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R. T. THORNBERRY

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ELECTROSTATIC SPRAY COATING OF NONCONDUCTING ARTICLES

Filed June 10, 1957

2 Sheets-Sheet 1

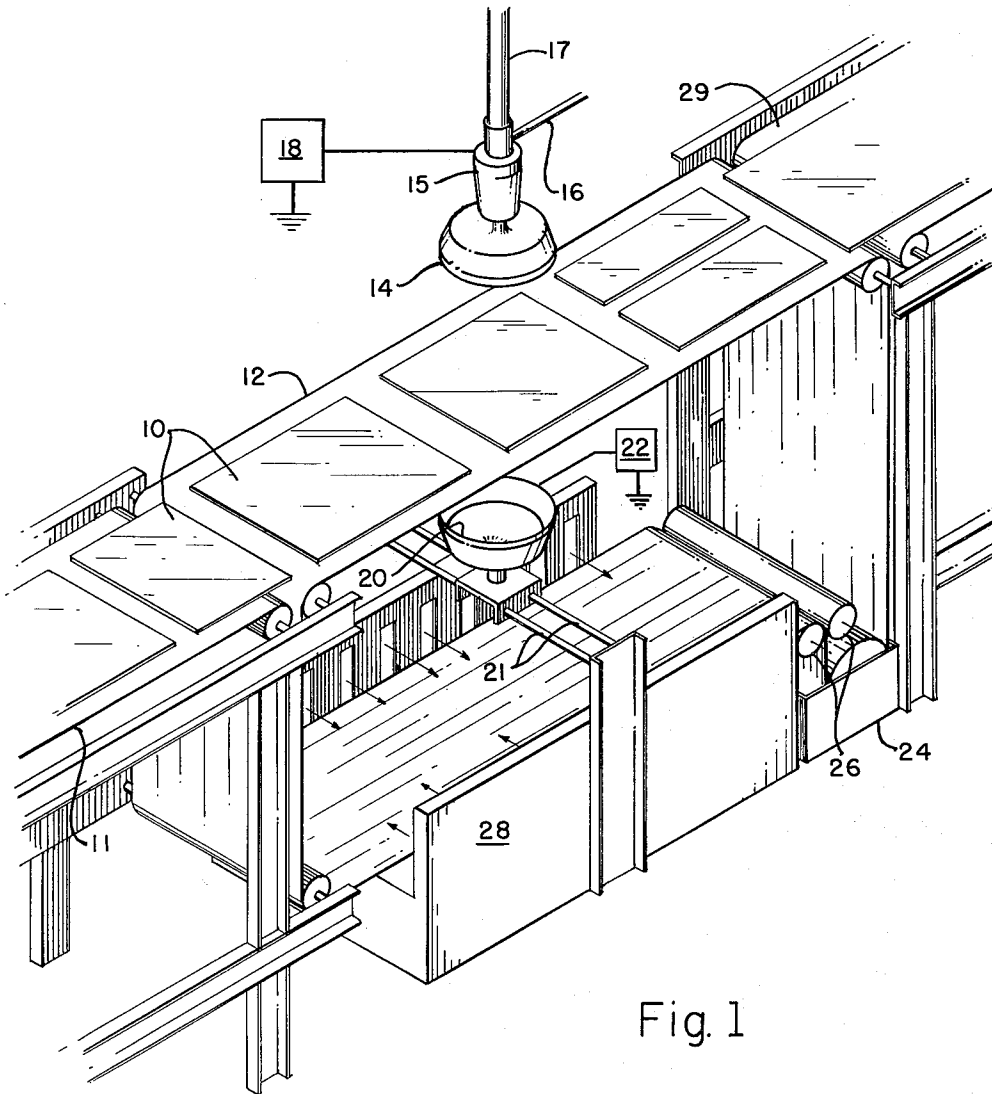


Fig. 1

INVENTOR.

RICHARD T. THORNBERRY

BY

Harry E. Downer
Wm. J. Plimpton
Attorneys

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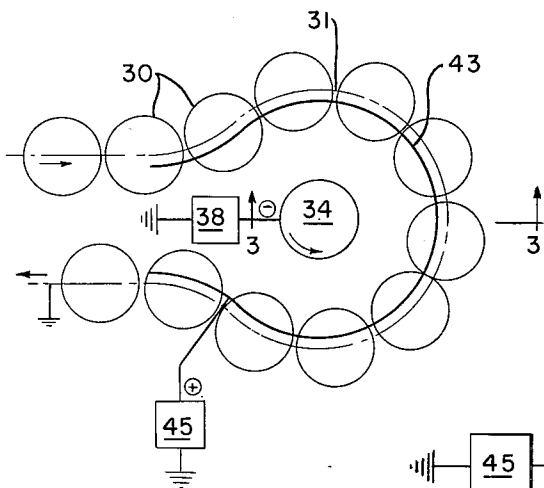


Fig. 2

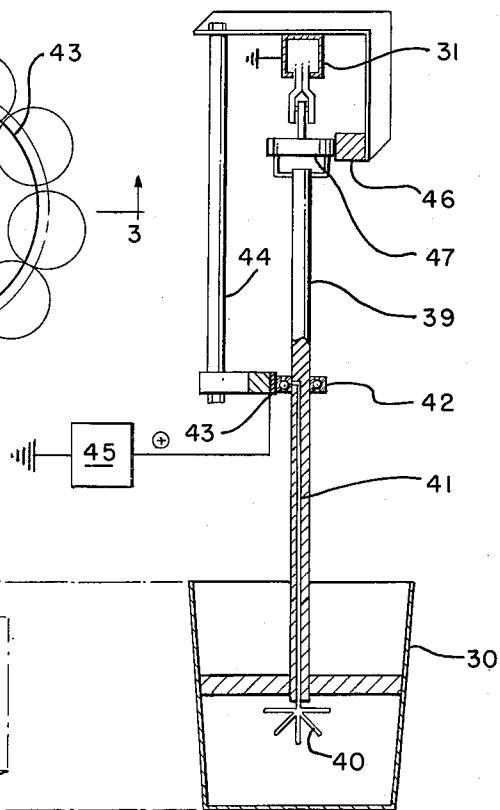
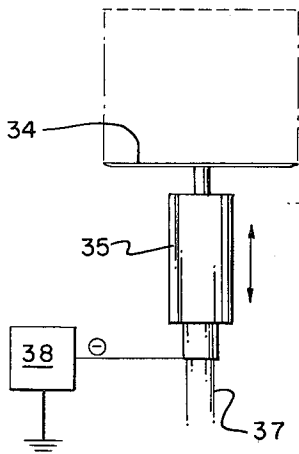


Fig.3



INVENTOR.

RICHARD T. THORNBERRY

BY

Harry & Dooner
Lynchinson.

Attorneys

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ELECTROSTATIC SPRAY COATING OF NON-CONDUCTING ARTICLES

Richard T. Thornberry, Indianapolis, Ind., assignor to Ransburg Electro-Coating Corp., Indianapolis, Ind., a corporation of Indiana

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1 Claim. (Cl. 117-93)

This invention relates to electrostatic coating methods and apparatus and particularly to improvements in the electrostatic coating of articles made of relatively non-conducting material such as glass, wood, fibre, plastic and the like.

The spray coating of articles with the aid of an electrostatic field is well known. The electrostatic coating of articles made essentially of nonconducting material has long been a problem since the electrostatic field tends to build up a static charge on the surface of a nonconducting article which interferes with deposition of the similarly charged spray particles. A number of suggestions have been made for improving the electrostatic spray coating of nonconducting articles, including wetting the article with a conducting liquid, "spraying" the article with oppositely charged ions to electrically neutralize the surface charge accumulated on the nonconducting surface, and heating the article to render it electrically conducting. U.S. Patents 2,723,921, 2,698,814 and 2,662,833 contain suggestions for electrostatically spray coating non-conducting articles.

I have discovered an improved system for electrostatically spray coating a surface of the sheet-like portion of an article made of relatively nonconducting material by positioning that portion of the article in a predetermined electrostatic field so that the article surface to be coated will assume and retain throughout the coating operation a predetermined potential, preferably ground potential. Essentially this is achieved by establishing an electrostatic field between a highly charged positive electrode on the one hand and a highly charged negative electrode on the other and placing the article surface to be coated in the mid-portion of this field with one electrode directly facing the surface of the sheet-like article portion to be coated and the other electrode directly facing the other side of said sheet-like portion.

The principles, as well as the advantages, of my invention will be readily understood from the following detailed description of two embodiments of the invention and the attached drawings in which:

FIG. 1 is an isometric view illustrating one form of the invention;

FIG. 2 is a plan view, somewhat diagrammatic, illustrating another embodiment of the invention; and

FIG. 3 is a detailed view of a portion of the apparatus shown in FIG. 2.

FIG. 1 illustrates a form of the invention for applying a protective coating onto the surface of glass plates. A plurality of glass plates 10 are delivered to the coating apparatus by a conveyor belt 11. The coating apparatus includes a power driven conveyor belt 12 moving in a generally rectangular path. Belt 12, which is made of some suitable nonconductive webbing, is adapted to receive the glass plates from belt 11 and convey them in a horizontal plane through the coating zone. A bell-shaped atomizing device 14 is positioned with its axis normal to plates 10 directly above belt 12. Atomizer 14 is mounted on the end of the rotatable shaft of motor 15, which in turn is suspended from an insulated support 17. Liquid coating material is fed through a conduit 16 to a passageway through the center of the shaft of motor 15 and thence to the interior surface of bell-shaped atomizer 14. The motor and atomizer are maintained

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at high voltage, preferably a negative voltage of approximately 80,000 volts, by connection to a source of high voltage 18.

An electrode 20, preferably with a circular edge and shaped like atomizer 14, is positioned axially beneath atomizer 14 and conveyor belt 12. Electrode 20 may be positioned so that the upper surface of plates 10 will lie at the midpoint between atomizer 14 and electrode 20 as the glass plates pass between them. Electrode 20 is mounted on a plurality of supports 21 of insulating material so that it is isolated from ground and the electrode is maintained at high voltage, preferably at a positive voltage of slightly more than 80,000 volts by connection to a source of high voltage 22.

A bath of solvent may be maintained in a trough 24 and the rollers supporting belt 12 arranged so that the belt will pass through the solvent bath in trough 24. A pair of rollers 26, designed to wring solvent from belt 12, may be positioned to engage the belt as it leaves trough 24 in order to provide a simple means for removing excess coating material from belt 12. If desired, heated air may be directed to pass over the recently cleaned portion of belt 12 by means of blower 28 in order to dry the belt. A further roller conveyor 29 is arranged to receive the coated plates from belt 12 and transport them away from the coating apparatus.

In operation of the apparatus illustrated in FIG. 1, glass plates to be coated are brought to the coating apparatus on belt 11 and automatically transferred onto the upper portion of belt 12. An electrostatic field of high potential is established between the annular atomizing edge of atomizer 14, which is maintained at approximately 80,000 volts negative, and electrode 20, which is maintained at slightly more than 80,000 volts positive, with a spacing of approximately 24 inches between atomizer 14 and electrode 20.

Atomizer 14 may be rotated at a speed of approximately 900 r.p.m. by motor 15. Liquid coating material is fed through conduit 16 to the rotating interior surface of atomizer 14 where the liquid is spread into a thin expanding film and atomized into the electrostatic field from adjacent the annular edge of atomizer 14 as a spray of finely divided liquid particles.

It will be apparent that due to the similarity between charged atomizer 14 and charged electrode 20 that the electrostatic field between them will be symmetrical about a plane normal to the lines of force of the field and passing through the midpoint between the atomizer and the electrode, and that such plane will be at essentially ground potential. By positioning the surface to be coated of the nonconducting glass plate in this plane of "enforced" ground potential or in a plane of potential slightly above ground in the direction of the electrode, the portion of the electrostatic field existing between the atomizer and the glass surface to be coated will be substantially identical with the electrostatic field which would exist if the article were made of metal or other fully conducting material and accordingly spray particles will be attracted to and deposited on the article surface without an undesirable particle-repelling charge being built up on its surface.

It has been found desirable that the electrode which faces the rear surface of the nonconducting article, that is, the surface not to be coated, be maintained at a potential slightly higher than that of the atomizer when the article surface to be coated is positioned equidistant between the atomizer and the electrode. The potential of the electrode may be lowered without adversely affecting the spray coating if the electrode is placed somewhat closer to the article than is the atomizer, but in all cases the electrode should be charged to a substantial potential above

ground. Irrespective of the exact potential of the electrode, the object is to position the surface to be coated in the plane of "enforced" ground potential or in a plane of potential slightly above ground in the direction of the electrode.

A test was conducted in which the surface of the glass plate to be coated was silvered to make it conductive. This silvered surface was grounded through a microammeter and voltage source 22 was made inoperative. When the silvered surface was spray coated under these conditions, a current was noted through the ammeter to ground indicating that, except for the path provided to ground through the ammeter, the surface to be coated would accumulate a charge. The test was repeated, except that voltage source 22 was made operative so as to charge electrode 20. In spray coating under these conditions, no current flow through the ammeter to ground was noted indicating that the silvered surface of the glass plate was being maintained at ground potential without the accumulation of any substantial charge. In order to compare the actual deposition of coating material on glass plates, both with electrode 20 charged and uncharged, a further series of tests were run. A much heavier and more uniform coating was obtained when electrode 20 was charged to a positive voltage of approximately 85,000 volts than was obtained when electrode 20 remained at ground potential.

Turning now to FIGS. 2 and 3, there is shown another embodiment of the invention for electrostatically coating the outer surface of wastebaskets made of fibreboard. A succession of similar fibre wastebaskets 30 are suspended from a conveyor 31 having a looped portion arranged as a major segment of a circle concentrically about a reciprocable atomizing disc 34. Disc 34 is mounted on the upper end of the rotatable shaft of motor 35, which in turn is mounted on the upper end of a support 37 made of suitable insulating material. Liquid coating material is fed through a conduit (not shown) through the center of the shaft of motor 35 and thence to the upper surface of disc 34. The motor and disc are maintained at high voltage, preferably a negative voltage of approximately 80,000 volts, by connection to a source of high voltage 38.

Baskets 30 are each suspended from conveyor 31 by a hanger 39 made of insulating material. Hanger 39 is also used to support an electrode 40 which is positioned inside the basket and spaced equidistant from the interior surface of the basket. Electrode 40 is maintained at a high voltage of a polarity opposite to that of disc 34 through wire 41 which is encased in support 39. Wire 41 is electrically connected to a metal roller bearing 42. As the wastebaskets are moved around the disc, bearing 42 is maintained in friction contact with a metal member 43 which extends in a circular path around disc 34 and is insulingly supported from conveyor 31 by a plurality of insulated rods 44. Member 43 is directly connected to the high voltage positive terminal of voltage source 45. Electrode 40, which preferably consists of a cluster of pointed needles, is thus maintained at a substantial positive voltage in relation to ground.

Conventional means are provided in the form of a rotator bar 46 mounted on conveyor 31 and wheel 47 mounted on support 39 for rotating the wastebaskets about their vertical axes as they move along their looped

path propelled by conveyor 31. In order to increase the vertical width of the spray pattern of disc 34, means may be provided for axially reciprocating the disc and motor on their support 37.

In operation of the apparatus illustrated in FIGS. 2 and 3, the wastebaskets 30 are mounted on a plurality of hangers 39 and moved in a looped path by conveyor 31 about disc 34. An electrostatic field is established between the edge of the disc 34, maintained at approximately 80,000 volts negative, and electrode 40, maintained at a substantial positive polarity. The disc is rotated by motor 35 and liquid coating material is fed to the upper surface of the disc. Under the action of centrifugal force the liquid spreads into a thin film covering the upper surface of the disc and is atomized as a spray of fine liquid particles into the electrostatic field existing between the disc and electrode 40 to be deposited on the outer surface of baskets 30.

The potential of electrode 40 is adjusted so that the sheet-like article portion of basket 30 between the disc and electrode will be maintained as closely as possible to ground potential or at a slightly positive potential. The exact potential of electrode 40 will depend upon the size and shape of basket 30, as well as on the distance between the closest article portion of basket 30 and disc 34. The presence of electrode 40 positively charged in relation to ground, irrespective of its actual potential, results in a better coating of the outer surface of the basket than is obtained without such positively charged electrode.

Two forms of apparatus have been illustrated utilizing my invention, but it is to be understood that other forms of atomizers and other types of apparatus may also be utilized without departing from the scope of the present invention and no limitation should be implied from the detailed description herein set forth.

I claim:

A method of electrostatically coating a surface of a sheet-like article made of nonconducting material, comprising maintaining a first electrode at a substantial polarity relative to ground and maintaining a second electrode spaced from said first electrode at a substantial opposite polarity relative to ground thereby to create an electrostatic field therebetween, providing in the region adjacent said first electrode a spray of finely divided particles charged similarly to said first electrode, passing the sheet-like article through the mid-portion of said electrostatic field with the article surface to be coated facing the spray of charged particles, and maintaining said article surface at all times during the coating thereof exposed to only that portion of said electrostatic field created by said first electrode thereby to electrostatically attract the spray particles to said surface and deposit them onto the surface as a coating.

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