

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) ELECTROSTATIC SPRAYING APPARATUS AND PROCESS

(71) We, HAJTOMU- ES FELVONOGYAR, of 98, Fehérváriút, Budapest XI., Hungary, a body corporate organized under the laws of Hungary, 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:—

This invention concerns apparatus and process for electrostatic spraying of pulverulent or fibrous materials, and although it is not so restricted, it will be particularly described with reference to spraying of synthetic resin powders.

There are several known industrial electrostatic spraying apparatuses for spraying pulverulent or fibrous materials. They are based on the principle that the spraying device, which is connected to one (advantageously, negative) pole of a high-tension electric power source, electrically charges the material to be sprayed, which material will then be deposited on the workpiece to be sprayed which is connected to the opposite pole of the power source. It is also known in the spraying of paints to use spray chambers.

The main disadvantage of known spraying apparatus is connected with losses in the material to be sprayed due to intermittent operation and to the spray falling short of or passing by the workpiece.

In some currently used spraying apparatus, a collecting tray is placed under the workpiece for collecting the sprayed pulverulent or fibrous material that has missed the workpiece. From time to time the material collected in the tray is returned to the container in which the material is stored. However, in this way only that portion of the "lost" material which falls into the tray can be re-used. The material that passed by the workpiece or fell outside the tray cannot be recovered in a clean and usable state.

[Price 25p]

In another known apparatus, suction is exerted in the spray space to suck in not only the air, but also the floating material particles, which are then passed through a cyclone system to separate out the solid particles or fibres from the air. The solid material is then continuously or intermittently and manually returned to the storage container. However, this apparatus suffers from the disadvantages of excessive space requirements and high capital costs; furthermore, the strong suction exerted on the spray space reduces the directing effect of the electrostatic field on the solid particles, with a consequential decrease in the efficiency and quality of the spraying.

The present invention seeks to provide apparatus which substantially eliminates the above-mentioned disadvantages, and which enables synthetic resin powders and fibrous materials to be sprayed continuously.

According to the present invention in one aspect, there is provided electrostatic spraying apparatus for spraying a workpiece with pulverulent or fibrous material, comprising a spraying booth formed by a spraying chamber and a material storage container in open communication with each other, at least one spraying head in said chamber which head includes means for electrostatically charging the material to be sprayed, injector feeding means in communication with said container for delivering said material to said head(s), said feeding means including a delivery conduit and ducting which is spaced from said conduit and is connectable to a source of pressurised gas or air, whereby in use said gas or air is passed to said conduit and entrains particles of said material therewith, and means for varying the spacing between said conduit and the ducting to regulate the quantity of said material delivered to said head(s).

According to another aspect of this in-

vention, there is provided an electrostatic spraying process comprising positioning a workpiece to be sprayed in a spraying booth formed by a spraying chamber and
5 a material storage container in open communication with each other, passing pressurised gas or air to a ducting of an injector feeding means which also has a conduit spaced from the ducting so as to entrain particles of the material to be sprayed
10 and to deliver them to at least one spraying head, electrostatically charging the particles in said head(s), and regulating the quantity of material delivered to said head(s) by varying the spacing between
15 said ducting and said conduit of the injector feeding means.

In the preferred embodiment of this invention, the material particles which missed
20 the workpiece are kept in continuous, relatively gentle motion. A part thereof will then fall back into the feed/storage container, while another part will float as a mist within the spraying chamber and is
25 continuously deposited on the workpiece to be coated, whereby the output, efficiency and even the quality of the spraying process are improved.

For enhanced floating and maintenance
30 in a state of mist of the solid particles, a preferred feature of the apparatus of this invention provides air blowers as well as baffle plates in the spraying chamber for guiding the said particles towards the work-
35 piece to be coated or towards the said container.

Preferably, the blowers deliver air at a pressure between 0.1-0.3 atm. which keeps urging the particles in relatively gentle
40 motion towards the said container, the pressure being chosen such that the ensuing particle motion will not disturb the lines of force between the workpiece and the spraying device(s) to any appreciable extent;
45 at the same time, this gentle motion will help the coating of the workpiece and prevent the particles from being deposited on the side walls of the spraying chamber.

Advantageously, the feeding means in the
50 said container may be constituted by a bifurcated duct co-operating with ducting including at least two compressed-air blowers located in the lower part of the container, the bifurcated duct having an inlet
55 in each limb spacedly facing the blowers. In this way, the material to be sprayed will not get to the spraying head(s) with an excessive amount of air.

To ensure the continuous feeding of the
60 pulverulent or fibrous material, it is preferred to provide a pressure of between 0.1-0.3 atm. within the spraying chamber, which will act on the upper surface of the material within the container; alternatively
65 or additionally, a stirrer or agitator may be

built in the said container.

It has been found that the apparatus according to the preferred embodiment of this invention (described in detail below) provides a 50% increase in output compared
70 with known apparatuses.

To allow for the varying shapes and dimensions of different workpieces and in general, for the optimization of the use of the apparatus according to different
75 technological requirements, the bifurcated duct may be displaceable, e.g. may be raised or lowered, relative to the compressed air blowers, whereby to increase or decrease the quantity of the material fed.
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Optionally, the workpiece inlet and/or outlet of the spraying chamber may be provided with a moving air curtain.

The invention is described, merely by way of example, with reference to the accompanying drawings, wherein:—
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Fig. 1 is a schematic section of the spraying apparatus according to this invention, and

Fig. 2 is an enlarged section of the lower
90 part of the apparatus shown in Fig. 1.

Referring to the drawings, the spraying apparatus of this invention is an electrostatic sprayer which includes a spraying chamber 1 and a tapering, part-conical
95 material container 2 secured to the lower part of the chamber 1 so as to be in open communication therewith. The bottom of container 2 is provided with a pressure fluid; preferably compressed air, ducting 3
100 which in use is connected to a source of pressure fluid not shown. The ducting 3 terminates in a plurality of vertically directed nozzles 4, there being two such nozzles in this embodiment. Spaced above
105 the nozzles 4 are respective open-ended branches of a bifurcated material conveying conduit 5 mounted in the container 2 so as to be displaceable (by means not shown) in a vertical plane relative to the nozzles 4. An
110 electric motor 6 is provided to drive, in use, a stirring or scraping blade 7.

The spraying chamber is provided with two spraying heads 8 mounted on respective servomechanisms for vertical movement.
115 The spraying heads are each connected for flow via ducting 9 and conduit 5 to the nozzles 4. However, in certain applications one spraying head only may suffice.

The spraying heads 8 are each
120 electrically connected via a high-tension cable 10 to one pole, preferable the negative pole, of a high-tension electric power source 11, the other pole of which is electrically connected to a rail 13 on which
125 the workpiece 12 to be coated is movably mounted.

In operation, any sprayed particles which failed to reach the workpiece 12 will float as a mist in the spraying chamber 1
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which has therein a plurality of nozzles 14 connected to a source of compressed air not shown, and serving to blow the said particles. Adjacent the nozzles 14, baffle plates 15 (which may form part of the walls of the spraying chamber 1) are provided to deflect the air streams issuing from the nozzles 14 partly towards the container 2 and partly towards the workpiece 12.

The spraying chamber 1 has workpiece inlet and outlet apertures 16 which are respectively provided with means (not shown) for establishing a dynamic air curtain thereacross.

For cleaning purpose a suction fan 17 is connected to the spraying chamber 1.

In use, the container 2 is filled with the material to be sprayed and the high-tension power source 11 is switched on. At the same time the workpiece transporting mechanism is moved over rail 13 to convey a workpiece 12 through the inlet aperture 16 into the spraying chamber. Simultaneously, compressed air is blown through the ducting 3 and nozzles 4. The air issuing therefrom will entrain particles of the material to be sprayed which will be conveyed to spraying heads 8 via conduits 5 and ducting 9. In the spraying heads 8 the particles will be electrostatically charged and, under the influence of the electrostatic forces, will fly towards the workpiece 12. Excess particles, or particles that "missed" the workpiece 12, will eventually form a floating mist in the spraying chamber 1.

Air blown in through nozzles 14 and deflected by baffle plates 15 will direct these particles partly towards the workpiece 12 and partly towards the container 2, as already stated. The relatively low pressure—between 0.1-0.3 atm.—will not substantially affect the influence of the electrostatic field, but will keep the particles in continuous gentle motion. The air circulation produced in this way is sufficient for the substantial prevention of particle deposition on the side walls of the spraying chamber 1.

Regulation of the quantity of material to be sprayed is achieved by the movement of conduit 5 relative to the nozzles 4.

The continuous feeding of the pulverulent or fibrous material is ensured by a mild, approximately 0.1-0.3 atm., overpressure in the spraying chamber 1 which acts on the top surface of the material in the container 2. At the same time, coagulation of material in the container 2 is hindered or prevented by the blade 7 driven by the electric motor 6.

When the workpiece 12 has been coated, it is removed from the spraying chamber 1 through the outlet aperture 16, the air curtain of which will tend to remove excess

particles in the direction of the container 2.

The preferred embodiment of this invention provides practically loss-free operation and continuous coating. Typically, coating layers of 40 micron to 1.2 mm have been achieved with the apparatus of the present invention, while in the case of fibrous materials, fibre lengths of 0.2-3.0 mm have been found to be sprayable.

When spraying synthetic fibres, the nozzles 14 may be omitted.

When spraying material of a different colour or composition from the previous use, or when cleaning the apparatus, contaminating particles can be removed by removing the container 2 and actuating the nozzles 14 and the suction fan 15.

Although the specific description has been given for an electrostatic spraying apparatus, the applicability of the invention is evidently not so restricted, but may be used for spraying generally.

WHAT WE CLAIM IS:—

1. Electrostatic spraying apparatus for spraying a workpiece with pulverulent or fibrous material, comprising a spraying booth formed by a spraying chamber and a material storage container in open communication with each other, at least one spraying head in said chamber which head includes means for electrostatically charging the material to be sprayed, injector feeding means in communication with said container for delivering said material to said head(s), said feeding means including a delivery conduit and ducting which is spaced from said conduit and is connectable to a source of pressurised gas or air, whereby in use said gas or air is passed to said conduit and entrains particles of said material therewith, and means for varying the spacing between said conduit and the ducting to regulate the quantity of said material delivered to said head(s).

2. Apparatus as claimed in claim 1 wherein the interior of said chamber is provided with at least one nozzle connectable to a source of pressurised gas or air and with baffle means for guiding, in operation, floating particles of said material towards the workpiece and towards said container.

3. Apparatus as claimed in claim 1 or claim 2 wherein the said feeding means includes at least two pressure fluid inlet nozzles, the ducting having ends located adjacent to said nozzles.

4. Apparatus as claimed in claim 3 wherein said ducting is displaceably mounted relative to said nozzles, there being powered means for displacing the ducting.

5. Apparatus as claimed in claim 4 wherein the relative displacement is in vertical directions.

6. Apparatus as claimed in any previous claim wherein the said chamber is provided

which has therein a plurality of nozzles 14 connected to a source of compressed air not shown, and serving to blow the said particles. Adjacent the nozzles 14, baffle plates 15 (which may form part of the walls of the spraying chamber 1) are provided to deflect the air streams issuing from the nozzles 14 partly towards the container 2 and partly towards the workpiece 12.

The spraying chamber 1 has workpiece inlet and outlet apertures 16 which are respectively provided with means (not shown) for establishing a dynamic air curtain thereacross.

For cleaning purpose a suction fan 17 is connected to the spraying chamber 1.

In use, the container 2 is filled with the material to be sprayed and the high-tension power source 11 is switched on. At the same time the workpiece transporting mechanism is moved over rail 13 to convey a workpiece 12 through the inlet aperture 16 into the spraying chamber. Simultaneously, compressed air is blown through the ducting 3 and nozzles 4. The air issuing therefrom will entrain particles of the material to be sprayed which will be conveyed to spraying heads 8 via conduits 5 and ducting 9. In the spraying heads 8 the particles will be electrostatically charged and, under the influence of the electrostatic forces, will fly towards the workpiece 12. Excess particles, or particles that "missed" the workpiece 12, will eventually form a floating mist in the spraying chamber 1.

Air blown in through nozzles 14 and deflected by baffle plates 15 will direct these particles partly towards the workpiece 12 and partly towards the container 2, as already stated. The relatively low pressure—between 0.1-0.3 atm.—will not substantially affect the influence of the electrostatic field, but will keep the particles in continuous gentle motion. The air circulation produced in this way is sufficient for the substantial prevention of particle deposition on the side walls of the spraying chamber 1.

Regulation of the quantity of material to be sprayed is achieved by the movement of conduit 5 relative to the nozzles 4.

The continuous feeding of the pulverulent or fibrous material is ensured by a mild, approximately 0.1-0.3 atm., overpressure in the spraying chamber 1 which acts on the top surface of the material in the container 2. At the same time, coagulation of material in the container 2 is hindered or prevented by the blade 7 driven by the electric motor 6.

When the workpiece 12 has been coated, it is removed from the spraying chamber 1 through the outlet aperture 16, the air curtain of which will tend to remove excess

particles in the direction of the container 2.

The preferred embodiment of this invention provides practically loss-free operation and continuous coating. Typically, coating layers of 40 micron to 1.2 mm have been achieved with the apparatus of the present invention, while in the case of fibrous materials, fibre lengths of 0.2-3.0 mm have been found to be sprayable.

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Although the specific description has been given for an electrostatic spraying apparatus, the applicability of the invention is evidently not so restricted, but may be used for spraying generally.

WHAT WE CLAIM IS:—

1. Electrostatic spraying apparatus for spraying a workpiece with pulverulent or fibrous material, comprising a spraying booth formed by a spraying chamber and a material storage container in open communication with each other, at least one spraying head in said chamber which head includes means for electrostatically charging the material to be sprayed, injector feeding means in communication with said container for delivering said material to said head(s), said feeding means including a delivery conduit and ducting which is spaced from said conduit and is connectable to a source of pressurised gas or air, whereby in use said gas or air is passed to said conduit and entrains particles of said material therewith, and means for varying the spacing between said conduit and the ducting to regulate the quantity of said material delivered to said head(s).

2. Apparatus as claimed in claim 1 wherein the interior of said chamber is provided with at least one nozzle connectable to a source of pressurised gas or air and with baffle means for guiding, in operation, floating particles of said material towards the workpiece and towards said container.

3. Apparatus as claimed in claim 1 or claim 2 wherein the said feeding means includes at least two pressure fluid inlet nozzles, the ducting having ends located adjacent to said nozzles.

4. Apparatus as claimed in claim 3 wherein said ducting is displaceably mounted relative to said nozzles, there being powered means for displacing the ducting.

5. Apparatus as claimed in claim 4 wherein the relative displacement is in vertical directions.

6. Apparatus as claimed in any previous claim wherein the said chamber is provided



with workpiece inlet and outlet apertures which are closed, in use, by dynamic air curtains, respectively.

7. Apparatus as claimed in any preceding
5 claim substantially as hereinbefore described with reference to an shown by the accompanying drawings.

8. An electrostatic spraying process comprising positioning a workpiece to be
10 sprayed in a spraying booth formed by a spraying chamber and a material storage container in open communication with each other, passing pressurised gas or air to a
15 ducting of an injector feeding means which also has a conduit spaced from the ducting so as to entrain particles of the material to be sprayed and to deliver them to at least one spraying head, electrostatically charging the particles in said head(s), and regulating
20 the quantity of material delivered to said head(s) by varying the spacing between said

ducting and said conduit of the injector feeding means.

9. A process as claimed in claim 8 wherein the mist of solid particles in said 25 chamber not deposited on the workpiece is guided by air currents towards said container and towards said workpiece.

10. A process as claimed in claim 8 substantially as hereinbefore described with 30 reference to and shown by the accompanying drawings.

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