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APPARATUS FOR POWDER SPRAYING

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2 Sheets-Sheet 1

FIG. 3

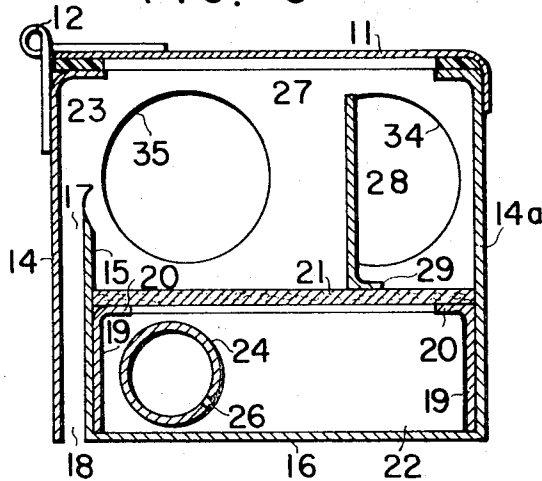


FIG. 5

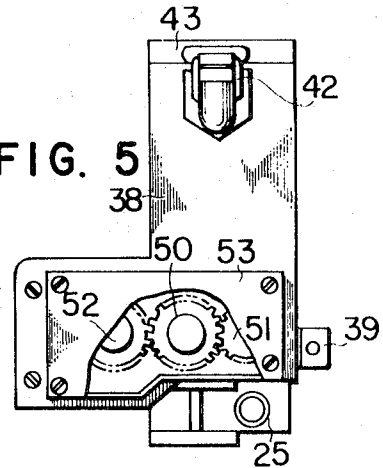


FIG. 6

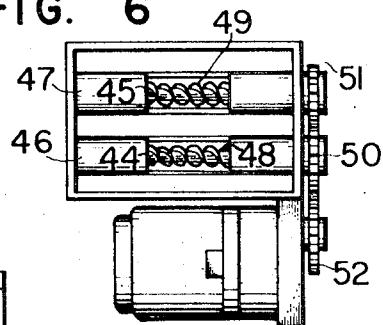


FIG. 4

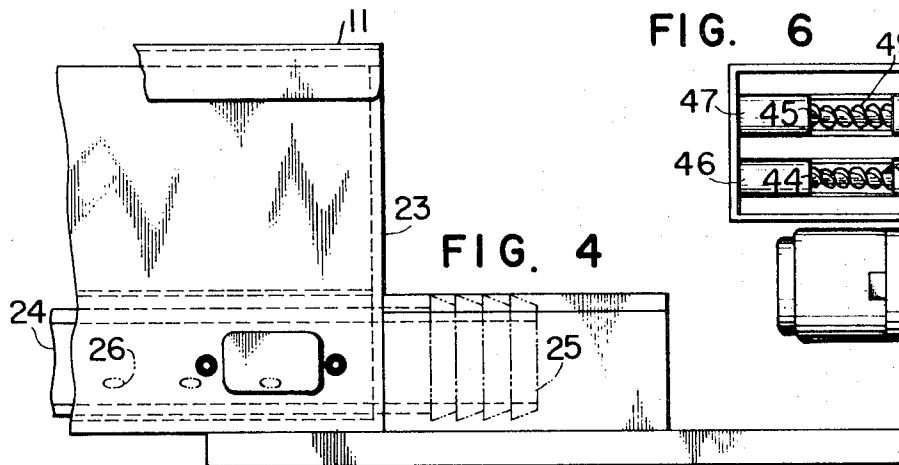
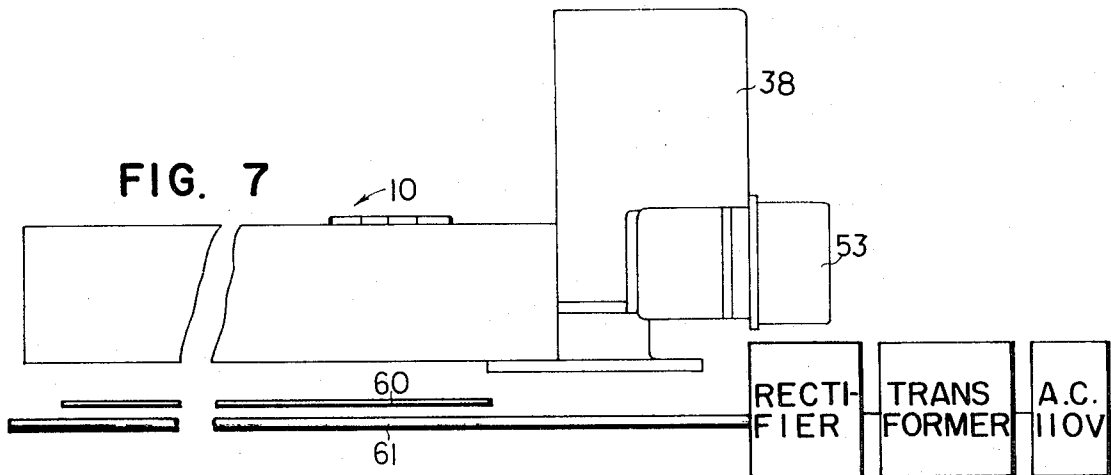


FIG. 7



RECTIFIER TRANSFORMER A.C. 110V

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APPARATUS FOR POWDER SPRAYING

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9 Claims

ABSTRACT OF THE DISCLOSURE

An elongated square-shaped fluidizing case contains an outlet for the powder to be sprayed, a vertical weir board and a horizontal porous rectifying board. An air chamber for introducing compressed air into a powder layer is located below the rectifying board, and a fluid chamber communicating with the outlet is provided above the rectifying board. A device for feeding a fixed amount of powder continuously to the fluid chamber is connected with the fluidizing case. When the powder is fed into the fluid chamber, the air blowing from the air chamber forms a fluidized bed of powder. The powder elutriated from the fluidized bed is ejected by the air through the outlet to be sprayed upon the surface of the object being treated.

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for powder spraying and refers more particularly to an apparatus for spraying powder upon the surface of papers and films and on boards made of glass, metal, synthetic resins and the like.

Dry powder is sprayed upon surfaces to prevent ink offset on any printed sheet and to eliminate blocking in the processing of synthetic film or rubber sheeting.

In a conventional apparatus of this type of powder spray, powder supplied to a hopper is removed by rotating a roller and is then dropped from the roller by means of sparks generated from a discharge tube. However, in this apparatus it is difficult to keep the spray conditions constant, and since the powder is sprayed in form of a fog, it can detrimentally affect the health of operators and may soil the factory. Further, an inconvenience has been experienced in operating the apparatus since the apparatus must be stopped while powders are being supplied.

The present invention is based on the consideration that, when a fluidized bed is formed by blowing up powder layers from below by a gas, an aggregative fluidization takes place wherein groups of particles forming the powder may aggregate and move. A characteristic feature of this aggregative fluidization is that there is a comparatively large and fast scale of movement. When the current velocity of the gas is gradually increased, the powder is carried over accompanying the gas so that the so-called elutriation phenomenon takes place. This phenomenon easily takes place particularly when fine particles are used as starting materials.

An object of the present invention is to provide an apparatus for powder spraying of simple structure, wherein the powder is carried over from the surface of the fluidized bed by means of the elutriation phenomenon and can be uniformly sprayed on the surface of an object even if the spray area is of comparatively long size.

Another object of the present invention is to provide an apparatus for powder spraying of the described kind wherein the powder is fed from only one side of the apparatus and yet is sprayed uniformly on an object having a comparatively long spray area and wherein the

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powder is continuously sprayed without it being necessary to stop the operation for powder refilling.

A further object of the present invention is to provide proper powder spraying, wherein the powder blown downwardly will not be splashed as fog and will not soil the area around the apparatus.

Further objects and advantages will become apparent in the following description in the specification.

SUMMARY OF THE INVENTION

The apparatus for powder spraying of the present invention includes a preferably square-shaped vertical feed box combined with an elongated, preferably square-shaped fluidizing case. Both the feed box and the fluidizing case are provided with hinged top covers. Means for feeding the powder to be sprayed at a fixed rate to the lower portion of the feed box are provided to the lower portion of the feed box. The interior of the fluidizing case is separated into an upper fluid chamber and a lower air chamber by a horizontal rectifying board having fine pores. One side of the board is attached to a side wall of the case while the other side terminates at a distance from the opposite side wall and is attached to a vertical weir board which is attached to the bottom of the case. The passage between the weir board and this opposite side wall terminates in an outlet which extends the entire length of the case. Powder is supplied from the feed box into the fluid chamber, while compressed air is supplied into the air chamber. Compressed air forms a fluidized bed of powder in the air chamber and powder elutriated from the fluidized bed moves over the top of the weir board into the passage and is ejected through the outlet.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings, showing by way of example only, a preferred embodiment of the inventive idea.

In the drawings:

FIG. 1 is a plan view, partly in section, of an apparatus for powder spraying according to this invention;

FIG. 2 is partially a front view of the apparatus shown in FIG. 1 and partially a section along the line II—II of FIG. 1;

FIG. 3 is a transverse section along the line III—III of FIG. 1;

FIG. 4 is a fragmentary front view of the end parts of the air chamber, through which a pipe is inserted;

FIG. 5 is a side elevation, partly in section, showing the gear train of a feed box;

FIG. 6 is a top view of a feed screw conveyor and a recovery screw conveyor;

FIG. 7 is a diagrammatic front view showing an object to be sprayed and an electrode located below the apparatus of the present invention.

PREFERRED EMBODIMENT OF THE INVENTION

The apparatus for powder spraying shown in FIGS. 1 and 2 is usually placed above the moving materials which are to be sprayed at right angles to their direction of movement. The apparatus comprises an elongated square-shaped fluidizing case 10 and a device 36 for stocking powder and for feeding and recovering the powder in and from the fluidizing case 10.

A top cover 11 is connected to the case 10 by hinges 12 and locks 13 for opening and closing the upper opening of the case 10. The case 10 includes thin side walls or boards 14 and 14a and a bottom 16. As shown in FIG. 3, a weir board 15, the upper edge of which is a knife edge, extends upwardly from the bottom 16 and is spaced from the wall 14. The height of the weir board 15 is substantially less than that of the case 10. The bottom 16 does

not extend into a vertical passage 17 formed between the weir board 15 and the side wall 14, so that an opening 18 is provided which extends substantially along the entire length of the case 10.

Reinforcing boards 19 of inverse L-shaped are fixed to the weir board 15 and the side wall 14a; their horizontal parts 20 are turned and are located lower than the height of the weir board 15. A porous rectifying board 21 of cellular type is attached to the parts 20, for example, by adhesive, to separate the inner space of the case 10 into two chambers. As the porous rectifying board 21, a sintered porous metal plate or a sponge made of synthetic resins is used. The fine continuous pores are smaller than the diameters of powder particles, for example, they may amount to 5μ to 10μ .

A horizontal conduit pipe 24 for feeding compressed air is provided in an air chamber 22, below the rectifying board 21. The pipe 24 extends along the entire length of the chamber 22 passing through a side wall 23 which forms another side of the case 10. An end of the conduit pipe 24 is located outside of the case 10. As shown in FIG. 4, this end forms a spigot 25, so that a hose may be connected easily thereto. Within the air chamber 22 the pipe 24 is provided with a plurality of small holes 26 located at the same intervals and so directed that compressed air ejected through the small holes 26 will not blow directly upon the rectifying board 21.

A partition strip 28 is fixed to the rectifying board 21 along the total length thereof by its bent lower edge 29. This partition strip 28 divides the space above the rectifying board 21, namely, the fluid chamber 27, into two compartments. The partition strip 28 is lower than the upper surface of the case 10, so that there is a space between the upper edge of the strip 28 and the top cover 11. However, the partition strip 28 is higher than the weir board 15. A restricted passage 30 is provided at one end of the partition strip 28, as shown at the lower left end of FIG. 2.

Conventional electric vibrators 32 are attached to the side wall 14a opposite the other side wall 14 and are provided with a plug receptacle 33.

Two holes 34 and 35 are provided in the side wall 23 above the rectifying board 21.

When a powder feeding chamber 36, which will be described hereinafter, is connected to the side wall 23 of the fluidizing case 10, these two holes 34 and 35 provide a feeding port and a recovery port, respectively, for screw conveyors.

A reduction motor 37 is fixed to one side of a vertical feed box 38. The feed box 38 is removably connected to the side wall 23 of the case 10 by conventional connecting means, in the example shown in FIGS. 1 and 2, by flanges 39, fitting bolts and nuts 40. The feed box 38 is open at the upper end thereof and, like the fluidizing case 10, has a top cover 43 fixed by hinges 41 and locks 42 for the opening and closing of the upper opening of the box 38.

A feed rotor 48 and a recovery rotor 49 having screw-shaped blades are rotatably secured in the lower portion of the feed box 38 within cylindrical guides 46 and 47, respectively, the central parts of which are open and form ports 44 and 45, as shown in FIG. 6. Spur gears 50 and 51 are fixed to the shafts of rotors 48 and 49, respectively, and these two gears form a gear train together with another spur gear 52 fixed to the drive shaft of the reduction motor 37. Thus the gears 50 and 51 rotate in opposite directions. The revolutions of the feed rotor 48 are comparatively low, about 50 r.p.m., and the ratio of the number of teeth of the spur gear 50 to that of the spur gear 51 is about three to one. These spur gears 50, 51 and 52 are covered with a cover 53 to protect the operator.

The operation of the described apparatus is as follows:

After the filling box 38 has been filled by the powder to be sprayed by opening the top cover 43, the reduction motor 37 is operated so that the rotors 48 and 49 are

rotated by the gear train 52, 50 and 51. The powder in the feed box 38 is continuously and constantly supplied upon the rectifying board 21 in the fluidizing case 10 by the rotation of the screw blade of the feed rotor 48 by way of the port 44, the inside wall of the cylindrical guide 46 and the hole 34 of the side board 23.

In the air chamber 22 compressed air is continuously ejected from the small holes 26 in the conduit pipe 24. The compressed air becomes equalized in pressure in the air chamber 22 and flows uniformly to the fluid chamber 27 passing through the porous rectifying board 21. When the velocity of the air flowing in the fluid chamber 27 is greater than the incipient fluidization velocity, the powder layer on the rectifying board 21 will expand and a fluidized bed or liquid layer of aggregate state is formed wherein the upper layer of the powder will move in waves so that the powder will spread. The partition strip 28 contributes to the faster movement of the powder to the opposite end of the feed rotor 48. The position of the partition strip 28 is, preferably, somewhat toward the side board 14a relatively to the center of the case 10, as shown in FIG. 1 and FIG. 3, thus forming a narrower compartment for the feed rotor side. The liquid layer of the powder reaches the restricted passage 30 of the partition strip 28, will pass through this passage, and then the liquid layer will return to the end of the recovery rotor due to rotation of the recovery rotor 49.

To provide the steady state as quickly as possible, it is advantageous to spread a certain amount of powder directly on the rectifying board 21 by opening the top cover 11 of the fluidizing case 10.

Since the powder is being stirred violently in the fluidized bed or the liquid layer in the aggregative state formed by the compressed air, powder is mixed homogeneously and speedily, even if it is fed from one side of the fluidizing case 10. Furthermore, when the velocity of the compressed air becomes higher, the powder in the fluidized bed will be elutriated therefrom accompanied by the air. The powder elutriated from the fluidized bed or liquid layer in the compartment on the side of the feed rotor 48 goes over the partition strip 28 and the weir board 15 together with powder elutriated from the fluidized bed in the other compartment, so that the powder will be sprayed on the selected object through the passage 17 and the outlet 18.

Since the powder stored in the feed box will not be blown even if the top cover 43 is opened while in operation, the refilling of powder in the feed box can be made at any desired time without stopping the operation.

Vibration of vibrators 32 prevents the powder from adhering to the inside wall of the liquid chamber 27 and protects the liquidity of the powder.

While the above is a description of the preferable embodiments of the present invention, many changes and modifications may be made therein. For example, the position of the partition strip 28 may be changed, and even if the partition strip 28 is removed altogether, a uniform spray of comparatively long area can be achieved. But in this case the powder fed to the fluid chamber 27 will be directly recovered by the recovery rotor. Furthermore, by adjusting the revolutions of the feed rotor and the amount of the compressed air to be fed, the recovery rotor can be eliminated.

Moreover, by separating the feed box 38 from the fluidizing case 10, the cylindrical guides 46 and 47 may be connected with holes 34 and 35 of the side board 23 by means of conduit pipes.

In order to prevent the powder from splashing beyond the object 60 which is being sprayed, according to this invention a known apparatus for charging static electricity to the powder to be sprayed is provided in the vicinity of the outlet 18 of the case 10 and another apparatus 61 for charging static electricity by a different electrode is provided below the object 60 being sprayed, so

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that the powder is positively sprayed on the object, thereby providing a very clean operational environment and an effective powder spray.

I claim:

1. An apparatus for powder spraying comprising:
a vertical feed box having a top cover;
means for feeding the powder continuously at a fixed amount provided in the lower portion of the feed box;
means for driving said powder feeding means;
an elongated fluidizing case having side walls, a bottom, and a top cover;
a vertical weir board within said case, a narrow space being provided between the top cover of the case and the upper end of the weir board;
a horizontal fine porous rectifying board mounted between said weir board and a side wall of said case, thereby separating the case into an upper fluid chamber and a lower air chamber, a passage being formed between the weir board and an adjacent side wall of said case, said passage communicating with an outlet of equal width extending along the entire length of the bottom of said case;
means connecting said feed box with said fluidizing case and feeding powder into said fluid chamber by said powder feeding means; and
means supplying compressed air into said air chamber of the fluidizing case;
whereby powder elutriated from the upper surface of fluidized bed in the aggregative state on the rectifying board may go over the weir board, pass through the outlet and be sprayed on an object.

2. An apparatus for powder spraying in accordance with claim 1, wherein the powder feeding means include means recovering the powder at the lower portion of the feed box, wherein means driving the powder feed means also drive said recovering means, and wherein means connecting the feed box with the fluidizing case include means recovering powder overflowing from the powder recovering means.

3. An apparatus for powder spraying in accordance with claim 2, further comprising a vertical partition strip mounted upon said rectifying board and separating said fluid chamber into two compartments, said strip being higher than said weir board but being spaced from the top cover of the fluidizing case and having a restricted hole adjacent its lower end, and wherein means connecting the feed box with the fluidizing case feed powder into one of said compartments and recover powder overflowing from another compartment.

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4. An apparatus for powder spraying in accordance with claim 3, further comprising means having an electrode located in the vicinity of the outlet of the fluidizing case and below the object to be sprayed for charging static electricity to the powder to be sprayed and to the object to be sprayed.

5. An apparatus for powder spraying in accordance with claim 3, further comprising vibrators mounted on an elongated wall of said fluid chamber.

6. An apparatus for powder spraying in accordance with claim 3, wherein said means supplying compressed air into said air chamber comprise a pipe extending through the entire length of the air chamber and having a plurality of small holes for blowing compressed air.

7. An apparatus for powder spraying in accordance with claim 3, wherein said powder feeding and powder recovering means include separate screw conveyors, and wherein said driving means include a gear train and a reduction motor driving said gear train, the screw conveyor of the powder recovering means revolving faster than the screw conveyor of the powder feeding means.

8. An apparatus for powder spraying in accordance with claim 7, wherein the means connecting said feed box with said fluidizing case connect said feed box directly to a side wall of the case opposite to the restricted hole of the partition strip, the last-mentioned side wall having holes on both sides of the partition strip communicating with said feed screw conveyor and recovery screw conveyor, respectively.

9. An apparatus for powder spraying in accordance with claim 7, wherein the means connecting said feed box with said fluidizing case comprise conduit pipes connected to holes formed in a side wall of the case on opposite sides of the restricted hole of the partition strip, said holes being located on both sides of the partition strip and communicating with the powder feed screw conveyor and recovery screw conveyor of said feed box.

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JOHN P. McINTOSH, Primary Examiner

U.S. Cl. X.R.

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