United States Patent [19]

Smith

[11] **3,889,636**

[45] **June 17, 1975**

[54] **COATING OF SUBSTRATES WITH PARTICLE MATERIALS**

[76] Inventor: **Willoughby Arthur Smith,** The Mead, Sidcot, Winscombe, England

[22] Filed: **Dec. 29, 1972**

[21] Appl. No.: **319,381**

[30] **Foreign Application Priority Data**

Aug. 2, 1972 United Kingdom 36087/72

[52] **U.S. Cl.** **118/621;** 118/627; 118/629; 239/3; 239/15

[51] **Int. Cl.** **B05c 5/02**

[58] **Field of Search** 118/621, 624, 627, 629; 239/3, 15; 117/17.5

[56] **References Cited**

UNITED STATES PATENTS

2,558,376	6/1951	Opp et al.	239/15
2,827,394	3/1958	Sherman	239/15
3,327,948	6/1967	Gignoux	239/15
3,339,840	9/1967	Point	239/3
3,342,415	9/1967	Point	239/15
3,347,469	10/1967	Ross et al.	118/627 X
3,496,911	2/1970	Chmelar	118/621
3,498,540	3/1970	Adams	239/15
3,551,178	12/1970	Chmelar	118/629
3,575,344	4/1971	Angelico	239/3
3,637,135	1/1972	Luderer et al.	239/3

Primary Examiner—Mervin Stein
Assistant Examiner—Leo Millstein
Attorney, Agent, or Firm—Holman & Stern

[57] **ABSTRACT**

Apparatus for electrostatically applying a coating of a particle material to a substrate surface to which a settable adhesive has been applied, including a container for the particle material which can pass gravitationally to a power-driven agitating and metering device and through an electrostatically chargeable electrode from which the charged particle material can then pass downwardly through a main discharge opening to the substrate surface, or said main discharge opening can be closed and the charged particle material can then be fed by the agitating and metering device to an air operated injector device from which the particle material can be delivered through a flexible pipe to a portable handle device to which different subsidiary discharge heads can be applied and electrostatically charged electrodes are positioned at or adjacent subsidiary discharge head openings to again charge or boost the charge applied to the particle material prior to discharge towards the substrate surface.

6 Claims, 6 Drawing Figures

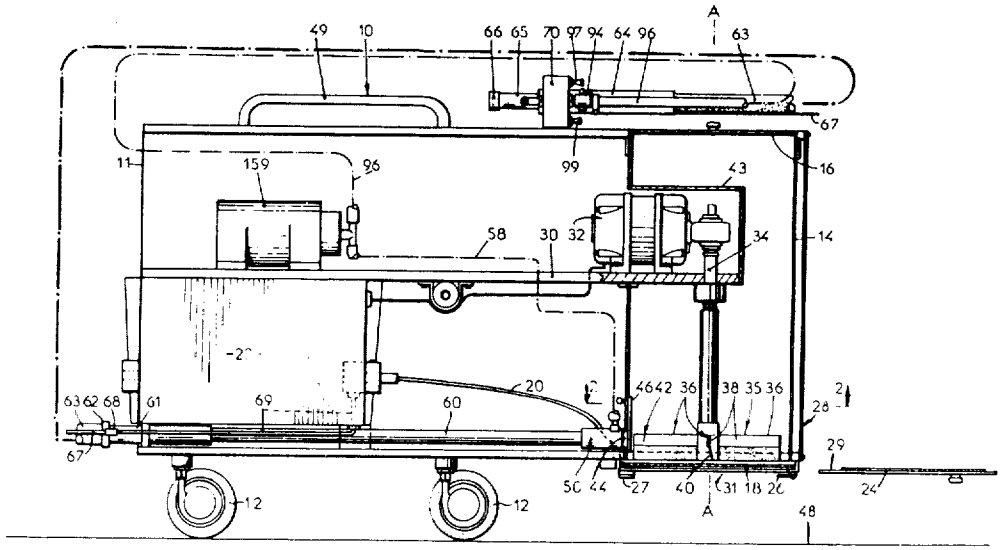
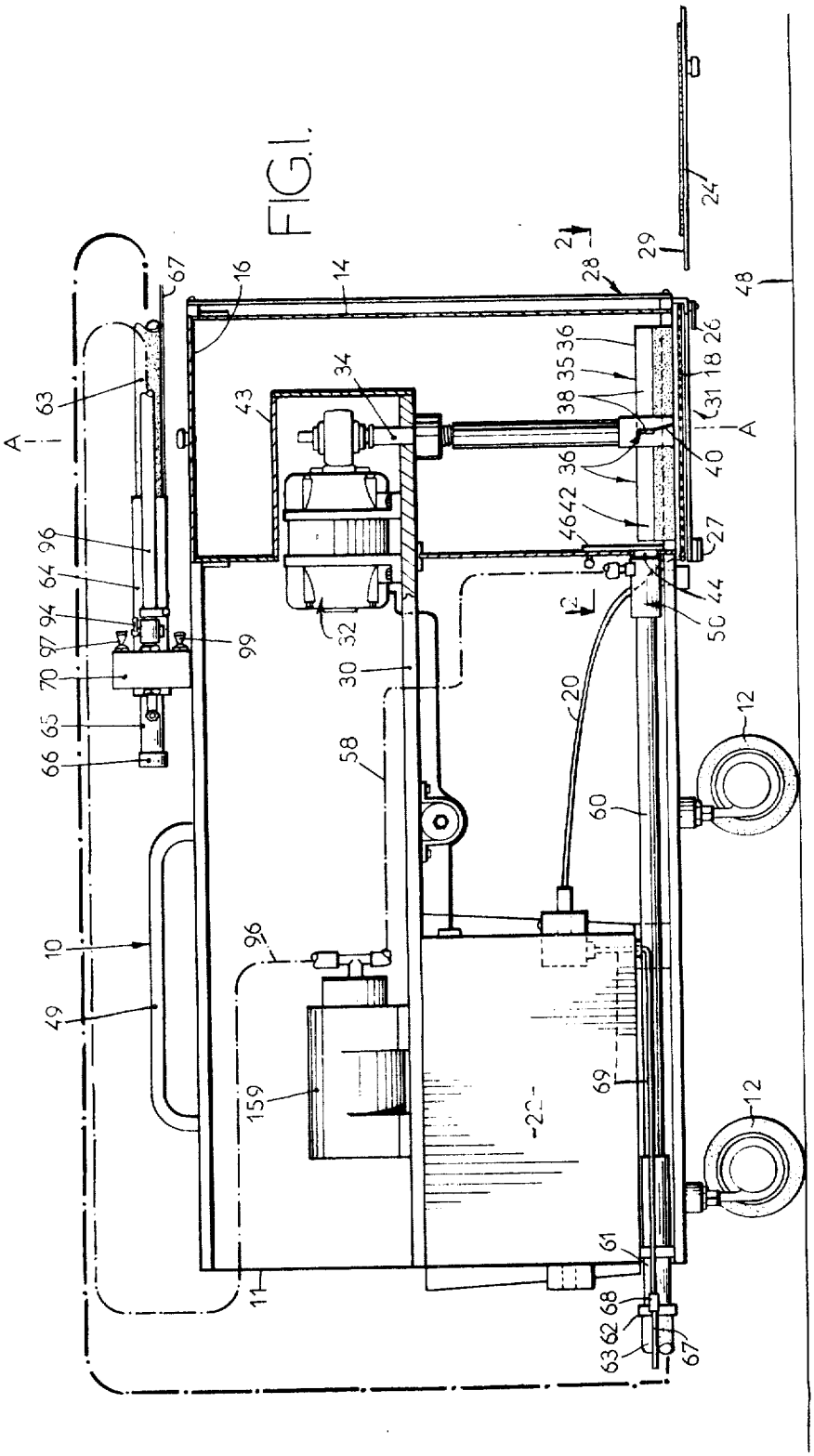


FIG.1.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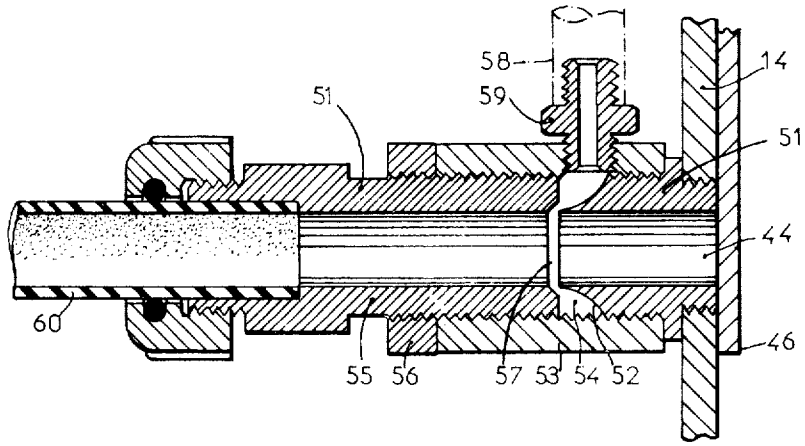

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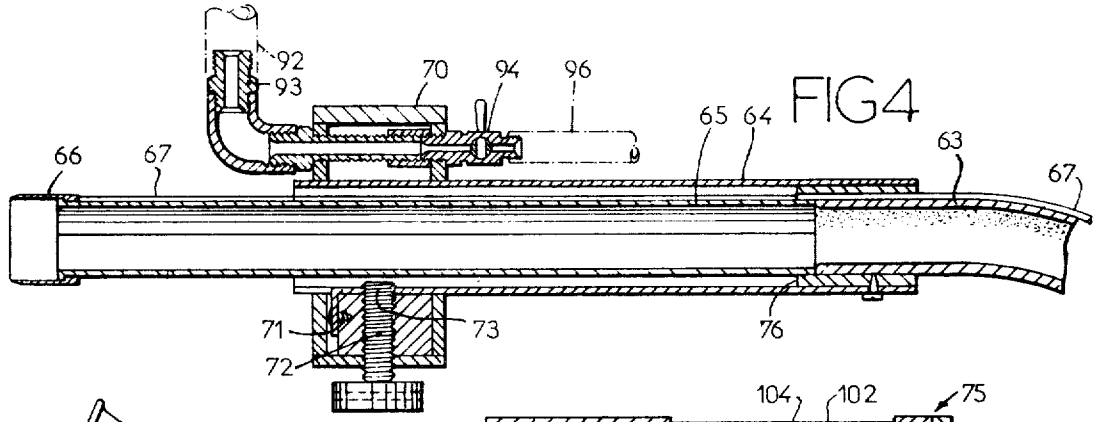

FIG4

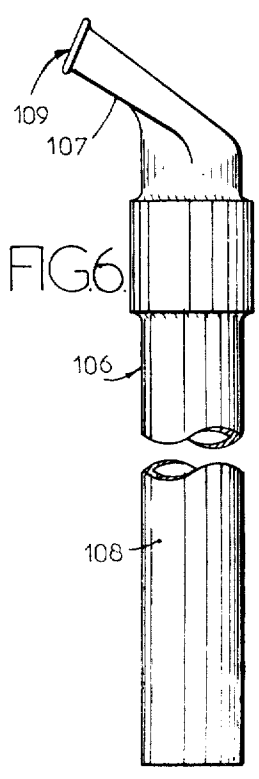

FIG.6.

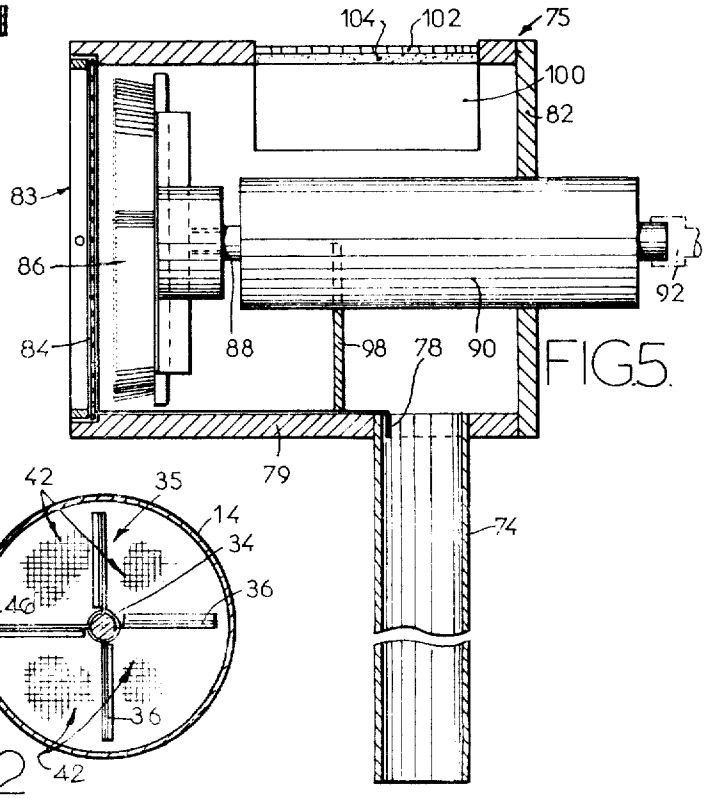

FIG.5.

FIG2

COATING OF SUBSTRATES WITH PARTICLE MATERIALS

BRIEF SUMMARY OF THE INVENTION

According to the present invention apparatus for electrostatically applying a coating of a particle material to a substrate surface to which a settable adhesive has been applied, is of the kind comprising a container for a stock of particle material, a main discharge head affording a main discharge head opening, an electrostatic generator, an electrode connected to the electrostatic generator so as to be charged thereby and disposed between the container and the discharge head opening to charge the particle material prior to discharge thereof through said opening wherein are the improvements comprising a metering device disposed between the container and the discharge head opening and connected to power operated driving means whereby the metering device is driven to accurately regulate the flow of particle material to the main discharge head opening in a uniform stream.

The metering device may comprise a rotatably mounted paddle having blades between which are formed measuring chambers for the particle material.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be more particularly described by way of example with reference to the accompanying drawings in which:

FIG. 1 is a part-sectional side view of a floor supported part of the apparatus including a main discharge head,

FIG. 2 is a sectional plan view of FIG. 1 on the lines 2—2 thereof,

FIG. 3 is a sectional side view on an enlarged scale of an injector device for propelling the particle material,

FIG. 4 is a sectional side view on an enlarged scale of a handle device for attachment thereto of a subsidiary discharge head,

FIG. 5 is a sectional side view of one subsidiary discharge head, and

FIG. 6 is a side view of a further subsidiary discharge head.

The floor supported part of the apparatus is indicated at **10** in FIG. **1** and comprises a frame **11** supported on floor engaging wheels or castors **12** and supported by the frame at one end thereof is a cylindrical container **14** of which the longitudinal axis A—A is vertically disposed and at the top of the container is a removable perforate or imperforate lid **16** which can be removed to enable particle material such as fibres or granules such as of cork, wood chips, sand or other particle materials to be placed in the container after which the lid is replaced. At the lower end of the container **14** is a horizontal metal electrode **18** which is of openwork mesh formation of such dimensions as to resist the easy passage therethrough whilst, however, permitting the passage therethrough, of the selected particle material. The electrode **18** is connected by an electrically conductive lead **20** to an electrostatic generator unit **22** supported at the other end of the frame and suitably adapted to be connected to a mains electric supply source.

An imperforate blanking panel or closure means **24** can be removably secured to the lower end of the container **14** which is provided with a turn-button **26** and a socket **27** to be engaged by a tongue **29** of the panel which can be engaged by said turn-button so as to close the lower end of the container below the electrode **18** and said blanking panel **24** can be removed after manual release of the turn-button so that the lower end of the container **14** can form a main discharge head indicated generally at **28** and having a main discharge head opening **31.**

A horizontal platform **30** of the frame extends partially into the container **14** and supports an electric motor **32** which is arranged to drive, at variable speeds, a vertical spindle **34** of which the axis is co-axial with the vertical axis A—A of the container **14** and supported at the lower end of the spindle **34** is a combined agitating and metering device in the form of a rotatable paddle **35** and composed of four radially disposed paddles or blades **36** which are equiangularly spaced apart and each blade comprises a rigid mounting strip **38** to which is secured a rubber or other flexible wiper blade **40** of which the lower portion extends below the mounting strip and the lower horizontal edge of the lower portion wipes over in contact with or closely adjacent the mesh electrode **18.** Thus four equal substantially sector-shaped measuring chambers **42** are provided between the blades of the paddle to receive the particle material fed into the container **14.**

The electric motor **32** and the upper part of the spindle **34** are separated from the container **14** by an imperforate protective cover **43.**

An opening or port **44** is formed in a side wall of the container **14** adjacent the lower end thereof and, at least in main, is below the upper horizontal edges of the paddles **36** so that said opening or port is disposed horizontally opposite the measuring chambers **42** as the paddles **36** sweep across said opening or port in fairly close proximity thereto. The opening or port **44** can be closed by a control means in the form of a vertically movable slide **46** when said slide is manually moved downwardly and said port can be opened by manually moving the slide **46** upwardly in which upper position the opening or port is placed in communication with the interior of the chamber **14.**

In order to apply a coating of particle material to a substrate surface such as the floor surface **48** or a sheet of any suitable material resting thereon, said surface has applied thereto a suitable settable adhesive and, after the container **14** has been at least partially filled with the particle material and the blanking panel **24** has been removed and the opening or port **44** has been closed, the electric motor **32** is started whereby the agitating and metering device **35** is rotated at a speed adjusted to suit the particular particle material and the electrode **18** is electrostatically charged and the particle material passes downwardly under gravitational compulsion through the electrode **18** so that a stream of electrostatically charged particles pass vertically downwardly and are attracted to the substrate surface **48** so as to coat said surface and form a part thereof after the adhesive has set. The entire substrate surface can easily be coated with the particle material by manually propelling the ground supported apparatus **10** over said surface by handle means **49.**

In order to apply a coating of a particle material to a substrate surface, after a settable adhesive has been applied thereto, such as for example a vertical wall sur-

face or a ceiling surface, the portable subsidiary discharge head illustrated in FIG. 6 may be employed.

For this purpose there is mounted in the floor supported part 10 an air operated injector device 50, see FIGS. 1 and 3, which comprises a tubular nozzle 51 which is screwed at one end into the container 14 and the bore of the nozzle affords the opening or port 44. The other end of the nozzle 51 is externally convergent, as indicated at 52, in an arcuate manner and an internally screw-threaded sleeve 53 is engaged with an externally screw-threaded part of the nozzle 51 so that an annular suction chamber 54 is provided within the sleeve and surrounding the convergent part 52 of the nozzle. As outlet pipe 55 is screwed into the bush 53 and is adjusted longitudinally thereof and locked in position by a lock-nut 56 so as to leave a gap 57 between the nozzle 51 and the outlet pipe 55 and the width of said gap 57 can be adjusted to suit various circumstances including the nature of the particle material being used.

An inlet nipple 59 is screwed into the sleeve 53 so that the bore of the nipple communicates with the annular suction chamber 54 and said nipple is connected by a flexible hose 58 to a power operated air compressor indicated at 159 mounted on the platform 30 of the frame 11 so that a current of air under pressure can be fed into the air injector device 50 and the air passes around the chamber 54 and is directed by the convergent part 52 of the nozzle through the gap 57 and into the bore of the outlet pipe 55 whereby suction is created in the bore of the nozzle 51 and thus at the opening or port 44 so that particle material can be drawn into the injector device from the container 14 when the slide 46 has been manually moved upwardly into a position opening said port 44 and the blanking panel 24 has been secured to the lower end of said container 14 to close the main discharge head opening 31. During the suction effect exerted by the injector device 50 on the particle material in the container 14, the combined agitator and metering device 35 is rotated at a suitable speed for the material so that said material is agitated and delivered to the opening or port 44 in a metered or controlled manner at a constant rate and before entering the opening or port 44, the particle material is electrostatically charged by reason of its proximity to the electrode 18.

The outlet pipe 55 of the injector device 50 has connected thereto one end of a circular pipe 60, see more particularly FIG. 1, of which one end 61 extends beyond the frame 11 and which end forms a spigot coupling end to detachably receive a socket coupling end 62 of a flexible hose 63, see also FIG. 4, which at its other end has mounted thereon a tubular socket handle 64 of a handle device and through which a tubular extension 65 or connection part of the hose 63 extends and said pipe 60 and hose 63 form a connecting passage. At one end of the extension 65, which extends beyond the handle 64, there is mounted externally thereon an electrostatic connecting ring or electrode 66 which is connected to a lead 67 which is mounted on the exterior of the extension 65 and of the hose 63 and at its other end can be detachably connected by a connection diagrammatically indicated at 68 to a lead 69 which is mounted on the exterior of the tube 60 and is connected to the electrostatic generator 22. Thus the leads 67 and 69 are supported by the hose 63 and tube 60 respectively and can be electrically connected together and disconnected by simple acts of connecting the hose 63 to the pipe 60 and disconnecting said hose and pipe respectively.

Secured to the socket handle 64 is a housing 70 to which the socket handle is earthed at 71 and supported by the housing 70 is a manually rotatable clamping screw 72 of which the inner end 73 enters the socket handle 64 to clamp onto a feed tube or connection part 74, see FIG. 5, of a subsidiary discharge head 75 of the manually supported apparatus part previously referred to, after said tube 74 has been inserted over the ring 66 and extension tube 65 into the socket handle 64 until the outer end of the tube 74 abuts a stop shoulder 76 in the socket handle and in which position the electrostatic connecting ring 66 contacts a connecting end of a lead 78 at the inner end of the tube 74.

The inner end of the feed tube 74 is secured in a cylindrical wall 79 of the subsidiary discharge head 75 which is closed at one end by an end plate 82 and at its other end provides a subsidiary discharge head opening 83 across which extends a metal electrode 84 of openwork mesh formation and connected to the lead 78. Spaced a small distance inwardly from the electrode 84 is a brush 86 which is in the form of a circular disc and of which the bristles extend from a backing pad towards the electrode 84 and said brush constitutes a discharge agitating means for the particle material and is secured to one end of a spindle 88 adapted to be rotated by an air-operated motor 90 supported by the end plate 82. The air motor 90 is connected by an air feed pipe 92 to a pipe union 93, see FIG. 4, mounted on the housing 70 which also supports a manually operable air control tap 94 communicating with the union 93 and with a pressure air feed pipe 96 connected to the air compressor 159 as indicated.

Mounted on the housing 70 is an electric switch 97 by which the electrostatic generator 22 can be readily connected to and disconnected from the mains supply and also a further electric switch 99 by which the electric motor 32 can be switched on and off and it will be appreciated that the control tap 94 and electric switches 97 and 99 are all conveniently placed for manual operation by a person holding the socket handle 64 which is shown for convenience only as resting on the top of the frame 11. If the air compressor 159 is electrically driven a further switch, not shown, may be mounted on the housing to start and stop the compressor.

The feed tube 74 of the subsidiary discharge head 75, see FIG. 5, enters the cylindrical wall 79 at an end portion thereof remote from the electrode 84 and disposed between said feed tube and electrode is a transverse baffle plate 98, which is of substantially semi-circular formation and extends between the wall 79 and the exterior of the air motor 90 which, in addition to having an air inlet in communication with the air feed pipe 92, preferably also has an air exhaust, not shown, externally of the head 75.

Formed in the cylindrical wall 79 at a diametrically opposite position to the feed tube 74 is a relief or bleed opening 100 across the entire area of which extends a perforated support grid 102 lined with a porous liner 104 which may be made of expanded polystyrene.

In order to apply a coating of particle material to a substrate wall or ceiling, after the feed tube 74 has been inserted into the socket handle 64 and the clamping screw 72 has been tightened onto the feed tube and the

substrate surface has had a suitable adhesive applied thereto, the operator grips the socket handle **64** and suitably orientates the portable subsidiary discharge head **75** so that the subsidiary discharge head opening **83** thereof, across which the electrode **84** extends, is directed to said adhesively coated substrate surface and the two manually operable switches **97** and **99** are operated to charge the electrodes **18** and **84** and to start the electric motor **32.** The air compressor **159** is also started in a manner dependent upon whether this is an electrically or, for example, an internal combustion engine driven air compressor and the control tap **94** is manually opened whereby the air motor **90** is caused to rotate the agitating brush **86.**

The opening or port **44** is manually opened by operation of the slide **46** and particle material in the container **14** is supplied in a constant regulated manner to said opening or port by the measuring chambers **42** of the agitating and metering device **35** which is rotated at a constant selected speed by the electric motor **32** and which speed is found to be suitable for the particular particle material being used. Resulting from the action of the injector device **50,** a stream of particle material which has been electrostatically charged by the electrode **18** is fed through the pipe **60,** hose **63** and extension **65** into the portable subsidiary discharge head **75** and the material passes past the agitating brush **86** and through the electrode **84** and subsidiary discharge opening **83** and thence onto the adhesively coated substrate surface. Surplus air passes through the opening **100** and is filtered by the liner **104** so that particle material does not pass through said opening.

Whilst the subsidiary discharge head **75** is satisfactory for coating the major parts of a wall or ceiling surface, it is not ideally suitable for coating the surfaces forming an inside corner and for this purpose a portable subsidiary discharge head **106,** illustrated in FIG. **6,** is employed. This subsidiary discharge head **106** comprises a circular feed pipe or connection part **108** which is adapted to be inserted into the socket handle **64** against the stop shoulder **76** and is secured by the clamping screw **72.** The subsidiary discharge head **106** is provided at its end opposite the feed tube **108** with a flattened fishtail formation **107** (illustrated in end elevation in FIG. **9**) affording an elongated rectangular discharge opening **109.** It follows, therefore, that the length of the opening is considerably greater than the width of the opening which is slightly smaller than the upright external width of the fishtail formation shown in FIG. **6.** The flattened fishtail formation **107** is capable of being inserted into inside corner formations to apply a particle material coating to the substrate surface or surfaces to completely cover said surface or surfaces.

The subsidiary head discharge opening **109** is not provided with an electrode and it is found that as the particle material is initially charged by the electrode **18,** it is sufficiently recharged or boosted by the electrostatically charged connecting ring or electrode **66** through which the particle material passes before being discharged through the opening **109.**

The strength or intensity of the suction effect developed by the injector device **50** can be varied by altering the width of the gap **50** by adjustment of the outlet pipe **55** relative to the nozzle **51** so that the rate of flow of the stream of air and particle material through the outlet pipe **55** can be adjusted to suit requirements. Furthermore, the supply of particle material to the port **44** and thus to the injector device **50** is controlled by the power driven agitating and metering device **35** so that an accurately regulated supply of particle material is provided for the injector device **50** and thus to the portable subsidiary discharge heads **75** or **106.** Alternatively, when the discharge head **28** is being used and the opening or port **44** has been closed by the slide **46,** the particle material is fed from the chambers **42** downwardly through the electrode **18** and main discharge head opening **31** at an accurately regulated uniform rate dependent partially upon the selected speed of rotation of the agitating and metering device **35.**

Thus, the agitating and metering device **35** is employed when any one of the three discharge heads **28,** 75 and **106** is used and ensures that an accurately controlled uniform rate of discharge of the particle material issues from the particular discharge head whereby a uniform coating of particle materials is applied to the substrate surface.

The distance of the adjusting or metering device **35** from the electrode **18** and of the brush **86** from the electrode **84** can be adjusted in any convenient manner to exercise a measure of control of discharge of the particle material from the heads **28** and **75** respectively and for this purpose the speed of rotation of said device **35** and brush **86** can also be adjusted.

Whilst the apparatus illustrated in the drawings is specifically intended for use with particle material in the form of fibres of such a length as to enable a pile carpet coating to be applied to a substrate surface and which fibres may be made of nylon or other suitable plastics or other material, it should be appreciated that the apparatus is also suitable for particle materials of other than fibrous formation. When fibres are employed, however, the effect of electrostatically charging the fibres is that during their movement from the appropriate discharge head **28, 75** or **106** they are caused to assume a parallel orientation and are aligned in the direction between the discharge head and the substrate surface and their velocity is such that their ends adjacent said surface penetrate the settable adhesive coating to a sufficient depth that the fibres are embedded in the adhesive coating and afford mutual support for each other and provide an upstanding pile on said substrate surface.

What is claimed is:

1. Apparatus for electrostatically applying a coating of a particle material to a substrate to which a settable adhesive has been applied, the apparatus comprising a container for a stock of particle material; a single metering means comprising a chamber supplied with particle material from the container and comprising a base and an upstanding peripheral wall, and a power rotatable paddle wheel having blades which are adapted to sweep the volume of the chamber on rotation of the paddle wheel and between adjacent blades there being defined compartments, each adapted to contain a predetermined amount of particle material, the paddle wheel having an axis of rotation which is disposed vertically, said chamber having two alternatively openable exits, one exit being disposed in the base and the other exit being disposed in said upstanding peripheral wall, a manually portable discharge head being provided in communication with said other exit, and said one exit constituting a downwardly directed discharge head; said single metering means serving to meter the amount

of particle material supplied to the discharge heads; the apparatus further including an electrostatic generator; main electrode means electrically connected to said generator and disposed in said chamber to electrically charge the particle material therein; and subsidiary electrode means electrically connected to said generator and associated with said portable discharge head.

2. Apparatus according to claim **1** wherein the main electrode means comprises a grid extending across said one exit.

3. Apparatus according to claim **1** and including a wheeled framework adapted to be movable over a horizontal floor surface, said downwardly directed discharge head being spaced above the level of the floor engaging wheels.

4. Apparatus according to claim **1** wherein a tubular connecting passage having a flexible part is provided in communication with said other exit and a pressure gas inlet is associated with the passage to provide a flow of gas under pressure to carry the particle material towards the manually portable discharge head when the pressure gas supply is operative.

5. Apparatus according to claim **1** wherein an agitating means is provided in the portable discharge head adjacent the subsidiary electrode means and power driving means are drivingly connected to the agitating means to operate same.

6. Apparatus according to claim **5** wherein the manually portable discharge head includes a relief opening having a porous covering, and a discharge opening spaced from said relief opening, the porous liner enabling surplus pressure gas to escape therethrough but preventing escape of particle material through the relief opening, and the agitating means and subsidiary electrode means being disposed in the path of the particle material as it passes to said discharge opening.

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