

PATENT SPECIFICATION

DRAWINGS ATTACHED

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Inventor: ALOIS CHEMELAR

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COMPLETE SPECIFICATION

Improvements relating to Electrostatic Coating

5 We, VELVETEX INDUSTRIAL CORPORATION, a Corporation organized according to the laws of Michigan, United States of America, of 18515, James Couzens Highway, Detroit, Michigan 48235, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to the application of coatings electrostatically and in particular to a method and, an apparatus useful in flocking electrostatically.

15 Numerous processes and apparatus are presently available for applying coatings to diverse types of objects. In the known processes and apparatus, a power supply has one of its output terminals electrically connected to an electrode in an applicator. Coating material is supplied to the applicator so as to be available at the electrode. The other output terminal is connected directly to the object to be coated to form a second electrode. This arrangement is particularly undesirable when the object to be coated is nonconductive or when large surfaces such as walls are to be coated. Frequently, these walls are constructed of nonconducting material which cannot be electrically connected to the second electrode in a practical manner. In this case, the other output terminal can be connected to a separate second electrode disposed relative to the object so as to place the object in an electrostatic field between the two electrodes. However, the reverse side of the wall remote from the applicator is, in many cases, inaccessible so that the second electrode cannot be disposed to place the surface of the wall in the electrostatic field.

40 United States Patent No. 2,706,963, entitled "Device for Fiber-Coating Materials and Objects," describes a method and apparatus used to apply flocking material to an adhesive coated wall with a hand-held applicator. An electrode in the applicator is

connected to one output terminal of a direct current-power supply. According to the method and apparatus described in the United States Patent No. 2,706,963, it is necessary to connect the other output terminal of the power supply to the adhesive coated wall. Such a procedure is useful only for limited applications on walls having a particular construction.

50 According to the present invention, a method of electrostatically applying a coating of fibres to an object comprises providing an electrical potential across a pair of output terminals of an electrical potential power supply, electrically connecting one of said terminals to an electrode, establishing an electrostatic field directly between said object and said electrode by disposing said electrode closely adjacent said object without making any direct electrically conductive connection between said object and the other of said output terminals either through an electrical conductor or through a highly electrically conductive earth connection, said object and said electrode being disposed in an environment free of other electrode means electrically connected directly to said other terminal either through an electrical conductor or through a highly electrically conductive earth connection, and supplying loose inert fibres in the vicinity of said field whereby said fibres are deposited electrostatically on said object by said field.

80 The present invention includes the combination of an object to which a coating of fibres is to be applied electrostatically; an applicator having a fibre outlet and an electrode supported on said applicator so as to be spaced adjacent said outlet, fibres being disposed in a loose condition in said applicator in the vicinity of said electrode; and a power supply having a pair of output terminals, one of said output terminals being electrically connected to said electrode; wherein said object is disposed in an environment free of other electrode means

[Price 5s.]

Price 25p

electrically connected directly to said other terminal either through an electrical conductor or through a highly electrically conductive earth connection whereby an electrostatic field can be established primarily only between said object and said electrode when said applicator is disposed with said outlet closely adjacent said object, to enable fibres in said applicator to be transmitted from said applicator to said object without any direct electrically conductive connection being made between said other output terminal and said object or between said other output terminal and other electrode means in said environment either through an electrical conductor or through a highly electrically conductive earth connection.

The invention is further described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 diagrammatically illustrates an operator using an applicator to apply flocking material to a vertical wall by the method and apparatus of the present invention.

Fig. 2 is a vertical cross section through the applicator illustrated in Fig. 1 with a portion of the wall also being illustrated closely adjacent the applicator.

Fig. 3 is a section along lines 3 to 3 of Fig. 2, and

Fig. 4 is a circuit diagram of the power supply used with the applicator.

Fig. 1 illustrates an operator 10 applying flocking fibres 12 to the exposed surface 14 of a solid wall 16 with a hand-held portable applicator 18. The surface 14 is coated with a layer of conductive adhesive 20. The adhesive 20 may be made conductive by dispersing finely divided metallic particles therethrough. A portable direct-current power supply 22 has a pair of output terminals 24, 26 (Fig. 4) which provide a high-voltage, low-amperage output. The terminal 24 is connected to a grid-type electrode 28 in the applicator 18 by a shielded lead 30 (Fig. 2). The terminal 26 is not electrically connected to the wall 16 or to the adhesive 20. The power supply 22 derives its input from any convenient source of electrical energy, as for example, from a conventional 110 volt, single phase, house circuit through a wall plug 32 and cord 33.

The applicator 18 (Figs. 2 and 3) generally comprises a box-like housing 36 having closed top and bottom walls. The front side of the housing, the left side as viewed in Figs. 1 and 2, is open to form an outlet 38 through which fibres 12 pass when they are acted on by an electrostatic field between the electrode 28 and the wall surface 14 together with the adhesive 20. The outlet 38 of the applicator 18 is closed by a removable flat screen 40 which is slidable in a guide formed by a pair of spaced lateral flanges 42, 44 on the housing 36 at opposite sides of the outlet 38.

The electrode 28 is mounted on one end of a tubular support 46 so as to lie inside the housing 36 closely adjacent the outlet 38 and the screen 40. The support 46 extends through a suitable aperture 48 in the bottom of the housing 36 so that the extension can serve as a handle 50. The support 46 has an integral radial flange 52 which is bolted on the housing 36 to mount the support 46 on the housing 36. Alternatively, the support 46 may be telescopically mounted on the housing 36 so that the electrode 28 can be adjusted relative to the outlet 38. The lead 30 passes through the bore of the support 46 and is electrically connected to the electrode 28 at 56 as by soldering. The housing 36, the screen 40, and the support 46 are all formed of suitable insulating material. The mesh size of the screen 40 is such that fibres 12 can pass freely through the openings when the longitudinal axes of the fibres are aligned in a direction between the applicator 18 and the wall 16, that is, generally perpendicular to the plane of the screen 40. However, the mesh is small enough to prevent fibres 12 from falling out of the applicator 18 unless they are aligned generally perpendicular to the screen.

Any conventional voltage multiplier can be used in the power supply 22. Fig. 4 illustrates the circuit diagram of one voltage multiplier which may be used. The plug 32 and the cord 33 are connected in a conventional 110 volt, single phase, supply to provide a single phase input across a pair of input leads 60, 61. The input also includes an earth wire 62 which is connected to an internal chassis (not shown) or to the housing of the power supply 22. A semiconductor voltage clipper or balancer, commercially known as a General Electric "Thyrector," 64 is connected in parallel with a primary winding 66 of a power transformer 68. The balancer 64 and the primary winding 66 are connected across the leads 60, 61 through a variable resistor 70. A fuse 72 and an on-off switch 74 are serially connected in the lead 61. Also connected across the leads 60, 61 is a pilot light 76 and a filament transformer 78 having four secondaries 80. The transformer 68 has a secondary winding 82 operatively connected in circuit with a conventional cascade voltage quadrupler comprising four capacitor banks 84 and four rectifiers 86 connected so as to provide a direct-current output voltage across an output resistor 88 connected between the output terminals 24, 26. The output voltage across the resistor 88 is four times the voltage across the secondary winding 82. The output terminal 26 and one side of the secondary winding 82 are also connected to the chassis (not shown) to provide an internal earth. The rectifiers 86 have their filaments connected to a respective one of the secondaries 80. Although the power supply 22 is illustrated as having a positive earth, it is to be

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To apply flocking fibres 12 to the surface 14 of the wall 16, the surface 14 is first coated with a layer of conductive adhesive 20. The screen 40 is moved outwardly of the housing, upwards as viewed in Figs. 2 and 3, to open the outlet 38 and provide access to the interior of the housing 36. Loose flocking fibres 12 are then placed in the housing 36 and the outlet 38 is closed by moving the screen 40 to its lower limit as viewed in Figs. 2 and 3. Commercially available flocking fibres are first treated to improve their conductivity. For example, rayon fibres may be treated with a salt solution. Nylon fibres may be treated with acetic acid. The plug 32 is connected in a wall socket (not shown), and the switch 74 is closed to energize the power supply 22 and provide a high magnitude voltage between the electrode 28 and the terminal 26. When the applicator 18 is disposed closely adjacent the wall 16 and the adhesive 20 thereon, approximately three to six inches, with the outlet 38 facing in a direction towards the wall 16, an electrostatic field exists between the electrode 28 and the adhesive 20 that is of sufficient magnitude to transmit or propel fibres 12 from the housing 36 through the outlet 38 and then deposit the fibres on the adhesive 20. It has been observed that the individual fibres 12 are oriented by the electrostatic field so that their longitudinal axes are perpendicular to the surface 14. Fibres 12 are propelled towards the adhesive 20 by the electrostatic field with a velocity sufficient to penetrate into the adhesive 20. Fibres 12 are retained on surface 14 by the adhesive 20 and are maintained generally perpendicular to the surface 14 by the electrostatic field. As the fibres accumulate on the surface 14 and the adhesive 20, they provide lateral support for one another so that when the applicator 18 is removed, the fibres will remain properly oriented with their axes perpendicular to surface 14. Additionally, as the adhesive 20 becomes heavily covered with the fibres 12, loose fibres that are not retained on the surface 14 by the adhesive 20 or by interference from fibres in the adhesive, return towards the electrode 28. These fibres will be recirculated between the electrode 28 and the adhesive 20 by the electrostatic field until they are picked up by the adhesive or fall out of the field. Deposition of the fibres on the adhesive 20 is enhanced by shaking the applicator 18 in a generally vertical direction to assure a sufficient supply of loose individual fibres 12 in the vicinity of the electrode 28. However, the fibres 12 remain substantially physically inert until they are propelled from the applicator 18 and deposited on the adhesive 20 by the electrostatic field.

Depending on the particular application, effective flocking can be achieved with a wide variety of adhesives having various types and quantities of conductive or metallic particles added to the adhesive, so long as the metal does not chemically or physically react with the adhesive adversely. The voltage magnitude at the electrode 28, and the type and size of flocking material, as well as the ambient environment in which the flocking is being performed, are also subject to wide variations without substantially impairing the effectiveness of the flocking operation. For example, with certain commercially available adhesives that are wet or under high humidity conditions, satisfactory flocking has been achieved without dispersing metallic particles in the adhesive. Additionally, the effectiveness of the flocking operation is enhanced when the fibres are treated so that they absorb some moisture from the surrounding environment to improve their conductivity before being subjected to the electrostatic field.

For purposes of illustration and not by way of limitation, satisfactory flocking has been achieved when three ounces of finely divided aluminium particles were thoroughly mixed with one gallon of a commercially available adhesive of the alkyd-base air-dry type. A mixture of rayon flocking fibres of equal parts, 0.055 inches long, 6 denier, and 0.090 inches long, 30 denier, were treated with a salt solution to improve their conductivity. The power supply 22 had a 500 watt input, a short circuit current of 0.02 amps across the terminals 24, 26, and an open circuit output voltage of approximately 40,000 volts. The output voltage between the electrode 28 and the terminal 26 was approximately 37,000 volts. The electrode 28 had dimensions of five by eight inches. A satisfactory coating was achieved when the applicator 18 was disposed so that its outlet 38 was generally parallel to the wall 16 and approximately three to six inches from the adhesive 20.

Although the terms "electrostatic" and "electrostatic field" have been used in this application to describe the electrical phenomena by which fibres 12 are transmitted and deposited from the applicator 18 to the coating 20, the electrical phenomena by which the process and apparatus described herein operate are not fully understood. Therefore, the terms "electrostatic" and "electrostatic field" as used herein, denote the field or charge that is provided by the method and apparatus described herein between the electrode and the wall or object. The terms "electrostatic" and "electrostatic field" are used in this broad sense because the terminal 26 is not connected to the wall 16 and the position of the terminal 26 and the power supply 22 relative to the wall 16 is not critical.

perpendicular to said screen, and a handle mounted on said housing and adapted to be grasped by hand for manually moving the applicator relative to said object, said electrode being disposed within said applicator housing relative to said confined fibres and said outlet whereby fibres can be propelled by said electrostatic field through said screen and outwardly of said housing through said outlet.

19. The combination claimed in claim 18 wherein said one side of said housing is a front side and is substantially fully open to form said outlet and said housing has substantially closed top and bottom walls and

wherein said screen is a flat screen and is removably mounted on said housing so as to close said open front side thereof, said electrode being disposed in said housing rearwardly of said screen.

20. The combination comprising an object to be coated with fibres, an applicator for the fibres and a power source arranged substantially as herein described with reference to and as illustrated in the accompanying drawings.

W. P. THOMPSON & Co.,
12 Church Street, Liverpool,
Chartered Patent Agents.

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