Sept. 26, 1961 B. K. G. SIGVARDSSON 3,001,719

ELECTROSTATIC COATING APPARATUS WITH ROTARY IMPELLER

Filed July 30, 1959 2 Sheets-Sheet 1

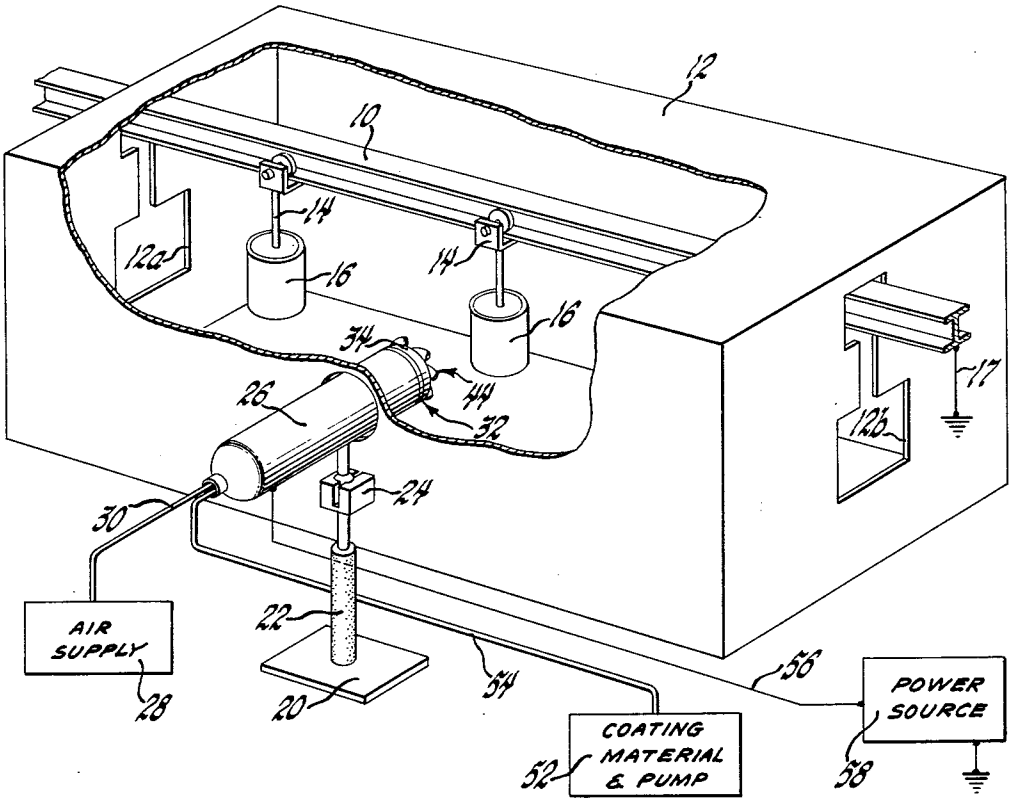


Fig. 1

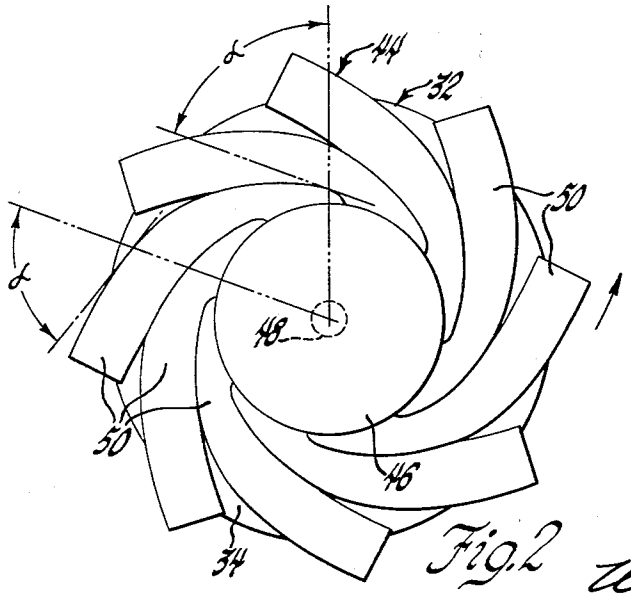


Fig. 2

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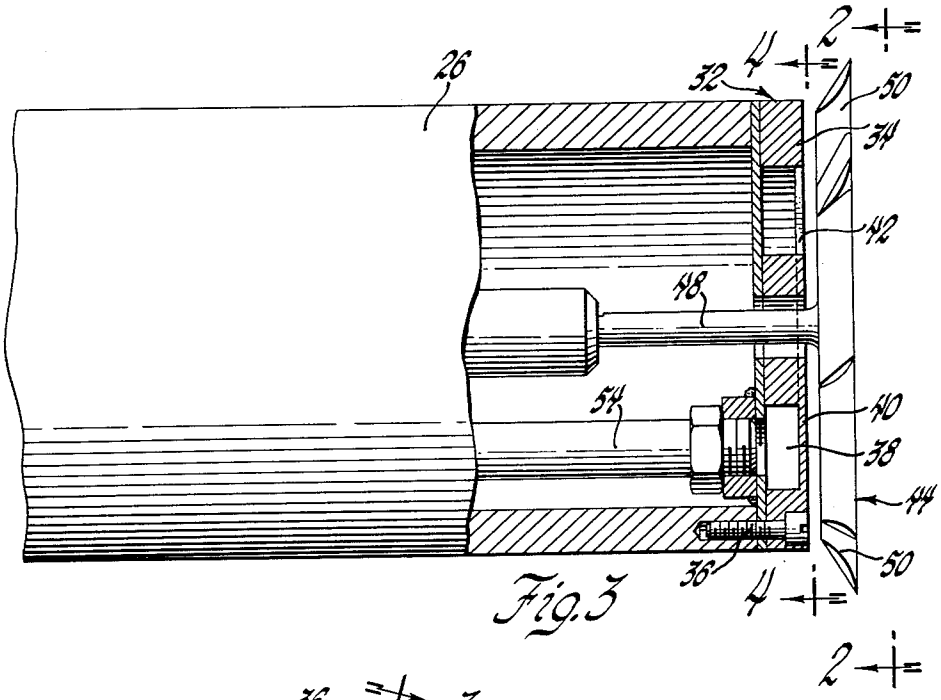


Fig. 3

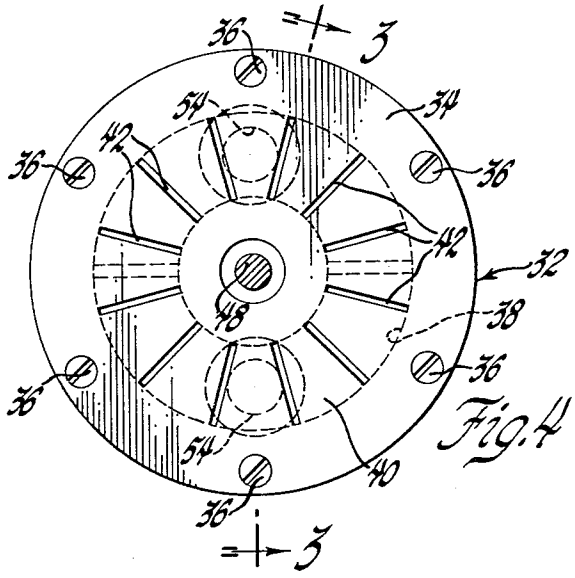


Fig. 4

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United States Patent Office 3,001,719 Patented Sept. 26, 1961

3,001,719
ELECTROSTATIC COATING APPARATUS WITH ROTARY IMPELLER

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Filed July 30, 1959, Ser. No. 830,646
7 Claims. (Cl. 239—15)

This invention relates to electrostatic coating apparatus, and more particularly to a rotary bladed impeller for electrostatic spray coating apparatus.

In the copending application of Charles W. Gardner and Bejron K. G. Sigvardsson, entitled "Electrostatic Coating Apparatus With Rotary Impeller," filed July 22, 1959, as Serial No. 828,897, assigned to the assignee of this application, there is disclosed an electrostatic coating apparatus wherein paint or other coating material is sprayed upon workpieces which pass through a coating zone along a conveyor. The apparatus includes feed means for distributing liquid coating material in an atomizing plane and a rotary impeller comprising a plurality of blades mounted closely adjacent the atomizing plane for rotation about an axis transverse thereto. Means are provided for rotating the impeller at a speed sufficient to atomize coating material distributed to said atomizing plane and there are also means for charging the coating material in the distributing means with a high voltage. In application Serial No. 828,897, the impeller comprises a hub having a plurality of blades mounted thereon so that during rotation the free outer end of each blade leads the inner fixedly mounted end thereof, and each blade lies in a plane which intersects the atomizing plane at an acute angle. The blades are straight measured longitudinally of their extent and are mounted tangentially of the hub.

This invention relates to an improvement in the impeller apparatus disclosed in application Serial No. 828,897. In my improved apparatus, the rotary impeller comprises a hub and a plurality of blades mounted thereon, each blade being curved in its longitudinal extent in the direction of rotation of the impeller 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. The curvature of each blade preferably is such that the angle subtended by a line radial of said hub and a line tangential of said blade edge at the point of crossing of said radial line is substantially constant at all points along the length of the blade. A blade approximating this formation describes an approximate arc drawn about a point displaced from the axis of rotation of the impeller. Preferably the free end of each blade extends around the impeller hub through an angle of more than ninety degrees and preferably the free end of each blade projects outwardly beyond the perimeter of the distributing means. The new form of impeller blades results in improved performance in electrostatic spray coating apparatus of this type, particularly in that the coating material is more evenly distributed along the extent of each blade during operation so that a finer and more evently distributed atomization is obtained.

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 improved impeller of this invention, a portion of the paint booth being broken away to show the conveyor and workpieces carried thereon;

FIG. 2 is a front view of the impeller, taken along the line 2—2 of FIG. 3;

FIG. 3 is a side elevation, partly in vertical section, of the apparatus; and

FIG. 4 is a vertical section taken along the line 4—4 of FIG. 3.

Referring now more particularly to the drawings, FIG. 1 shows a painting system utilizing the improved impeller which is the subject 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 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** which is of conventional and well known type, is mounted on the support bracket **24** 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 preferably is circular in form and which is secured by one or more bolts **36** to the support member **24**. As shown in FIG. 3, the housing **34** has an internal annular distributor chamber **38** with a planar front face **40** having a plurality of equally spaced radial slots **42** communicating with the chamber **38** and opening out through the planar front face **40** so that liquid coating material which is supplied under low pressure to the chamber **38** is distributed through the slots **42** to a plurality of locations in an atomizing plane forwardly of the housing **34**.

Forwardly of the distributor housing **34** there is a rotary impeller designated generally as **44**. The impeller has a hub **46** secured to the free end of the output shaft **48** of the air motor **26** and a plurality of impeller blades **50** are mounted on the hub.

During operation, the internal feed chamber **38** of the distributor housing is fed with liquid coating material from a supply **52** which is connected to the chamber **38** by a feed tube **54**. The liquid coating material supply **52** includes a conventional low pressure pump which feeds the chamber **38** with liquid coating material under a few pounds of pressure so that the coating material is forced under low pressure into the slots **42** which communicate with the chamber **38** and the coating material is distributed to a plurality of locations in an atomizing plane on the planar front face **40** of the housing. The pressure at which the coating material is fed 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 slot. The air motor housing, distributor and impeller are connected by a lead **56** to an electrical power source **58** which develops a unidirectional voltage of the order of 100 kilovolts. The power source may be of conventional commercially obtainable type.

The impeller in the apparatus illustrated has eight blades, each of which is riveted or otherwise secured to

the hub 46. Each blade lies closely adjacent the planar front face 40 of the distributing means, but is spaced therefrom and is rotatable about an axis transverse thereto as shown in FIG. 3. Each of the impeller blades is curved in its longitudinal extent in the direction of rotation of the impeller so that the free outer end of each blade of the impeller leads the inner fixedly mounted end when the impeller is rotated to minimize the radial velocity of coating material on the blades. The curvature of each blade preferably is such that the angle subtended by a line radial of the hub and a line tangential of the blade edge at the point of crossing of the radial line is substantially constant at all points along the length of the blade as is shown in FIG. 2, where the angle defined above is indicated by the symbol α. This construction is approximated if the blade is formed on an arc drawn about a point displaced from the axis of rotation of the impeller. Preferably, the free end of each blade extends around the hub through an angle of more than ninety degrees. As illustrated in FIG. 3, each of the blades preferably is shaped generally as an air foil in transverse section with the leading edge of each blade being closer to the face 40 of the distributing means than is the trailing edge of the blade, and preferably each of the blades projects outwardly beyond the perimeter of the feed distributing means.

In operation, liquid coating material, as paint, is supplied under a few pounds of pressure to the distributing means 32 so that it oozes out of each of the slots 42 in the planar front face 40 of the housing 34, and the power source 58 applies a high unidirectional voltage so that the coating material in the distributor is highly charged as it emerges in the atomizing plane. The air motor 26 rotates the impeller at a speed sufficient to atomize coating material which emerges from the feed distributor into the atomizing plane. In practice, I prefer to rotate the impeller at a speed of approximately 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 48) toward the workpiece 16 as it passes the coating station in the booth 12. The curved configuration of the blades 12 tends to distribute the coating material over the entire length of the blades. Since the blades are curved in the direction of rotation so that the free outer end of each blade leads the inner fixedly mounted end of the blade during rotation, the radial velocity of coating material on the blades is minimized. Preferably, each blade lies in a plane which intersects the atomizing plane defined by the front face 40 of the distributor housing at an acute angle so that the leading edge of each blade is closer to the atomizing plane than the trailing edge of the blade as shown in FIG. 3 so that the coating material is atomized and projected axially toward the workpiece.

While I have shown and described one embodiment of my 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.

What is claimed is:

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 hub and a plurality of blades mounted thereon, said blades lying 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 acute angle, with the leading edge of each blade being closer to said atomizing plane than is the trailing edge of the blade, and each blade being curved in its longitudinal extent in the direction of rotation of the impeller; means for rotating said impeller at a speed sufficient to atomize said coating material which is distributed in said atomizing plane; and means for charging the coating material with a high voltage.

2. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of stationary locations in an atomizing plane; a rotary impeller comprising a hub and a plurality of blades mounted thereon, said blades lying 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 acute angle, with the leading edge of each blade being closer to said atomizing plane than is the trailing edge of the blade, and each blade being curved in its longitudinal extent in the direction of rotation of the impeller, the curvature of each blade being such that the angle subtended by a line radial of said hub and a line tangential of said blade edge at the point of crossing of said radial line is substantially constant at all points along the length of the blade; 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.

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; a rotary impeller comprising a hub and a plurality of sharp edged blades mounted thereon, said blades lying closely adjacent but spaced from 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 acute angle, with the leading edge of each blade being closer to said atomizing plane than is the trailing edge of the blade, and each blade being curved in its longitudinal extent in the direction of rotation of the impeller so that the free outer end of each blade leads the inner fixedly mounted end thereof to minimize radial velocity of coating material on the blade during rotation, the curvature of each blade being such that the angle subtended by a line radial of said hub and a line tangential of said blade edge at the point of crossing of said radial line is substantially constant at all points along the length of the blade; 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.

4. Electrostatic coating apparatus of the character described, including: feed means for distributing liquid coating material to a plurality of stationary locations in an atomizing plane; a rotary impeller comprising a hub and a plurality of blades mounted thereon, said blades lying closely adjacent said atomizing plane for rotation about an axis transverse thereto, each blade being shaped generally as an air foil in transverse section and each blade being curved in its longitudinal extent in the direction of rotation of the impeller, the curvature of each blade being such that the angle subtended by a line radial of said hub and a line tangential of said blade edge at the point of crossing of said radial line is substantially constant at all points along the length of the blade; 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.

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, a rotary impeller comprising a hub and a plurality of free ended blades mounted thereon, said blades lying closely adjacent said atomizing plane for rotation about an axis transverse thereto, each blade being curved in its longitudinal extent in the direction of rotation of the impeller, the curvature of each blade being such that the angle subtended by a line radial of said hub and a line tangential of said blade edge at the point of crossing of said radial line is substantially constant at all points along the length of the blade, the free end of each blade projecting outwardly beyond the perimeter of the feed

distributing means; 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.

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; a rotary impeller comprising a hub and a plurality of blades mounted thereon, said blades lying closely adjacent but spaced from said atomizing plane for rotation about an axis transverse thereto, each of said blades being generally air foil shaped in transverse section and each blade 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 is the trailing edge of the blade, each blade being curved in its longitudinal extent in the direction of rotation of the impeller so that the free outer end of each blade leads the inner fixedly mounted end thereof to minimize radial velocity of coating material on the blade during rotation, the curvature of each blade being such that the angle subtended by a line radial of said hub and a line tangential of said blade edge at the point of crossing of said radial line is substantially constant at all points along the length of the blade, the free end of each blade extending around the hub through an angle of more than ninety degrees and the free end of each blade projecting beyond the perimeter of the feed distributing means; 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.

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; a rotary impeller comprising a hub and a plurality of blades mounted thereon, said blades having thin sharp edges extending throughout the entire length of the blade and each blade lying closely adjacent said atomizing plane for rotation about an axis transverse thereto, each blade being curved in its longitudinal extent in the direction of rotation of the impeller, and each blade being formed on an approximate arc drawn about a point displaced from the axis of rotation of the impeller; 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.

References Cited in the file of this patent

UNITED STATES PATENTS

1,736,799	Planert	Nov. 26, 1929
1,832,096	Chaffee	Nov. 17, 1931
2,665,942	Bowen	Jan. 12, 1954