discharge at the edge 24 of the ring. Coating liquid is supplied to the chamber 26 of the rotor through a conduit 27, made

of an electrically insulating substance. In some instances, coating liquid may be mixed in the chamber **26**. The conduit **27** extends through the sleeve **14** and is thus attached to the stationary tube **8** by the collar **13**. Since the chamber is rotating at a high speed, centrifugal force will cause the coating liquid to flow up its wall in a film of uniform thickness. As the liquid reaches the mouth of the chamber of the rotating member, it moves radially more violently and rapidly, since there is little or no restraint on it. Also, as the liquid moves outwardly, it will spread over an increasingly larger area and the film will thin out proportionately. As the film passes beyond the metal ring **7** or **19**, which is maintained at a high negative potential, the particles are thoroughly electrified by the corona discharge. All the particles, being of the same polarity, explode and are repelled by each other and by the ring itself, forming a fine mist or fog which is attracted to the article A to be coated, since it is grounded and of the opposite polarity.

The usual practice is to mount the spraying device adjacent a moving conveyor on which are positioned the articles to be coated. If the articles are larger than the effective coverage area of the spraying device, the latter is secured to a suitable reciprocating apparatus, such as a hydraulic piston with suitable controls for optimum stroke and rate of motion.

As can be seen readily by the foregoing disclosure, this invention has many advantages over other sprayers of this type. The location and configuration of the metal rings concentrates the electrical energy at the point of maximum effectiveness for liquid dispersion. Also there is little electrical energy lost because the area of the highly charged surface is small. These factors will result in more economical operation of the sprayer and in more even coating.

I claim:

1. An electrostatic sprayer apparatus for spraying an article to be coated, said apparatus including a rotor made of an electrically non-conductive material having an annular coating material discharge edge and adapted to centrifugally project particles of coating material substantially radially outwardly therefrom, an annular charging electrode having an outwardly projecting continuous sharp edge spatially disposed, adjacent, and subtsantially parallel to said coating material discharge edge to charge and repel the particles of coating material as they are centrifugally projected in the form of an atomized spray from the rotor material discharge edge, means to apply coating material to said rotor, and means to apply one polarity of a high potential to the article to be coated and an opposite polarity to said annular charging electrode, whereby the centrifugally projected coating material in the form of an atomized spray at no time is subjected to direct electrical contact with the annular charging electrode and wherein the centrifugally atomized particles of coating material are directly charged electrostatically by the annular charging electrode after being centrifugally atomized.

2. Apparatus for use in a system for spraying articles to be coated with particles of coating material and wherein said articles are electrically charged at one polarity and adapted to be coated by particles of coating material of a different polarity, comprising a centrifugal atomizer and including an element of non-conducting material and having a peripheral coating material discharge edge for centrifugal atomization therefrom of coating material to be mechanically projected toward said articles, and a charging electrode having a continuous sharp edge spatially disposed from and adjacent said coating material discharge edge, said charging electrode being adapted to be electrically charged at a predetermined polarity to establish an electrostatic field adjacent said centrifugal atomizer material discharge edge to charge said centrifugally atomized particles for electrostatic deposition onto said articles after centrifugal atomization of said coating material into particles projected from said non-conducting element without having any direct electrical contact between the coating material and the charging electrode, wherein said particles are directly charged after formation and while in transit toward said articles to be coated.

3. For use in applying spray coating material to an article charged at one electrical polarity by employing centrifugal atomization and electrostatic deposition of said coating material onto said article, centrifugal atomization element means including an atomization element with at least a portion of non-conducting material and adapted to receive and centrifugally discharge therefrom said coating material, said centrifugal atomization element means having an annular peripheral edge for the discharge therefrom of said coating material in comminuted form, charging electrode means having a metallic continuous sharp charging edge means spatially disposed from but adjacent said peripheral edge of the centrifugal atomization discharge element, whereby when said charging electrode means is charged at the electrical polarity oppoiste to that of said article, said coating material particles will be charged at the same polariy as the charging electrode means upon emanation of said coating material in atomized form from said centrifugal atomizing element means having said portion of non-conducting material to coat said article with said charged particles of coating material without said coating material coming into direct electrical contact with the charging electrode means.

4. An atomizer head for use in centrifugal atomization and electrostatically charging material for spray coating an article with charged particles of one polarity of coating material emanating from said atomizer head and attracted electrostatically to an article charged of the polarity opposite to that of the charged particles, said atomizer head including a rotatable element having at least a material discharge edge of ametallous material for centrifugally discharging radially therefrom particles of coating material in atomized form, and electrically conductive means having a continuous peripheral electrostatic charging edge spatially disposed from said material discharge edge of the ametallous rotating element and adjacent thereto to electrostatically directly charge, when energized, said particles of coating material discharged therefrom, and while in transit to the article to be coated beyond the confines of the coating material discharge edge.

5. An electrostatic spraying device for spraying articles to be coated with particles of coating material comprising rotor and stator elements arranged coaxially and each having adjacent edge portions disposed respectively equidistant and in a predetermined spatial relation adjacent to one another for establishing a uniform corona discharge area therebetween, said rotor element being substantially disc-shaped and adapted to provide an annular spray centrifugally projected from said edge portion, said stator element having its said edge portion terminating in a substantially sharp peripheral edge spatially disposed and adjacent said rotor edge portion, means for coupling a source of high potential with the stator element for establishing a corona discharge in said corona discharge area for electrostatically charging the particles of coating material as they are centrifugally projected in the form of an atomized spray from said rotor, and means for supplying coating material to the rotor element, said rotor element being made of substantially electrically non-conducting material to prevent the coating material applied thereto from direct contact with said source of high potential, whereby atomization in the form of a spray of the coating material is produced centrifugally by said rotor element of substantially electrically non-conducting material and the particles of said spray are deposited predominately by

electrostatic action in the electrostatic field between said stator and the articles to be coated.

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