

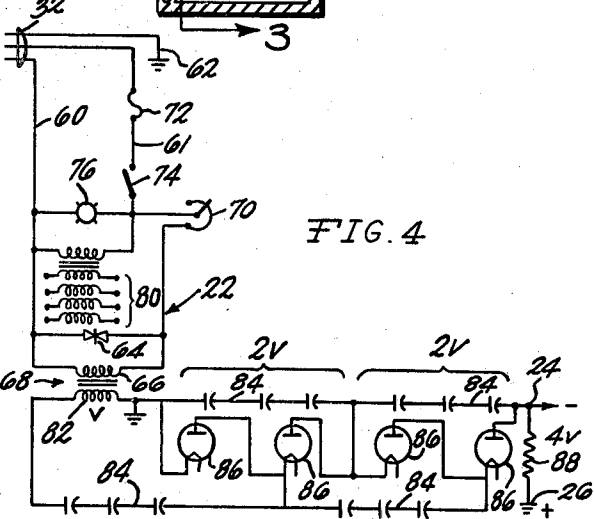
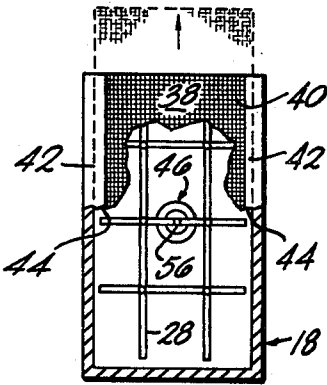
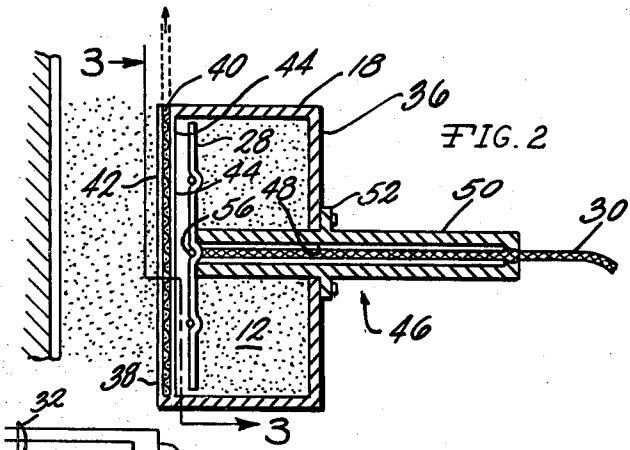
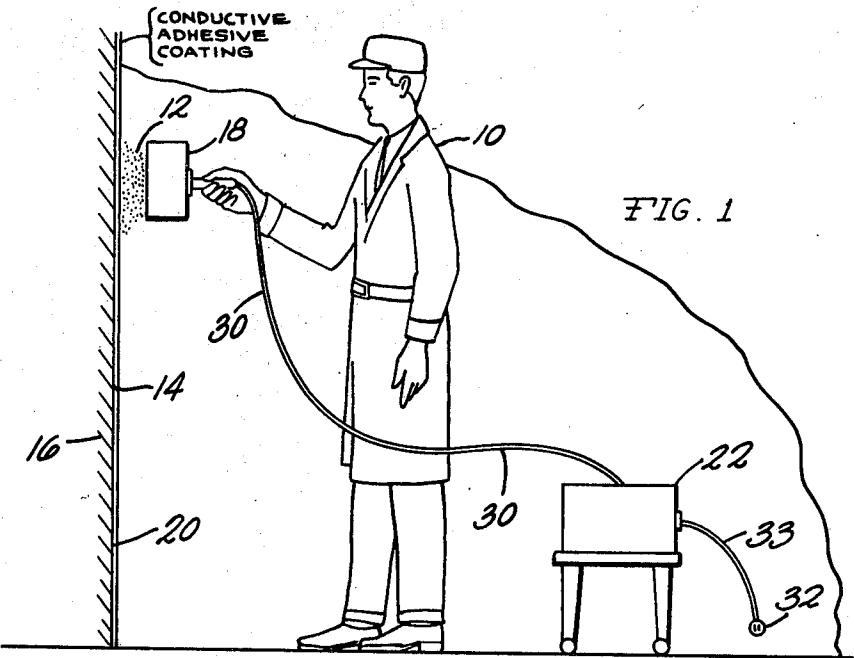
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3,496,911

ELECTROSTATIC FLOCKING

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3,496,911

ELECTROSTATIC FLOCKING

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2 Claims

ABSTRACT OF THE DISCLOSURE

Flocking fibers are deposited electrostatically on a wall or other object made of non-conductive material by means of a portable hand-held applicator having fibers contained therein by a screen and including an electrode. The object is coated with an adhesive having a conductivity substantially greater than the conductivity of the object. An electrostatic field of sufficient magnitude to transmit fibers from the applicator to the coating is established by disposing the applicator closely adjacent the coated object without making any direct electrically conductive connections between the coated object and the power supply and without using any conventional second electrode disposed behind the object and electrically connected to the power supply.

This application is a division of my copending application Ser. No. 382, 501, filed July 14, 1964, and entitled "Electrostatic Flocking."

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

Numerous processes and apparatus are presently available for applying coatings to diverse types of objects. However, 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. Alternatively, the other output terminal is 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.

For example, a U.S. Patent issued to Rudolf Hug, Patent No. 2,706,963, dated Apr. 26, 1955, and entitled "Device for Fiber-Coating Materials and Objects," discloses 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 disclosed in the Hug Patent, 2,706,963, it is necessary to connect

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the other output terminal of the power supply to the adhesive coated wall. Such a procedure is impractical, inconvenient, and useful, if at all, only for limited applications on walls having a particular construction.

The objects of this invention are to provide a method and apparatus that overcome the above referred to deficiencies; that are constructed simply and economically; that provide effective coatings; and that are particularly useful in electrostatic flocking.

In the drawings:

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—3 of FIG. 2.

FIG. 4 is a circuit diagram of the power supply used with the present invention.

FIG. 1 illustrates an operator 10 applying flocking fibers 12 to the exposed surface 14 of a solid wall 16 with a hand-held portable applicator 18. Surface 14 is coated with a layer of conductive adhesive 20. 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. Terminal 24 is connected to a grid-type electrode 28 in applicator 18 by a shielded lead 30 (FIG. 2). In accordance with one aspect of the present invention, terminal 26 need not be connected to wall 16 or adhesive 20. 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.

Applicator 18 (FIGS. 2 and 3) generally comprises a box-like housing 36, one side of which, the left side as viewed in FIGS. 1 and 2, is open to form an outlet 38 through which fibers 12 pass when they are acted on by an electrostatic field between electrode 28 and wall surface 14 together with adhesive 20. Outlet 38 of applicator 18 is closed by a removable screen 40 which is slidable in a guide formed by a pair of spaced lateral flanges 42, 44 on housing 36 at opposite sides of outlet 38. Electrode 28 is mounted on one end of a tubular support 46 so as to be spaced closely adjacent outlet 38 and screen 40 inside of housing 36. Support 46 extends through a suitable aperture 48 in the bottom of housing 36 so that the extension can serve as a handle 50. Support 46 has an integral radial flange 52 which is bolted on housing 36 to mount support 46 and housing 36. Alternately, support 46 may be telescopically mounted on housing 36 so that electrode 28 can be adjusted relative to outlet 38. Lead 30 passes through the bore of support 46 and is electrically connected to electrode 28 at 56 as by soldering. Housing 36, screen 40, and support 46 are all formed of suitable insulating material. The mesh size of screen 40 is such that fibers 12 can pass freely through the openings when the longitudinal axes of the fibers are aligned in a direction between applicator 18 and wall 16, that is, generally perpendicular to the plane of screen 40. However, the mesh is small enough to prevent fibers 12 from falling out of applicator 18 unless they are aligned generally perpendicular to the screen.

Any conventional voltage multiplier can be used in power supply 22. FIG. 4 illustrates the circuit diagram of one voltage multiplier that has been used with the present invention. Plug 32 and cord 33 are connected in a con-

ventional 110 volt, single phase, supply to provide a single phase output across a pair of input leads 60, 61. The input also includes a ground wire 62 which is connected to an internal chassis (not shown) or to the housing of 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. Balancer 64 and primary winding 66 are connected across leads 60, 61 through a potentiometer 70. A fuse 72 and an on-off switch 74 are serially connected in lead 61. Also connected across leads 60, 61 is a pilot light 76 and a filament transformer 78 having four secondaries 80. 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 output terminals 24, 26. The output voltage across resistor 88 is four times the voltage across secondary winding 82. Output terminal 26 and one side of the secondary winding 82 are also connected to the chassis (not shown) to provide an internal ground. Rectifiers 86 have their filaments connected to a respective one of the secondaries 80. Although power supply 22 is illustrated as having a positive ground, it is to be understood that a negative ground power supply operates equally as well.

To apply flocking fibers 12 to the surface 14 of wall 16, surface 14 is first coated with a layer of conductive adhesive 20. Screen 40 is moved outwardly of the housing, upward as viewed in FIGS. 2 and 3, to open outlet 38 and provide access to the interior of housing 36. Loose flocking fibers 12 are then placed in housing 36 and outlet 38 is closed by moving screen 40 to its lower limit as viewed in FIGS. 2 and 3. Commercially available flocking fibers are first treated to improve their conductivity. For example, rayon fibers may be treated with a salt solution. Nylon fibers may be treated with acetic acid. Plug 32 is connected in a wall receptacle (not shown), and switch 74 is closed to energize the power supply 22 and provide a high magnitude voltage between electrode 28 and terminal 26. When the applicator 18 is disposed closely adjacent wall 16 and adhesive 20, approximately three to six inches, with the outlet 38 facing in a direction toward wall 16, an electrostatic field exists between electrode 28 and adhesive 20 that is of sufficient magnitude to transmit or propel fibers 12 from housing 36 through outlet 38 and then deposit the fibers on adhesive 20. It has been observed that the individual fibers 12 are oriented by the electrostatic field so that their longitudinal axes are perpendicular to surface 14. Fibers 12 are propelled toward adhesive 20 by the electrostatic field with a velocity sufficient to penetrate into adhesive 20. Fibers 12 are retained on surface 14 by adhesive 20 and are maintained generally perpendicular to surface 14 by the electrostatic field. As the fibers accumulate on surface 14 and adhesive 20, they provide lateral support for one another so that when applicator 18 is removed, the fibers will remain properly oriented with their axes perpendicular to surface 14. Additionally, as adhesive 20 becomes saturated with fibers 12, loose fibers that are not retained on surface 14 by adhesive 20 or by interference from fibers in the adhesive, return toward electrode 28. These fibers will be recirculated between electrode 28 and adhesive 20 by the electrostatic field until they are picked up by the adhesive or fall out of the field. Deposition of the fibers on adhesive 20 is enhanced by shaking applicator 18 in a generally vertical direction to assure a sufficient supply of loose individual fibers 12 in the vicinity of electrode 28. However, the fibers 12 remain substantially physically inert until they are propelled from applicator 18 and deposited on 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 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 fibers 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 aluminum particles were thoroughly mixed with one gallon of a commercially available adhesive of the alkyd-base air-dry type. A mixture of rayon flocking fibers of equal parts, 0.055 inch long, 6 denier, and 0.090 inch long, 30 denier, were treated with a salt solution to improve their conductivity. Power supply 22 had a 500 watt input, a short circuit current of 0.02 amp across terminals 24, 26, and an open circuit output voltage of approximately 40,000 volts. The output voltage between electrode 28 and terminal 26 was approximately 37,000 volts. Electrode 28 had dimensions of five by eight inches. A satisfactory coating was achieved when applicator 18 was disposed so that outlet 38 was generally parallel to wall 16 and approximately three to six inches from adhesive 20.

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

What is claimed is:

1. A portable apparatus for electrostatically applying a coating of fibers to an object comprising means forming a walled housing having an opening in one side thereof to serve as an outlet for fibers from said housing, said housing being constructed and dimensioned to facilitate manual manipulation thereof, screen means mounted in said housing and cooperating with said housing walls to form a chamber therein for confining loose bulk fibers and restraining bulk fibers from falling out of said housing through said outlet, a high voltage power supply, electrode means mounted on said housing and operatively connected to said power supply so as to establish an electrostatic field between said electrode means and said object when said electrode means is disposed closely adjacent said object, said electrode means being disposed within said housing relative to said confined fibers and said outlet so as to cause fibers to be propelled by said field through said screen means and outwardly of said housing through said outlet thereof, handle means mounted on said housing and adapted to be grasped by hand to manually move said housing, and wherein said housing, said electrode means and said screen means are movable as a unit relative to said object and said screen means has a mesh size correlated to the length of individual fibers so that the mesh size is small enough to restrain bulk fibers from passing therethrough and large enough to permit individual fibers to pass freely therethrough when longitu-

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dinal axes of said individual fibers are aligned in a direction generally perpendicular to said screen.

2. The apparatus set forth in claim 1 wherein said one side of said housing is the front side of said housing and is substantially fully open to form said outlet, said housing has substantially closed top and bottom walls, said screen means comprises a flat screen removably mounted on said housing to close said open side thereof, and wherein said electrode means is disposed in said housing rearwardly of said screen.

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EVERETT W. KIRBY, Primary Examiner

U.S. Cl. X.R.

117—17.5; 239—15