Dec. 11, 1962 B. K. G. SIGVARDSSON ET AL 3,067,949

ELECTROSTATIC COATING APPARATUS WITH ROTARY IMPELLER

Filed July 22, 1959 3 Sheets-Sheet 1

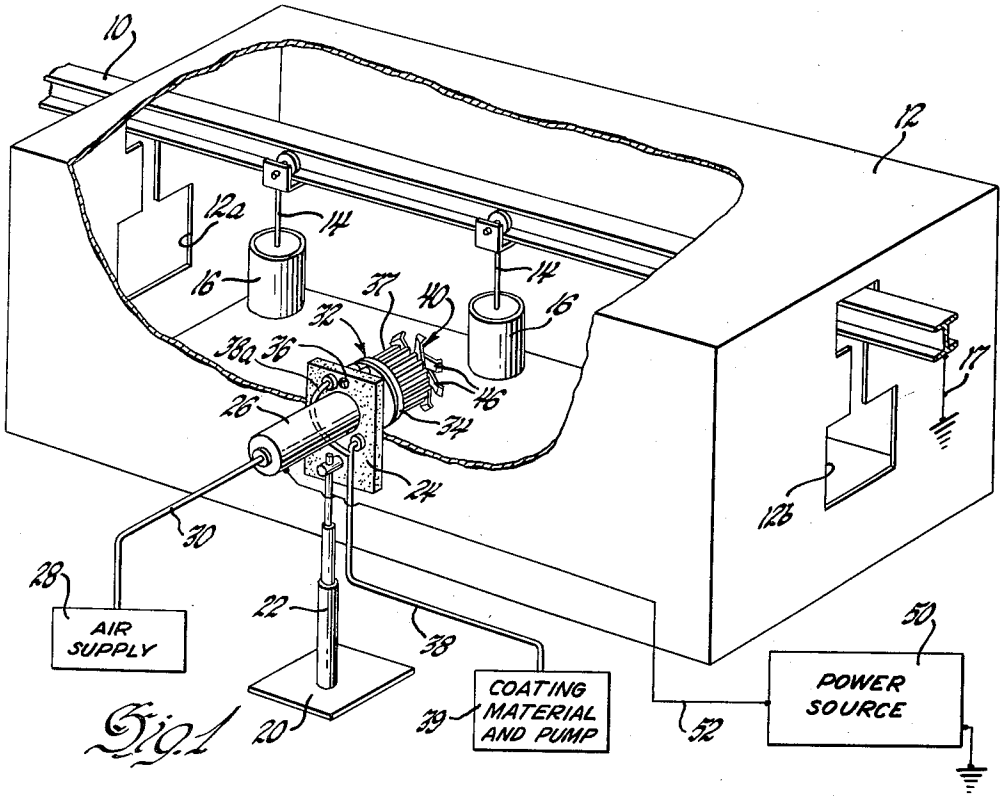


Fig. 1

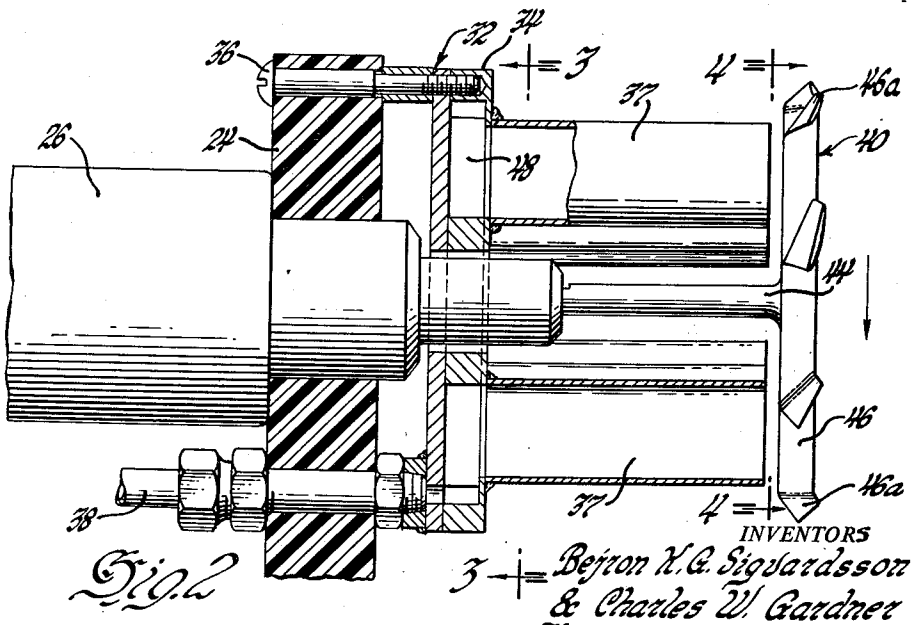


Fig. 2

INVENTORS
Bejron K. G. Sigvardsson
& Charles W. Gardner
BY
W. S. Pettigrew
ATTORNEY

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ELECTROSTATIC COATING APPARATUS WITH ROTARY IMPELLER

Filed July 22, 1959 3 Sheets-Sheet 2

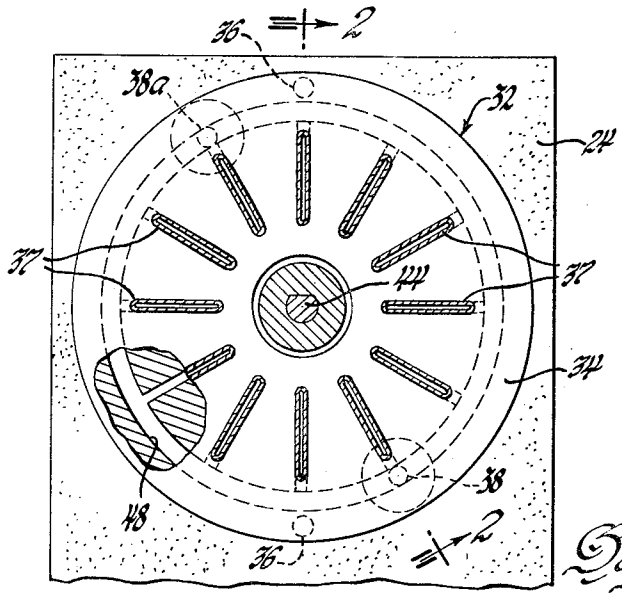


Fig. 3

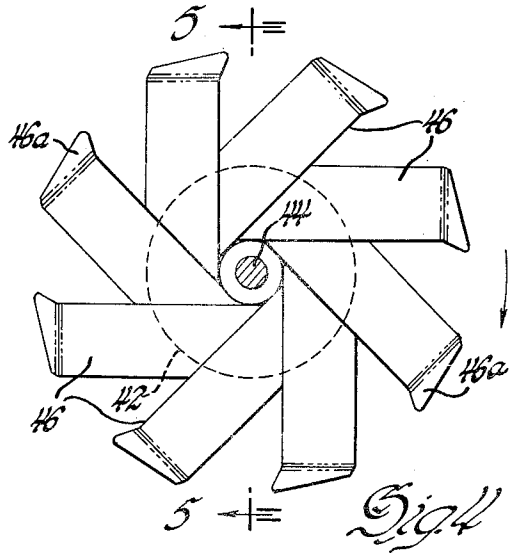


Fig. 4

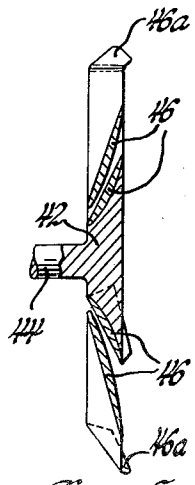


Fig. 5

INVENTORS
Bertil K. G. Sigvardsson
& Charles W. Gardner
BY
W. S. Pettigrew
ATTORNEY

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ELECTROSTATIC COATING APPARATUS WITH ROTARY IMPELLER

Filed July 22, 1959 3 Sheets-Sheet 3

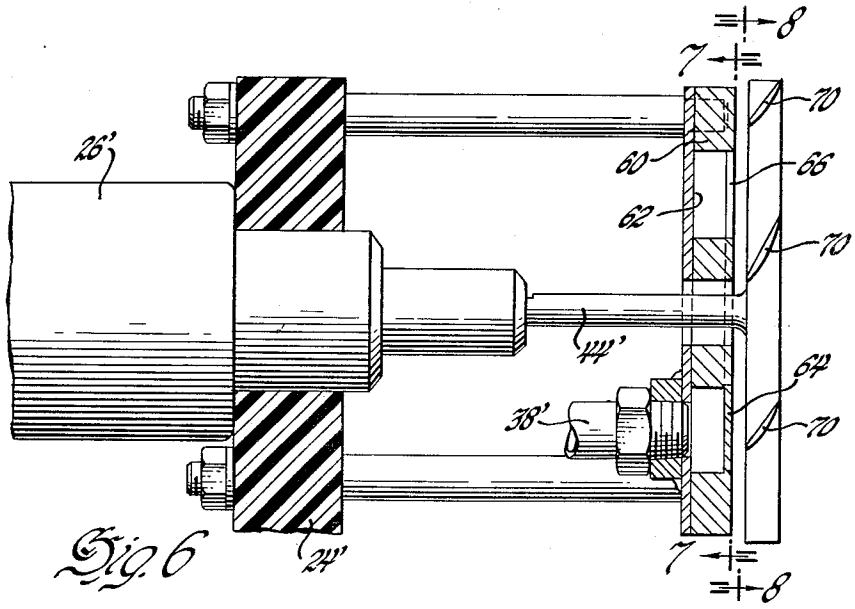


Fig. 6

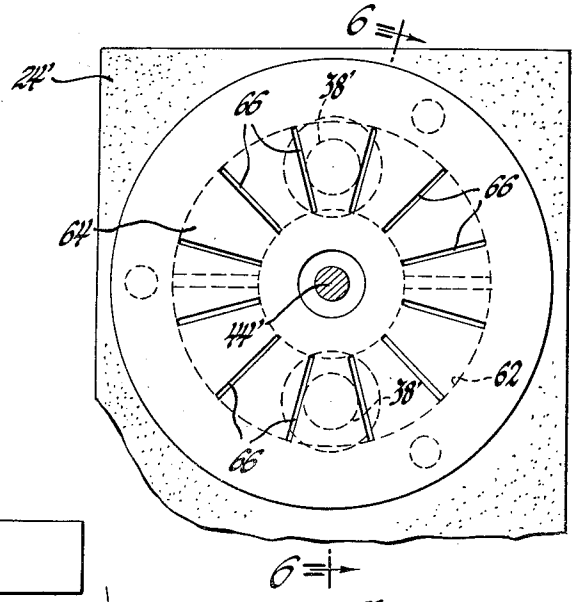


Fig. 7

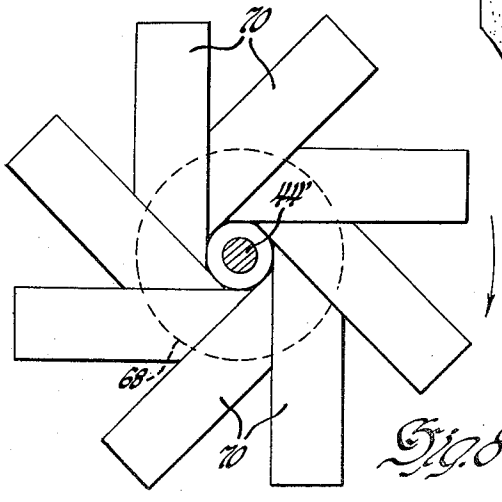


Fig. 8

INVENTORS
Bejzon K. G. Sigvardsson
& Charles W. Gardner
BY
W. S. Pettigrew
ATTORNEY

United States Patent Office 3,067,949 Patented Dec. 11, 1962

3,067,949

ELECTROSTATIC COATING APPARATUS WITH ROTARY IMPELLER

Bejron K. G. Sigvardsson, Detroit, and Charles W. Gardner, Pontiac, Mich., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Filed July 22, 1959, Ser. No. 828,897
13 Claims. (Cl. 239—15)

This invention relates to electrostatic coating apparatus, and more particularly to electrostatic coating apparatus employing a plurality of rotating blades to atomize liquid coating material and direct it toward the workpiece.

Various types of electrostatic coating systems have been developed in the past. While certain of these systems provide advantages in coating efficiency when comparet to conventional pneumatic spray arrangements, all the systems have had certain disadvantage which this invention overcomes. In one type of painting apparatus which is used successfully in industry, atomized particles of coating material are discharged from a conventional pneumatic spray gun and are directed through a high voltage electrostatic field toward the workpiece which is carried on a conveyor past a coating station. As the particles of coating material pass through the electrostatic field, they acquire an electrical charge and are attracted to the workpiece which generally is grounded. While this form of apparatus substantially cuts down the overspray which is inherent in pneumatic spraying systems, and while the apparatus has been successful commercially, it has certain disadvantages, particularly in the fact that the atomized coating material is blown from the pneumatic spray gun with such velocity that some particles pass by the workpiece. While the difference in electrical potential between the charged particles and the grounded workpiece creates an attraction which draws a large proportion of the particles to the workpiece, the velocity of some of the particles is so great that they pass by the workpiece and are wasted.

Another form of electrostatic coating apparatus comprises a disk or bell-shaped spray head which is charged to a high potential and rotated at a speed of approximately one thousand or more revolutions per minute. Coating material is fed to the spray head near the center thereof and is centrifugally moved as a film toward the periphery of the spray head from where it is atomized by the electrostatic field existing between the spray head and the grounded workpiece. Apparatus of this type has serious disadvantages in that its capacity or output of coating material is seriously limited; the apparatus is too selective as to the type of coating materials which can be used; and the contour of the workpiece has too great a bearing on the coating efficiency of the apparatus. Since the coating material is atomized and moved to the article solely as a function of the electrostatic forces, the output is very low when compared to systems in which the coating material is atomized and propelled toward the workpiece mechanically or pneumatically. Furthermore, the rotating spray head acts as a centrifugal separator on coating materials which contain heavy particles, so that the system cannot be used with many types of paint or other coating material. Also, since the coating material is not mechanically propelled toward the workpiece and the only force bringing the coating material to the work is the electrostatic field, projections, grooves, or other contour variations in the workpiece seriously affect the efficiency of the coating operation.

We have devised and are herein disclosing and claiming an improved electrostatic coating apparatus in which the coating material is charged to a high potential and

then is finely atomized by a rotary bladed impeller and projected as a cloud of charged particles finely atomized into space in the direction of the workpiece. This action results in a much greater efficiency in utilization of the coating material than is obtained from the pneumatic spray gun electrostatic type apparatus described above. Since the atomized particles are very small, the inertia of each particle is low. Also, the initial velocity imparted to the particles by the rotary impeller is sufficient to project them into the vicinity of the workpiece but is not so great that the particles, which have low inertia, are carried past the workpiece. The improved apparatus also provides important advantages over the whirling disk type spray head described above. In our improved apparatus, there is no centrifugal separator action so that the apparatus is not selective as to types of coating material which may be used. Since the particles are mechanically atomized and projected toward the workpiece, the output is much greater than can be obtained from the disk type apparatus, and this same mechanical projection results in improving the efficiency of the coating operation because the mechanically projected coating material particles effectively cover the entire workpiece and grooves and other contour variations in the workpiece do not seriously affect the efficiency of the coating operation.

One feature of the invention is that it provides improved electrostatic spray coating apparatus; another feature of the invention is that it provides electrostatic coating apparatus wherein charged liquid coating material is atomized and projected into spray toward a workpiece by a rotary bladed impeller; still another feature of the invention is that the impeller projects the atomized particles with sufficient velocity to project them into the vicinity of the workpiece but the velocity is not so great that the bulk of the particles will be thrown past the work; still another feature of the invention is that liquid coating material is distributed in an atomizing plane and a rotary bladed impeller mechanically atomizes this material and projects the atomized particles into space toward a workpiece; still a further feature of the invention is that the impeller comprises a plurality of blades mounted closely adjacent the atomizing plane but spaced therefrom for rotation about an axis transverse thereto; yet another feature of the invention is that each of the blades lies in a plane which intersects the atomizing plane at an acute angle, with the leading edge of each blade being closer to the atomizing plane than the trailing edge of the blade; still another feature of the invention is that each of the atomizing blades preferably is shaped generally as an air foil in transverse section and the free end of each of said blades preferably projects outwardly beyond the perimeter of the coating material feed means; and yet another feature of the invention is that each of the blades of the impeller is mounted at a location which is offset from the axis of rottation of the impeller, the free outer end of each blade leading the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation and thereby provide an even distribution of coating material over the edges of the blades and insure that the coating material is projected in the direction of the workpiece rather than at right angles thereto.

Other features and advantages of the invention will be apparent from the following description and from the drawings, in which:

FIG. 1 is an isometric view of a painting system employing the electrostatic coating apparatus of this invention, a portion of the paint booth being broken away to show the conveyor and workpieces carried thereon;

FIG. 2 is a view, partly in longitudinal vertical sec-

tion, showing a portion of the apparatus of FIG. 1 and taken along the line 2—2 of FIG. 3;

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

FIG. 4 is a transverse vertical section taken along the line 4—4 of FIG. 2 and showing the impeller;

FIG. 5 is a transverse vertical section through the impeller taken along the line 5—5 of FIG. 4;

FIG. 6 is a view similar to FIG. 2 but showing a modified form of the invention and being taken along the line 6—6 of FIG. 7;

FIG. 7 is a transverse vertical section taken along the line 7—7 of FIG. 6; and

FIG. 8 is a view of the impeller of the modified form of the invention; being taken along the line 8—8 of FIG. 6.

Referring now more particularly to the drawings. FIG. 1 shows a painting system utilizing the electrostatic coating apparatus of this invention. A conventional monorail conveyor **10** passes through a paint booth **12**. The conveyor **10** is provided with a plurality of article supports **14** which may be driven along the conveyor in conventional and well known manner (not shown) to carry workpieces **16** past a coating station or zone in the booth. Openings **12***a* and **12***b* are provided in the respective entrance and exit ends of the booth to permit passage of the workpieces **16** into and out of the booth. The conveyor **10**, article supports **14** and workpieces **16** are grounded as indicated diagrammatically at **17**.

The electrostatic coating apparatus is arranged so that it projects electrically charged atomized coating material particles into the booth **12** toward articles **16** as they pass the coating station, the booth being provided with an opening (not shown) into which the impeller portion of the coating apparatus may extend.

The electrostatic coating apparatus is mounted on an insulating stand including a floor support **20** and an upright post **22** which at its top end, mounts an insulating support bracket **24**. An air motor **26** is mounted on the support bracket **24**, the housing of the air motor projecting through an opening in the bracket. The air motor is of conventional well known type and is driven by a compressed air supply **28** which is connected to the air motor **26** by a tube **30**.

Mounted on the front end of the air motor housing is a feed device designated generally as **32** comprising a distributor housing **34** which is secured by one or more bolts **36** to the support member **24**, and a plurality of distributor tubes **37** which communicate with a chamber in the housing and which are adapted to distribute liquid coating material to a plurality of locations in an atomizing plane forwardly of the housing **34**. The distributor housing **34** is connected by a feed tube **38** to a supply **39** of liquid coating material which, in the system illustrated, is paint.

Forwardly of the open end of the distributor tubes, there is a rotary impeller designated generally as **40**. The impeller has a hub **42** secured to the free end of the output shaft **44** of the air motor **26** and a plurality of impeller blades **46** are mounted on the hub.

Referring now more particularly to FIGS. 2–5, the distributor housing **34** preferably is circular in form as illustrated and has an internal feed chamber **48** which, during the operation of the apparatus, is filled with liquid coating material from the supply **39**. As shown in FIG. 1, the feed tube **38** has a parallel extension **38***a*. The feed chamber **48** is divided into upper and lower portions by a horizontal partition, the upper portion of the chamber being fed by the extension **38***a* and the lower portion being fed by the main feed tube **38**. This arrangement reduces the hydrostatic pressure of coating material in the feed chamber and assures more uniform distribution of coating material over the vertical outlet face of the feed chamber. The liquid coating material supply **39** includes a conventional low pressure pump which

feeds the chamber **48** with liquid coating material under a few pounds of pressure so that the coating material is forced under low pressure into the distributor tubes **37** which are mounted on the housing **34**, the bore of each tube communicating with the chamber **48**. As shown best in FIGS. 2 and 3, the distributor tubes **37** are flattened so that their internal bores are effectively slots and the tubes are mounted so that these slots extend radially of the forward face of the housing **34**. All the distributor tubes are of the same length and terminate in the same plane so that when liquid coating material is fed under low pressure to the chamber **48**, it is distributed by distributor tubes **37** to a plurality of locations in an atomizing plane. The pressure of the coating material may be varied depending on the volume of output desired. Preferably, the pressure is so adjusted that the liquid coating material oozes from the open forward end of each distributor tube.

In the apparatus illustrated, the impeller has eight blades, each of which is riveted or otherwise secured at its inner end to the hub **42**. The blades are mounted closely adjacent the atomizing plane into which liquid coating material is emitted by the distributor tubes, but the blades are spaced from this plane and are adapted to rotate about the axis of the air motor shaft **42** which extends transversely to the atomizing plane. Each of the blades preferably is formed in transverse section as an air foil section as appears best in FIGS. 2 and 5, and the blades also preferably extend outwardly beyond the perimeter of the distributor housing **34**. Each of the blades lies in a plane which intersects the atomizing plane at an acute angle, with the leading edge of each blade being closer to the atomizing plane than the trailing edge of the blade. In the embodiment of the invention which is illustrated in FIGS. 1 through 5, each blade is turned forwardly at its outer end as designated at **46***a*. This arrangement is not essential to the successful operation of the apparatus. Referring to FIG. 4, each of the blades is mounted at a location which is offset from the axis of rotation of the impeller, the free outer end of each blade leading the inner fixedly mounted end thereof during rotation to minimize the radial velocity of coating material on the blades; that is, with reference to FIG. 4, the impeller rotates in a clockwise direction. This arrangement provides an even distribution of coating material over the edges of the blades and insures that the coating material is projected in the direction of the workpiece rather than at right angles thereto.

Means are provided for charging the housing **34**, which is of electrically conductive material, and coating material therein with a high unidirectional voltage. Referring to FIG. 1, there is a power source **50** having a high voltage output lead **52** which is connected to the metallic housing of the air motor **26** so that effectively the entire apparatus comprising, the air motor, the housing, the distributor tubes, and the impeller, is charged with a high unidirectional voltage which preferably is of the order of 100 kilovolts, and coating material in the distributing means likewise is charged. Preferably, the high voltage used is negative with respect to ground, although again this is not necessary to the practice of the invention.

In operation, liquid coating material, as paint, is supplied under a few pounds of pressure to the distributing means so that it oozes out of each of the atomizing tubes at the free end thereof, and the power source applies a high unidirectional voltage to the apparatus so that the coating material is highly charged as it emerges in the atomizing plane. The air motor **26** is operated so that the impeller rotates at a speed sufficient to atomize coating material which emerges from the distributor tubes into the atomizing plane. In practice, we prefer to rotate the impeller at a speed of about 10,000 revolutions per minute although this speed is not critical. The impeller blades atomize the coating material into very fine particles and project them forwardly (axially of the shaft

44) toward the workpiece **16** as it passes the coating station in the booth **12**. The finely atomized particles are drawn by electrostatic attraction to the grounded workpice **16** so that the workpiece becomes covered with a film of the coating material.

Because of the electrostatic attraction between the atomized coating material and the workpiece, there is a distinct wrap-around effect and the entire surface of a cylindrical workpiece, as illustrated, will be coated even though the workpiece is not rotated. Because of the very fine atomization, each particle of coating material has a very low inertia and the efficiency of the apparatus is of the order of 95%, i.e., about 95% of coating material which is emitted from the distributor tubes is deposited on the workpiece. Since the atomized particles are physically projected toward the workpiece, contour irregularities, such as grooves or projections, on the workpiece will receive a film of coating material which would not be the case if electrostatic forces alone were relied upon to project the particles from the coating apparatus to the workpiece.

The atomization of the coating material in this apparatus is the result of several factors, the first of which is turbulence in the impeller resulting from pressure and velocity changes therein. This turbulence is increased by the air foil transverse sectional configuration of the blades and by the fact that each blade lies in a plane which intersects the atomizing plane at an acute angle as described above. A second factor in the atomization of the coating material is a mechanical chopping effect. In this connection, it should be noted that the radial velocity of the coating material on the blades, that is, the effect of centrifugal force, is decreased by mounting each blade at a location which is offset from the axis of rotation of the impeller so that the free outer end of each blade leads the inner fixedly mounted end. This construction also tends to give a more even distribution over the edges of the blades as the impeller rotates. A third factor in causing atomization of the coating material is the suction effect of the impeller. This suction effect is due to a partial vacuum which is developed primarily because of the high angular velocity of the air foil section impeller blades.

In this apparatus, the coating material is atomized and projected to the vicinity of the workpiece even though no electrical charge is applied. The electrostatic charge is used only to attract the coating material particles to the workpiece as they float as a cloud in the general vicinity of the workpiece.

FIGS. 6, 7, and 8 show a modified form of the invention in which the feed means for distributing the liquid coating material is changed and in which the impeller blades are of slightly different configuration. In this modified form, the air motor **26'** is similar to the air motor **26** in the embodiment earlier described as is the mounting means including the support bracket **24'**. The feed means comprises a circular housing having an internal feed chamber with a planar front face formed with a plurality of equally spaced radial slots communicating with the chamber and opening into an atomizing plane. The metallic housing **60** has an internal feed chamber **62** which is annular in shape and which has a planar front face **64** formed with a plurality of equally spaced radial slots **66** which communicate with the chamber **62** and which open into an atomizing plane. When liquid coating material is fed under low pressure into the chamber **62** through a feed pipe **38'** which is connected to a coating material supply, the liquid coating material oozes out of the slots **66** onto the planar front face of the distributing device.

The impeller comprises a hub **68** which is mounted on the output shaft **44'** of the air motor **26'** and a plurality (eight in the embodiment of the invention) of blades **70** are mounted on the hub **68**. As in the embodiment of the invention first described, the blades **70** are mounted closely adjacent the atomizing plane but are spaced therefrom as shown in FIG. 6, for rotation about an axis transverse thereto. Each of the blades lies in a plane which intersects the atomizing plane at an acute angle, with the leading edge of each blade being closer to said atomizing plane than the trailing edge of the blade. Each of the blades is shaped generally as an air foil in transverse section and each of the blades is mounted at a location which is offset from the axis of rotation of the impeller, as shown in FIG. 8, so that the free outer end of each blade leads the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation in a clockwise direction as viewed in FIG. 8. FIG. 6 shows how the free end of each blade projects outwardly beyond the perimeter of the housing **60** although this latter feature is not necessary to the successful practice of the invention.

During operation, coating material in the chamber **62** is charged with a high unidirectional voltage. This may be accomplished, as in the embodiment earlier described, by connecting all the metallic parts, i.e., the air motor, the housing, and the impeller, to a source of voltage preferably of the order of 100 kilovolts. Coating material is supplied under a few pounds of pressure to the housing and oozes onto the outer planar face **64** thereof through the slots **66**. The impeller is rotated at a speed sufficient to atomize the coating material, preferably at a speed of the order of 10,000 revolutions per minute so that the charged liquid coating material is finely atomized and projected toward the workpiece as a finely atomized charged cloud, and electrostatic attraction attracts the atomized particles to the workpiece.

While we have shown and described certain embodiments of our invention, it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

We claim:

1. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material in an atomizing plane; a rotary impeller comprising a plurality of blades mounted closely adjacent said atomizing plane for rotation about an axis transverse thereto, each of said blades being mounted at a location which is offset from the axis of rotation of said impeller, the free outer end of each blade leading the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation; means for rotating said impeller; and means for charging the coating material with a high unidirectional voltage.

2. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of locations in an atomizing plane, comprising a housing with an internal circular feed chamber communicating with a plurality of radial slots which open into said plane; a rotary impeller comprising a plurality of blades mounted closely adjacent said atomizing plane but spaced therefrom for rotation about an axis transverse thereto, each of said blades lying in a plane which intersects said atomizing plane at an acute angle, with the leading edge of each blade being closer to said atomizing plane than the trailing edge of the plane, each of said blades being mounted at a location which is offset from the axis of rotation of said impeller, the free outer end of each blade leading the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation; means for rotating said impeller at a speed sufficient to atomize coating material from said locations; and means for charging said housing and coating material with a high unidirectional voltage.

3. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of locations in an atomizing

plane, comprising a housing with an internal circular feed chamber having a plurality of radial slots opening into said plane; a rotary impeller comprising a plurality of baldes mounted closely adjacent said atomizing plane but spaced therefrom for rotation about an axis transverse thereto, each of said blades lying in a plane which intersects said atomizing plane at an angle, with the leading edge of each blade being closer to said atomizing plane than the trailing edge of the blade, each of said blades being shaped generally as an air foil in transverse section and each of said blades being mounted at a location which is offset from the axis of rotation of said impeller, the free outer end of each blade leading the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation and the free end of each of said blades projecting outwardly beyond the perimeter of said housing; motor means for rotating said impeller at a speed sufficient to atomize coating material from said locations; and means for charging said housing and coating material with a high unidirectional voltage.

4. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of locations in an atomizing plane, comprising a stationary housing having an internal feed chamber with a planar front face formed with a plurality of radial slots communicating with said chamber and opening into said plane; a rotary impeller comprising a plurality of blades mounted closely adjacent said atomizing plane for rotation about an axis transverse thereto; means for rotating said impeller at a speed sufficient to atomize coating material emanating from said slots; and means for charging the coating material with a high voltage.

5. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of locations in an atomizing plane, comprising a housing having an internal feed chamber with a planar front face formed with a plurality of radial slots communicating with said chamber and opening into said plane; a rotary impeller comprising a plurality of blades mounted closely adjacent said planar front face but spaced therefrom for rotation about an axis transverse to said atomizing plane, each of said blades lying in a plane which is angular to said atomizing plane, with the leading edge of each blade being closer to said atomizing plane than the trailing edge of the blade; means for rotating said impeller at a speed sufficient to atomize coating material emanating from said slots; and means for charging the coating material with a high voltage.

6. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of locations in an atomizing plane, comprising a circular housing having an internal feed chamber with a planar front face formed with a plurality of equally spaced radial slots communicating with said chamber and opening into said plane; a rotary impeller comprising a plurality of blades mounted closely adjacent said planar front face but spaced therefrom for rotation about an axis transverse to said atomizing plane, each of said blades being mounted at a location which is offset from the axis of rotation of said impeller, the free outer end of each blade leading the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation; means for rotating said impeller at a speed sufficient to atomize coating material emanating from said slots; and means for charging the coating material with a high voltage.

7. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of locations in an atomizing plane, comprising a circular housing having an internal feed chamber with a planar front face formed with a plurality of equally spaced radial slots communicating with said chamber and opening into said plane; a rotary impeller comprising a plurality of blades mounted closely adjacent said planar front face but spaced therefrom for rotation about an axis transverse to said atomizing plane, each of said blades lying in a plane which intersects said atomizing plane at an acute angle, with the leading edge of each blade being closer to said atomizing plane than the trailing edge of the blade, each of said blades being mounted at a location which is offset from the axis of rotation of said impeller, the free outer end of each blade leading the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation, the free end of each of said blades projecting outwardly beyond the perimeter of said housing; motor means for rotating said impeller at a speed sufficient to atomize coating material emanating from said slots; and means for charging said housing and coating material with a high unidirectional voltage.

8. Apparatus of the character claimed in claim 7, wherein the free end of each blade is bent forwardly in the general direction of a projection of the axis of rotation of said impeller.

9. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of locations in an atomizing plane, comprising a housing having an internal feed chamber and a plurality of equally spaced flattened tubes communicating with said chamber and extending forwardly thereof and terminating in said plane; a rotary impeller comprising a plurality of blades mounted closely adjacent said plane but spaced therefrom for rotation about an axis transverse thereto, each of said blades being mounted at a location which is offset from the axis of rotation of said impeller, the free outer end of each blade leading the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation; means for rotating said impeller; and means for charging the coating material with a high voltage.

10. Apparatus of the character claimed in claim 9, wherein the free end of each blade is bent forwardly in the general direction of a projection of the axis of rotation of said impeller.

11. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of locations in an atomizing plane, comprising a circular housing having an internal feed chamber and a plurality of equally spaced flattened tubes communicating with said chamber and extending forwardly thereof and terminating in said plane, the long dimension of each flattened tube extending in directions radial of said housing; a rotary impeller comprising a plurality of blades mounted closely adjacent said atomizing plane but spaced therefrom for rotation about an axis transverse thereto, each of said blades lying in a plane which intersects said atomizing plane at an acute angle, with the leading edge of each blade being closer to said atomizing plane than the trailing edge of the blade, each of said blades being mounted at a location which is offset from the axis of rotation of said impeller, the free outer end of each blade leading the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation; means for rotating said impeller at a speed sufficient to atomize coating material emanating from said tubes; and means for charging said housing and coating material with a high voltage.

12. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of locations in an atomizing plane; a rotary impeller comprising a plurality of blades mounted closely adjacent said atomizing plane for rotation about an axis transverse thereto, each of said blades lying in a plane which intersects said atomizing plane at an angle, with the leading edge of each blade being closer to said atomizing plane than the trailing edge of the blade,

and each of said blades being so mounted that the free outer end of each blade leads the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation; means for rotating said impeller at a speed sufficient to atomize coating material which is distributed in said atomizing plane; and means for charging the coating material with a high voltage.

13. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of locations in an atomizing plane; a rotary impeller comprising a circular hub having a plurality of blades mounted thereon closely adjacent said atomizing plane for roation about an axis transverse thereto, said hub being smaller in diameter than said feed means and each blade being mounted tangentially of said

hub so that the free outer end of each blade leads the inner fixedly mounted end thereof to minimize the radial velocity of coating material on the blades during rotation; means for rotating said impeller at a speed sufficient to atomize coating material which is distributed in said atomizing plane; and means for charging the coating material with a high voltage.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,067,949 December 11, 1962

Bejron K. G. Sigvardsson et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 31, for "spray" read -- space --; line 56, for "rottation" read -- rotation --; column 5, line 4, for "pice" read -- piece --; column 7, line 4, for "baldes" read -- blades --; column 9, line 14, for "roation" read -- rotation --; column 10, line 12, list of references cited, for "Re. 24,062" read -- Re. 24,602 --.

Signed and sealed this 20th day of August 1963.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents