July 23, 1968 R. J. BLACKWELL 3,393,662

APPARATUS FOR ELECTROSTATIC SPRAY COATING

Filed Dec. 30, 1964 3 Sheets-Sheet 1

FIG. 1.

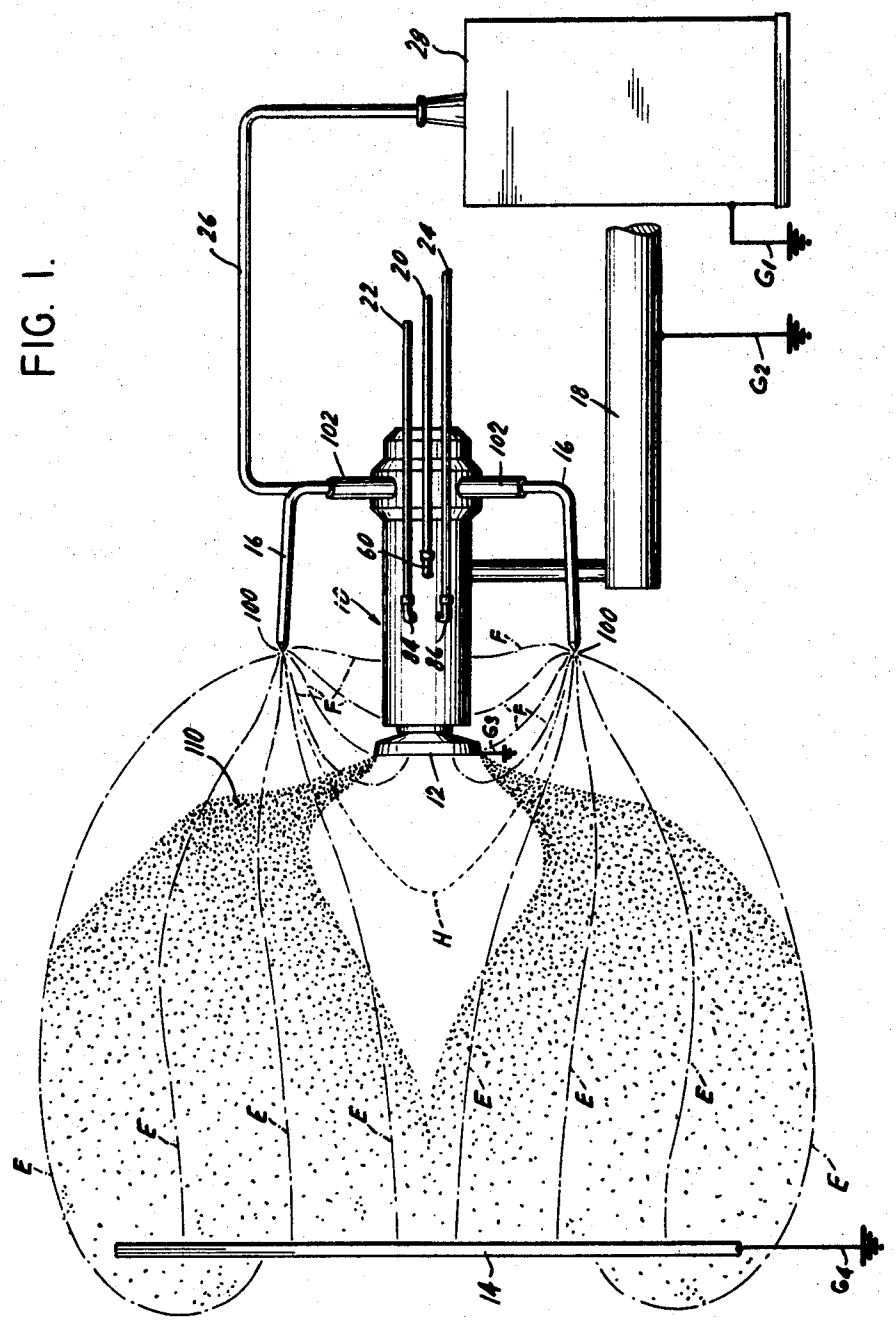

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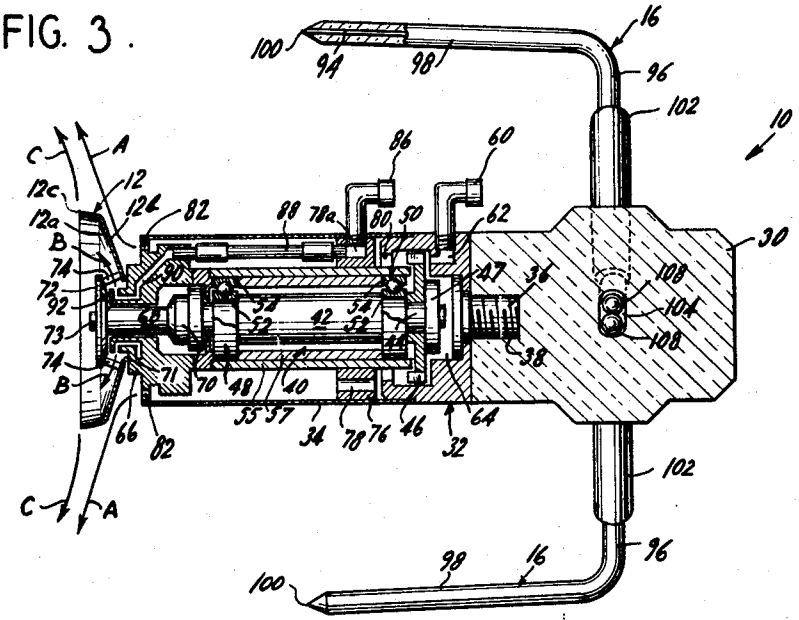
FIG. 3.



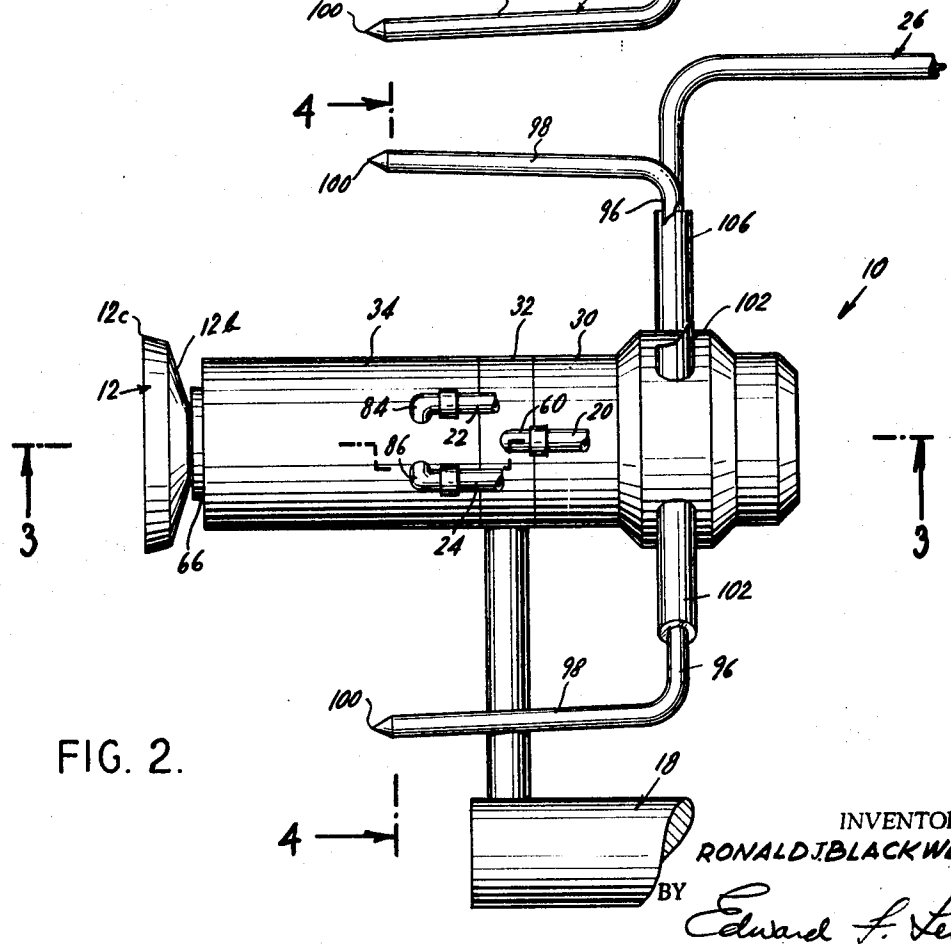


FIG. 2.

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APPARATUS FOR ELECTROSTATIC SPRAY COATING

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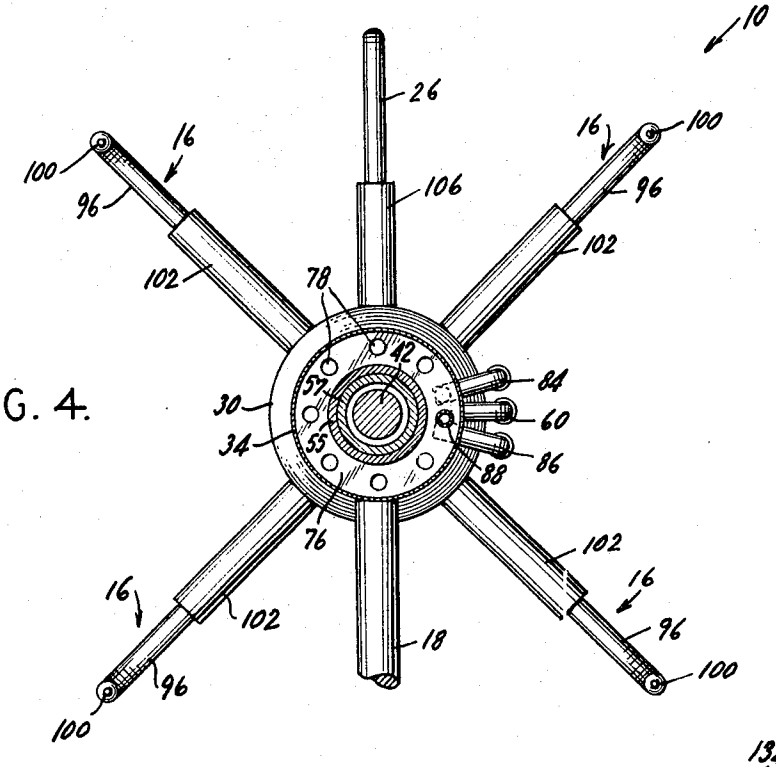

FIG. 4.

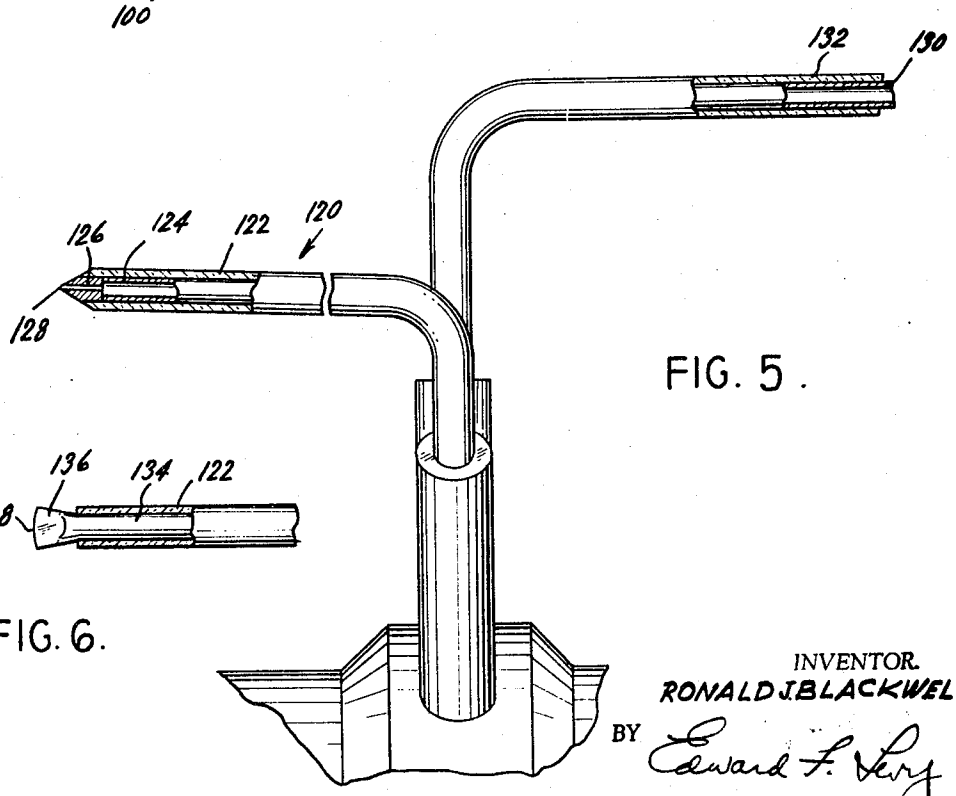

FIG. 5.

FIG. 6.

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3,393,662

APPARATUS FOR ELECTROSTATIC SPRAY COATING

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11 Claims. (Cl. 118—626)

ABSTRACT OF THE DISCLOSURE

Apparatus for the electrostatic spray coating of articles wherein a rotary atomizer head is employed for centrifugally atomizing liquid coating material fed thereto, the articles to be coated are mounted forwardly of the atomizer head, and a high voltage electrode is located rearwardly of the atomizer head. Both the atomizer head and the articles to be coated are maintained at a potential opposite to that of the electrode whereby an electrostatic spray-depositing field is established between the electrode ad the articles to be coated, which field surrounds the atomizer head for receiving therein atomized coating material projected radially from the rotating atomizer head.

The present invention relates to improvements in electrostatic spray systems, and in particular to a novel and improved apparatus for spray coating articles wherein the deposition of the coating material is accomplished by means of electrostatic forces.

In the application of liquid materials, protective coatings, paints, finishing materials, fungicides, bacterial solutions, and the like, in the form of a spray to various articles, it is well-known to provide an electrostatic field between a charging electrode and the article to be coated, the electrostatic field serving to charge the spray particles and deposit them upon the article to be coated. Such a spray system has found widespread use particularly in the field of paint spraying, because of the efficiency of the electrostatic field in depositing the spray upon the object to be coated.

In the more recent developments of electrostatic spray deposition, an atomizer head is provided and is maintained at a very high electrical potential thereby serving as the charging electrode, while the article to be coated is maintained at ground potential, thereby creating a strong electrostatic field between the spray head and the work. If the applied voltage is sufficient, the field is effective to direct the liquid spray toward the grounded article to be coated and to deposit the spray on said article with very high efficiency.

While in some systems, the coating materials are atomized mechanically, as by means of a conventional air spray gun, and the atomized particles are propelled physically in the electrostatic field between an independent charging electrode or grid and the article to be coated, where the atomizer head itself is maintained at high potential to become the charging electrode of the field, the coating material thereon would atomize by means of electrostatic forces if the material was formed in a thin film having a sharp edge. Such electrostatic atomization is advantageous in that it avoids the necessity of providing means for mechanical atomization. In commercial use, the atomizer head is usually in the form of a disc or cup which is rotated by a motor to feed the coating material in the form of a fine film to its edge.

The provision of an atomizer head at high potential has its limitations and disadvantages. While deposition efficiency of the atomized spray increases with the increase of voltages employed, where electrostatic atomization is employed, it has been shown that there is a maximum potential gradient, above which the quality of atomization deteriorates. Thus deposition of the coating material suffers due to the requirements of electrostatic atomization. Further, where the atomizer head is maintained at a high potential and the articles to be coated are grounded, there is a tendency for arcing between the atomizer head and the articles, particularly where the head is brought close to the articles or where the articles are carried on a conveyor and swing toward the atomizer head. Since most coating compositions are combustible and some are highly inflammable, such arcing incurs a serious fire or explosion hazard. In addition, where the atomizer head is maintained at high potential, the coating material feed lines, pump and controls, as well as air and motor controls are also at high potential, presenting a serious shock hazard when they are approached by the operator.

It has been thought necessary to maintain a high potential gradient between the atomizer head and the article to be coated in order to obtain proper electrostatic deposition, even where the coating material was atomized by mechanical means. Thus, if both the atomizer head and article to be coated were maintained at the same potential in an electro-static field, it would be expected that the atomized paint would, under the influence of the field, be directed away from the article to be coated rather than toward it. I have found, however, that where both the article to be coated and the atomizer head are maintained at the same potential, preferably ground potential, and an electrostatic field of suitable geometry is created surrounding these members, the field may be made effective to deposit the atomized coating material on the article with even greater efficiency than in the previous systems.

It is an object of the present invention, therefore to provde an elecrostatic spray coating system wherein the coating material is centrifugally atomized from an atomizer head and wherein both the atomizer head and article to be coated are maintained at the same potential, preferably ground potential. In such an arrangement, there is no tendency for sparking or arcing between the atomizer head and the article to be coated, and the danger of shock to the operator in approaching or touching the atomizer head and its associated parts and controls is minimized.

Another object of the invention is the provision of an electrostatic spray coating system of the character described in which a rotary centrifugal atomizer head is employed together with a drive motor sufficient to rotate the head at extremely high velocities, thereby producing by centrifugal means atomized particles of a size smaller than that obtainable by electrostatic atomization. Since the centrifugal atomization is independent of the electrostatic forces of the surrounding field, there is no limit on the potential gradient of the field, and optimum deposition of the atomized spray may be obtained.

In accordance with the invention, there is provided an electrostatic spray coating system including an atomizer unit having a rotary head, means to feed coating material to said head and means for rotating said head to atomize the coating material centrifugally in the form of a fine spray flung radially from said head. One or more charging electrodes are located a short distance rearwardly of said head and spaced outwardly thereof, the charging electrodes being maintained at a high potential relative to an article to be coated which is spaced forwardly of said head and is preferably grounded. The atomizer head is also grounded and maintained at the same potential as the article to be coated. A strong electrostatic field is created between the charging electrode and the article to

be coated outwardly of and surrounding the atomizer head in such a manner that when the atomized spray is propelled radially from the atomizer head, it enters this electrostatic field and is carried thereby to the article to be coated, being deposited on the latter. Means may be provided to supply a shroud of air under pressure around the atomized spray, the air shroud providing a forward component of movement to the spray, concentrating the same, and dampening its radial movement so that it is prevented from travelling radially through the field without coming under the influence thereof.

Additional objects and advantages of the invention will become apparent during the course of the following specification when taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of a spray assembly made in accordance with the present invention and indicating the electrostatic fields which exist during the operation thereof, portions of the assembly being broken away or shown schematically for convenience of illustration;

FIG. 2 is a side elevational view of the atomizer unit and charging electrodes utilized in the assembly of FIG. 1, with portions thereof broken away;

FIG. 3 is a section taken along line 3—3 of FIG. 2;

FIG. 4 is a section taken along line 4—4 of FIG. 2;

FIG. 5 is an enlarged partial side elevational view, partially broken away and shown in section, of a modified form of charging electrode which may be employed in the spray assembly; and

FIG. 6 is an enlarged partial side elevational view, partially broken away and shown in section, of still another form of charging electrode.

Referring in detail to the drawings, and in particular to FIG. 1, there is shown a liquid spray coating system employing an atomizer unit **10** having a rotatable atomizer head **12**, an article **14** to be coated, and charging electrodes **16** therefor. The atomizer unit **10** is mounted on a support arm **18** mounted on a stand, pedestal, or reciprocating apparatus (not shown).

The atomizer unit **10** contains an air motor which rotates the atomizer head **12** at high speed so that the liquid coating material fed thereto is atomized centrifugally. A pipe or conduit **20** connects the air motor to a source of air under pressure (not shown) such as a conventional air pump, for driving the motor. The source of air also supplies air under pressure to the interior of the atomizer unit **10** through pipe or conduit **22** for supplying a shroud of air around the spray of liquid coating material atomized by the head **12**, in a manner to be presently described. The liquid coating material is supplied to the interior of atomizer unit **10** and thence to the atomizer head **12** through a pipe or conduit **24** connected to a liquid supply pump (not shown) of the usual type. In addition, a conductive cable **26** leading from one terminal of a high voltage power supply **28** leads within the atomizer unit **10** and is connected to the charging electrodes **16**.

The atomizer unit **10** includes a rear base portion **30**, a metallic impeller housing **32** and a metallic motor casing **34** interconnected to provide a completed assembly. Referring particularly to FIG. 3, it will be seen that the rear base portion **30** is solid and made of insulating material such as molded nylon. The impeller housing **32** is securely mounted on base portion **30** by means of a screw **36** extending within a threaded bushing **38** inset in said base portion **30**. The impeller housing **32** is cylindrical, and the motor casing **34** is tubular and mounted on the forward end of said impeller housing in overlapping flush relationship therewith, as shown in FIG. 3, so as to form an air-tight seal therewith.

A metallic air motor **40** is mounted centrally within the motor casing **34**, said motor comprising a main shaft **42** having a rear terminal portion **44** of reduced diameter upon which an impeller **46** is rigidly mounted, as by means of nut **47**. The shaft **42** is rotatably mounted within motor casing **34** by a pair of ball bearing assemblies **48** and **50** at the opposite ends thereof, the annular inner races **52** of said ball bearing assemblies being secured to respective shoulders on the shaft **32**. The outer ball bearing races **54** are secured to the inner surface of a motor shell **55**, and are retained in position by a spacer tube **57**.

The impeller **46** is located within the impeller housing **32** and is freely turnable therein. The impeller **46** has a series of V-shaped impeller blades formed therein and is secured to main shaft **42** by a nut which is threaded on the rear portion **44** of said shaft and urges impeller **46** into frictional engagement with the inner race **52** of bearing **50** so that when the impeller is driven, the shaft **42** is rotated at high velocity.

The atomizer unit **10** has a motor air inlet coupling **60** which is threadedly mounted in the impeller housing **32** and communicates with a bore or port **62** which provides an air jet into the impeller chamber **64** within said impeller housing. The motor air supply pipe **20** is connected to the coupling **60** for supplying air under high pressure thereto.

The atomizer unit **10** has a nose portion **66** secured to the outer race **54** of ball bearing assembly **48** and to the forward end of motor casing **34**, the nose portion closing off the front end of said motor casing. The shaft **68** of atomizer head **12** is journalled in a central opening in said nose portion and carries at its inner end a chuck **70** which is rigidly coupled to the main shaft **42** of motor **40**.

The atomizer head **12** is made of conductive metal and is dish-shaped, having a forward interior surface **12***a* and a rear outer surface **12***b*. The head **12** has a large central opening **71**, and a mounting disc **72** is spaced forwardly of said central opening and is concentric therewith. The disc **72** is rigidly mounted on the atomizer head **12** by means of a plurality of spaced accelerator rods **74**. The mounting disc is secured to the front end of shaft **68**, as by a screw and nut **73**.

As shown in FIGS. 3 and 4, an annular disc **76** is rigidly mounted within the motor casing **34** just forwardly of the impeller housing **32**, the rear end portion of the motor shell **55** extending through the central opening in said disc **76** and being supported thereby. The disc **76** has an annular row of spaced openings **78** therein.

The forward wall of the impeller housing **32** has an enlarged opening **80** communicating with the interior of the motor casing **34** through the disc openings **78**. Thus, air introduced from motor air inlet coupling **60** to the impeller chamber **64**, drives the impeller and then passes through the opening **80** and disc openings **78** to the interior of the motor casing **34** from whence it exits through small apertures **82** in the forward face of nose portion **66**. This motor exhaust air impinges upon and is directed outwardly along the rear face of atomizer head **12** in general following the path indicated by the arrows in FIG. 3.

The pipe **22** supplying auxiliary shroud air under pressure, is connected to a coupling **84** which extends through the motor casing **34** and communicates with the openings **78** in disc **76**. This shroud air travels forwardly through the interior of motor casing **34**, joining with the motor exhaust air, and escapes through the forward apertures **82**, following the path of arrows, to form an air shroud about the atomized spray, as will be presently described.

The liquid coating supply conduit **24** is connected to a coupling **86** which extends through the motor casing **34** and into disc **76**, communicating with an enclosed opening **78***a* in said disc, that is to say an opening **78***a* which does not extend through the rear surface of disc **76** and is therefore closed off at its rear end. A pipe **88**, extending through the interior of motor casing **34**, connects the closed-off coating material supply opening **78***a* with a bore **90** in nose portion **66**. The bore **90** in turn communicates with an annular passageway **92** formed in nose portion **66** and opening through the front surface thereof. A closed system for the coating material is thus provided, the material entering the interior of motor casing **34** through coupling **86**, then flowing through pipe **88** di-

rectly to bore **90** and being distributed about passageway **92** in an annular pattern as it leaves the forward end of nose portion **66**.

The forward central section of nose portion **66** extends into the central interior of atomizer head **12** and terminates in a circular flange **92** spaced slightly forwardly of the open end of annular passageway **90**. The flange **92** is normal to the axis of passageway **90** and acts as a baffle to direct the emerging coating material along the forward or inner surface of the atomizer head **12**, the coating material following the path indicated by arrows B in FIG. 3.

The charging electrodes **16** each comprise a cylindrical rod of insulating material, each rod being L-shaped and having a radially-extending arm **96** and a substantially perpendicular, forwardly-extending arm **98**. A wire **94** of copper or other highly conductive material is set within each charging electrode **16** and extends centrally and longitudinally through the arms **96** and **98**, as shown in FIG. 3. Each arm **98** and its wire **94** terminates in a sharply pointed tip **100**. As shown in FIGS. 2 and 3, each arm **98** forms with the respective arm **96** an angle slightly greater than 90° so that the tips **100** point slightly away from the atomizer unit **10**. The arms **96** each terminate in an integral enlarged hollow tubular portion **102** of insulating material which extends radially into the rear base member **30**, communicating with a circular recess **104** at the center thereof.

As shown in FIGS. 2 and 4, the high voltage cable **26** extends through a radially-disposed insulator sleeve **106** into the interior of rear base member **30**, where it is electrically connected to the joined ends of the charging electrodes **16**. This electrical connection is accomplished by a plurality of conductive metal balls **108** respectively secured to the wires **94** at the inner ends of the tubular portions **102** and to the end of cable **26**, the balls being pressed together and making good electrical contact in the circular recess **104**.

As was previously indicated, the atomizer head **12**, the motor casing **34**, impeller housing **32** and the constituent parts of motor **40** are all made of electrically conductive metal, as is the support arm **18** upon which the atomizer unit is mounted. The power supply **28** is a source of high voltage, one terminal of which is electrically connected to the charging electrodes **16** through cable **28**, and the other terminal of which is connected to ground as indicated at G_1 in FIG. 1. The other terminal of power supply **28** is also connected through ground to the support arm **18** and thus to the motor and atomizer head **12** which are therefore grounded as indicated at G_2 and G_3 in FIG. 1. The grounded terminal of the power supply **28** is also connected through ground to the article **14** to be coated as indicated by G_4 in FIG. 1. In practice, the grounding of article **14** would normally be accomplished through a grounded conveyor upon which article **14** is suspended by a hook or other means.

The power supply **28** is capable of supplying high voltages, for example, 100,000 volts or greater, depending upon the particular coating requirements, such as the spacing between the electrodes **16** and article **14**, the size, shape and constituent material of the article **14**, and the type of coating material employed. As is customary the power supply **28** is adjustable to vary the supplied voltage over a wide range, as desired. When the power supply is energized, an electrostatic field is established between the pointed tips of the charged electrodes **16** and the grounded article **14** to be coated. This primary electrostatic field is indicated by the lines of force E shown in FIG. 1. Since a plurality of electrodes **16** are arranged around the periphery of the atomizer unit **10**, the lines of force eminating from the individual electrodes complement each other to create a circular field completely surrounding the atomizer unit **10**.

A portion of the field created extends between the charging electrodes **16** and the atomizer head **12** and metallic motor body. This portion may be designated as a secondary field and is indicated in FIG. 1 by the lines of force F.

Since the coating material is atomized centrifugally there is no limit on the maximum voltage which may be supplied, and the only consideration is the requirements of coating deposition.

The electrode tips **100** are arranged in a circle concentric with the rotary axis of atomizer head **12** and are located rearwardly of said atomizer head a sufficient distance so that the surrounding field defined by lines of force E is wide enough at the plane surrounding the atomizer head **12** to receive and act upon all of the atomized droplets propelled radially from said head. It will be understood that instead of employing individual spaced electrodes arranged circularly around the atomizer, the arms **96** and **98** may be made of insulating material and may support at their ends an external electrode grid in the form of a conductive wire of small diameter connected to the power supply **28**. It will be appreciated that the electrode may, however, be made of any suitable material in any selected configuration and mounted adjacent the atomizer or on the atomizer by insulating means, according to the requirements of the coating operation.

In operation, air is fed under pressure through feed pipes **20** and **22** into the interior of the atomizer unit **10**, the air fed through pipe **20** passing at high velocity through the impeller chamber **64**, and by means of impeller **46**, causing the air motor **40** to rotate the atomizer head **12** at high velocity. The air supply for the motor may be regulated to adjust the rotational speed of the atomizer head in a range up to 50,000 r.p.m.

Liquid coating material is then fed through pipe **24** into the interior of atomizer unit **10**, the coating material flowing through pipe **88** and bore **90** into the space between the front surface of nose portion **66** and the disc **72**. Since the disc is rotating at high speed with the atomizer head **12**, the paint is ejected centrifugally onto the inner surface **12***a* of the atomizer head **12** and flows in a thin film outwardly of the surface **12***a* until it reaches the edge **12***c* of atomizer head **12**. Because of the high rotational speed of atomizer head **12**, the liquid coating material is atomized in very fine droplets from the circular edge **12***c*, forming a fine spray of liquid which spreads radially from the atomizer head. If no electrostatic field were provided, this spray of atomized liquid would not have sufficient forward velocity to reach the article **14** to be coated.

When the power supply **28** is energized, a high potential is created between the charging electrodes **16** on the one hand, and the grounded article **14** to be coated and grounded atomizer head **12**, on the other hand, creating the electrostatic field indicated by the lines of force E and F. In practice, the electrodes **16** are preferably negatively charged, while the atomizer head **12** and article **14** to be coated are positively charged. Since the atomizer head **12** and article **14** are both positively charged and are at the same potential and grounded, there is a zero average field therebetween. Thus, if the liquid coating material atomized by the head **12** were directed forwardly into the area indicated by the broken line H in FIG. 1, it would be under no field influence and would not, in this location, be deposited upon the article **14**. However, the atomized coating material is ejected radially outward from the atomizer head **12** so that it enters the field defined by lines of force E and is deposited by such field upon the article **14** in the manner now to be described, unless air is applied to the shroud in sufficient force to itself direct the atomized coating material particles toward the articles to be coated.

Because the tips **100** of charging electrodes **16** are sharply pointed, they emit a corona discharge, that is a copious quantity of negative ions which disperse throughout the field and travel toward the grounded article **14** of opposite polarity. The centrifugally atomized particles of coating

material leaving the grounded atomizer head **12** are positively charged through contact with said head. It would be expected that such positively-charged particles would be deposited on the pointed tips **100** of the charging electrode because of the field existing between said electrodes tips and the atomizer head. Quite unexpectedly, however, such deposition does not occur. It is believed that the reason for this is that the large supply of negative ions emitted by the electrode tips **100** neutralize approaching positively-charged particles of coating material and then charge these particles negatively so that the particles are repelled by the electrodes **16** toward the grounded article **14**.

In any event, the atomized particles of coating material are not directed rearwardly, but rather are physically propelled by centrifugal force in a radical direction so that they enter the primary field defined by lines of force E, as indicated by the stippled spray **110** in FIG. 1. The centrifugal and aerodynamic forces produced by the atomized head rotating at velocities in excess of 30,000 r.p.m. are sufficient to atomize the coating composition to average droplet sizes smaller than one mil, which is smaller than can be achieved by electrostatic atomization. Once the particles enter the field, they are bombarded by the negative ions emitted by the charging electrodes **16** and are negatively charged, being attracted to the article **14** and are deposited thereon. Thus, the atomized spray droplet or particles entering the surrounding field are attracted to the article **14** as the collecting electrode since article **14** has a considerably greater surface area than the pointed charging electrode tips **100**. The particles follow the lines of force E and deposit on the article **14** with the desired and well-known "wrap-around" effect.

The force with which the atomized droplets are propelled from the centrifugal atomizer head **12** is sufficient to carry them through the secondary field defined by lines of force F so that they do not have an opportunity to come under the influence of the secondary field. On the other hand, the propelling force is not sufficient to physically drive the particles entirely through the primary field particularly since this force is dampened by the shroud of air provided. This air shroud is provided by the air fed through inlet pipe **22** as well as the motor exhaust air, which combines within the atomizer unit and exits through the circular row of small apertures in the front wall of nose portion **66**. This stream of air under considerable pressure travels around the outer surface of the atomizer head **12**, leaving the atomizer unit in the general direction of the arrows A in FIG. 3 and forms a cone-shaped shroud about the spray of atomized paint particles, concentrating the spray pattern as the pressure of air fed through pipe **22** is increased. The air shroud also serves to decelerate the atomized particles as they travel further away from the spray head, thus insuring that these particles will travel slowly enough within the primary field to enable the force of the field to deposit the particles on the article to be coated. In addition, the air shroud acts upon the particles within the primary field, supplying a forward thrust to complement the deposition action of the field itself. This is particularly useful where the head is located at short distances from the article to be coated especially where it is desired to fill cavities and corners of the article.

The advantages of utilizing a grounded atomizer unit including a grounded atomizer head will be readily apparent. Highly combustible coatings can be employed in the system shown herein without incurring the danger of explosion or fire due to arcing. Whereas in systems in which the atomizer head is connected to high voltage and the article to be coated is grounded, arcing will occur when the head is brought close to the article (as by the article swaying on its conveyor), such arcing cannot occur between the grounded head and grounded article of the instant system. In addition, the coating material supply pumps and/or pressure tanks are also grounded so that the system lends itself to the application of heated or refrigerated liquid coatings, as well as paints or coating maerials normally applied at room temperature, without any of the shorting problems inherent in some of the previous systems. If intricately-shaped articles are to be coated, the atomizer head may be positioned close to the articles carried on a conveyor, in order to obtain optimum penetration into cavities and corners. The coating material supply controls, shroud air and motor air controls as well as the atomizer head itself may be freely handled by an operator without danger of shock.

FIG. 5 shows a modified form of changing electrode **120** in the form of a hollow tube **122** of insulating material. The electrode **120** is similar in size, shape and arrangement to the electrode **16** previously described. Within the insulating outer tube **122** is set an inner tube **124** of highly conductive metal terminating in a pointed tip **126** having a central through aperture **128**. The metal tube **124** serves the same purpose as the wire **94** of the electrodes **16** and is connected to the source of high potential in the manner previously described. The hollow metal tube **124**, however, also serves as a conduit for the shroud air and is fed by the shroud air supply pipe **22**. For this purpose, the electrical cable connected to the power supply **28** is made in the form of a hollow tube **130** covered by an insulating sleeve **132**. The air supply pipe **22** is connected to tube **130** so that air under pressure is fed therethrough to the interior of base member **30**, where it is distributed to the electrode tubes **124**. Thus air under pressure travels through the tube **124** of each charging electrode **120** and exits through aperture **128** which serves as a nozzle as well as the charging electrode tip. The air from all of the electrodes **120** combines to form a shroud around the spray of atomized particles eminating from the atomizer head.

FIG. 6 shows a further modification in the structure of the charging electrode. The hollow metal tube **134** is similar to the tube **124** and serves to supply shroud air therethrough, except that instead of terminating in a pointed tip, it has a flattened outer end **136** projecting outwardly of the insulating outer tube **122** and providing a narrow nozzle portion defining a relatively wide sharp edge **138**. The sharp edge **138** serves efficiently as the charging zone for the electrostatic field, while the wide nozzle opening provides a larger fan of shroud air which covers a greater area.

Although the atomizer head **12** is illustrated as a cup or cone-shaped rotary dispersal head, said head can be constructed in a variety of configurations such as in the form of a flat disc, fan blade, etc. For most operations rotary atomizer heads ranging in size between 1¾" to 6" diameter are utilized. Larger diameter rotary heads can be employed for specific applications when required.

Although the apparatus described herein is primarily intended for automated type coating systems in which the articles to be coated are carried on a conveyor, its structure may also be adapted to portable hand gun systems used for coating stationary articles, small articles, and for touch-up operations.

While preferred embodiments of the invention have been shown and described herein, it is obvious that numerous omissions, changes and additions may be made in such embodiments without departing from the spirit and scope of the invention.

What I claim is:

1. An electrostatic spray coating assembly for atomizing coating material and depositing the latter upon the surface of an article, said assembly comprising a rotary atomizer head having an atomizing surface for centrifugally atomizing liquid coating material and projecting the atomized coating material radially therefrom, means for feeding coating material continuously to said atomizing surface of said head, electrode means located rearwardly of said atomizer head, means mounting said article forwardly of said atomizer head, a high voltage source having one terminal electrically connected to said electrode

means and its opposite terminal connected to said article and to said atomizer head whereby the article and atomizer head are maintained at the same potential and an electrostatic field is established between the electrode means and article, said field surrounding and being spaced radially from said atomizer head for receiving therein atomized coating material projected radially from said atomizer head.

2. An electrostatic spray coating assembly for atomizing coating material and depositing the latter upon the surface of an article, said assembly comprising a centrifugal atomizer unit including a rotary atomizer head having an atomizing surface for projecting atomized coating material radially therefrom, electrode means surrounding said atomizer and located rearwardly of said atomizer head, a high voltage source having one terminal electrically connected to said electrode means and its other terminal electrically connected to said article for creating an electrostatic field between said electrode means and said article of sufficient strength to carry atomized coating material projected within said field to said article and deposit said coating material on the surface thereof, said other terminal being electrically connected to said atomizer head to maintain said atomizer head at the same potential as said article, said atomizer unit including means for rotating said atomizer head at a high velocity sufficient to atomize coating material fed to said head into fine droplets and to project said atomized droplets radially from said atomizing surface with sufficient force to propel said droplets into the electrostatic field between said electrode means and said article.

3. An electrostatic spray coating assembly for atomizing coating material and depositing the latter upon the surface of an article, said assembly comprising a centrifugal atomizer unit including a rotary atomizer head having an atomizing surface for projecting atomized coating material radially therefrom, electrode means surrounding said atomizer and located rearwardly of said atomizer head, a unidirectional high voltage source having one terminal electrically connected to said electrode means and its other terminal grounded and electrically connected to said article for creating an electrostatic field between said electrode means and said grounded article of sufficient strength to carry atomized coating material projected within said field to said article and deposit said coating material on the surface thereof, said grounded terminal being electrically connected to said atomizer head to maintain said atomizer head at the same ground potential as said article, said atomizer unit including means for continuously feeding coating material through said atomizer unit to said atomizer head and means for rotating said atomizer head at a high velocity sufficient to atomize coating material fed to said head into fine droplets and to project said atomized droplets radially from said atomizing surface with sufficient force to propel said droplets into the electrostatic field between said electrode means and said article.

4. An electrostatic spray coating assembly according to claim 3 in which said atomizer unit has a plurality of air outlet apertures located rearwardly of said atomizer head and in which said assembly also includes means for feeding air under pressure to the interior of said atomizer unit, said air emerging through said outlet apertures and forming a shroud about the atomized coating material projected from said atomizer head, said air shroud dampening the velocity of said atomized material travelling radially through said field.

5. An electrostatic spray coating assembly according to claim 4 in which said electrode means comprises a plurality of electrode elements mounted on said atomizer unit, insulated therefrom and spaced around the circumference thereof, each of sail electrodes comprising a radially-extending leg terminating in a forwardly-directed leg, the latter terminating in a pointed tip, each of said tips being spaced radially outward from said atomizer head and being located rearwardly thereof.

6. An electrostatic spray coating assembly for atomizing coating material and depositing the latter upon the surface of an article, said assembly comprising a centrifugal atomizer unit including a hollow body, a rotary atomizer head mounted on the forward end of said body and having an atomizing surface for projecting atomized coating material radially therefrom, motor means mounted within said body and having a drive connection to said atomizer head for rotating the latter, means for feeding liquid coating material through said atomizer body onto said atomizer head to said atomizing surface, means mounting said article spaced forwardly of said atomizer head, electrode means mounted on said atomizer body rearwardly of said head and surrounding the axis of rotation thereof, means electrically insulating said electrode means from said head, a high voltage source having one terminal electrically connected to said electrode means and its other terminal electrically connected to said article for creating between said electrode means and said article an electrostatic field spaced radially from and surrounding the axis of rotation of said atomizer head, said field being of sufficient strength to carry atomized coating material projected within said field to said article and deposit said coating material on the surface thereof, said other terminal being electrically connected to said atomizer head to maintain said atomizer head at the same potential as said article, said motor means being effective to rotate said atomizer head at a sufficiently high velocity to atomize coating material fed to said head into fine droplets and to project said atomized droplets radially from said atomizing surface with sufficient force to propel said droplets into the electrostatic field between said electrode means and said article, and means for feeding compressed air through the interior of said atomizer body to emerge rearwardly of said atomizer head, such that said air forms a forwardly and radially-extending shroud extending from said head toward said article.

7. An electroctatic spray coating assembly according to claim 6 in which said atomizer body has a front nose portion, rotatably mounting said atomizer head, and an annular row of air outlet openings located rearwardly of said head and arranged around the axis of rotation thereof.

8. An electrostatic spray coating assembly according to claim 6 in which said electrode means comprises a plurality of electrode elements mounted on said atomizer unit and spaced around the circumference thereof, each of said electrodes comprising a radially extending leg terminating in a forwardly-directed leg, the latter terminating in a pointed conductive tip, each of said tips being spaced radially outward from said atomizer head and being located rearwardly thereof pointing in the direction of said article, and means electrically insulating said electrode elements from said atomizer head.

9. An electrostatic spray coating assembly according to claim 8 in which each of said electrode elements comprises an insulated member having a central conductive member extending axially therethrough from said tip to the interior of said atomizer body, and means for electrically connecting said conductive members to each other and to said one terminal of the high voltage source within said atomized body.

10. An electrostatic spray coating assembly according to claim 9 in which each conductive member is hollow and its respective tip has an air outlet aperture therein in communication with said hollow conductive member, the opposite end of said hollow conductive member extending within said atomizer body and communicating with said air feeding means, whereby said shroud of air is generated from said electrode elements.

11. An electrostatic spray coating system for dispersing coating material and depositing the latter upon the surface of articles, said system comprising a rotary head for mechanically dispersing coating material and projecting said coating material radially therefrom, means for feeding coating material to said rotary head, electrode means

located adjacent said rotary head, means for transporting said articles past the rotary head, a high voltage source having one terminal electrically connected to said electrode means and its opposite terminal connected to said articles and to said atomizer head whereby the articles and rotary head are maintained at ground potential and an electrostatic field is established between the electrode means and articles.

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