United States Patent

[11] 3,623,453

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[21] Appl. No. **885,479**
[22] Filed **Dec. 16, 1969**
[45] Patented **Nov. 30, 1971**

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[32] Priority **Dec. 18, 1968**
[33] **Japan**
[31] **43/92314**

[54] **DEVELOPING APPARATUS FOR ELECTROPHOTOGRAPHY**
10 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **118/309,** 118/634
[51] **Int. Cl.** **B05b 5/04**
[50] **Field of Search** 118/309, 48, 634, 637

[56] **References Cited**

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2,759,450	8/1956	Vyverberg	118/309
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Primary Examiner—Louis K. Rimrodt
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ABSTRACT: A powder cloud developing apparatus comprises a housing having a top wall in which is formed an opening for receiving an image member, and having an inclined sidewall which is contiguous with the top wall. A flow control plate is arranged opposite the sidewall and defines a flow channel therewith. The plate has a width commensurate with the housing, and terminates adjacent the top wall to define an exit from the channel. A rotor having a length greater than its diameter is positioned horizontally below the plate, but above the bottom of the housing, and is peripherally provided with blades or projections which, upon rotation of the rotor, scramble developer charged between the rotor and the bottom and throw it against opposing surfaces of the flow control plate and the inclined sidewall. An air stream, created either by the bladed rotor or by separate fan means, conveys the developer through the channel and the exit so as to travel across the opening.

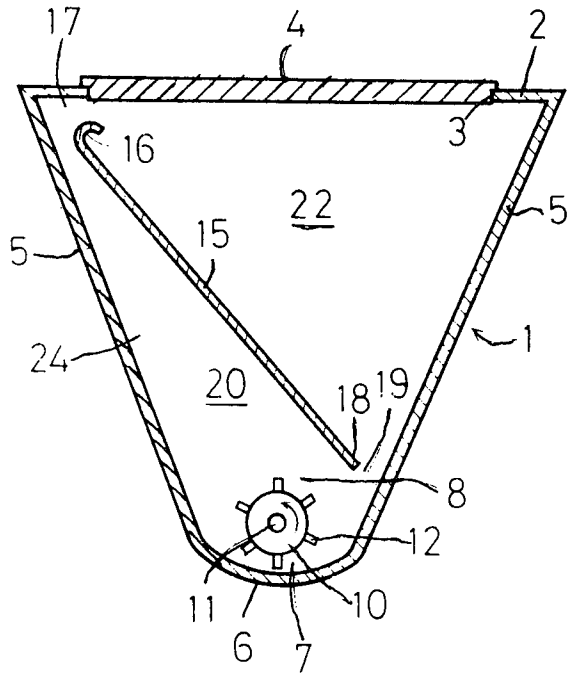


Fig 1

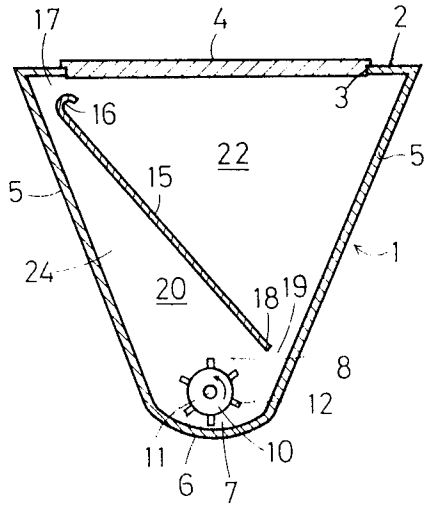
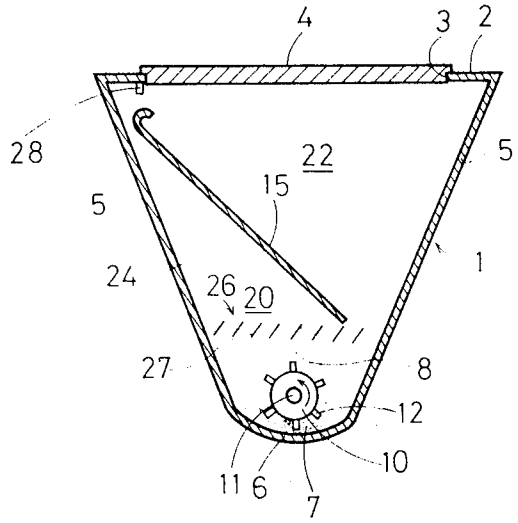


Fig 2



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Fig 3

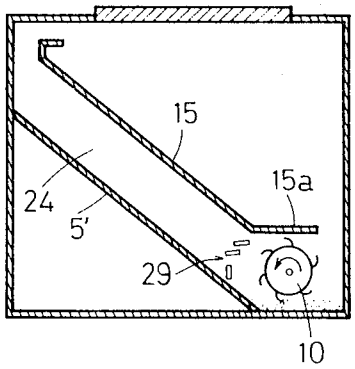
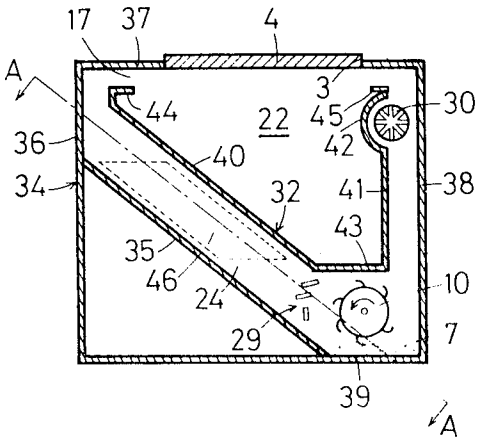


Fig 4



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Fig 4a

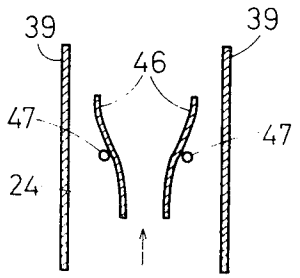
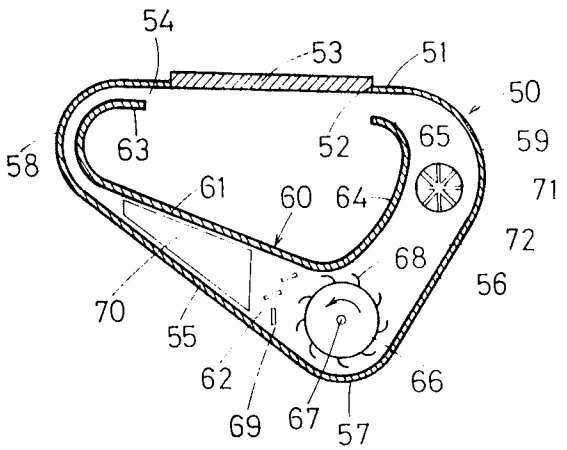


Fig 5



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DEVELOPING APPARATUS FOR ELECTROPHOTOGRAPHY

The invention relates to an apparatus for developing an electrostatic latent image formed on the surface of an insulating member, and more particularly to such apparatus incorporating the known powder cloud developing technique.

It is known that the development of an electrostatic latent image in the cascade process involves the difficulty to avoid the effect of fringing fields, that is, the toner particle being attracted strongly by the fringing fields around the periphery of charged areas of the latent image carrying member and leaving the middle of these areas undeveloped or underdeveloped. The toner cloud technique avoids the difficulty by providing a good, faithful development with varying potentials in various image areas, with good resolution and without appreciable nonuniformity in development.

Various proposals have been made to produce a powder cloud of toner charged oppositely to the polarity of the latent image. For example, U.S. Pat. No. 3,060,131 issued to H. E. Crumrine et al. Oct. 23, 1962 describes a powder cloud generating apparatus which is adapted for use in aircraft for a rapid development to permit repetitive processing of successive xerographic plates used in taking aerial photographs, but which is too large scale and complex in construction to permit its use in commercial copying machines. More practical method for developing electrostatic images is disclosed in U.S. Pat. No. 2,759,450 issued to R. G. Vyverberg, Aug. 21, 1956, in which a xerographic plate is supported in an opening in the top plate of a closed box with the electrostatic latent image facing down, and a cloud of charged carrier is sprayed upwardly against the plate by the action of a motor driven impeller. Further improvement of the continuous tone reproduction can be provided by locating an array of conductors or grid closely spaced from the xerographic plate and oppositely charged to the latter so as to cause a realignment of the electrostatic field surrounding the image, as described in U.S. Pat. No. 2,784,109 issued to L. E. Walkup, Mar. 5, 1957.

However, the prior art devices for developing electrostatic images by powder cloud technique have a number of drawbacks, i.e. expensive to manufacture, wasteful of developing material, the necessity of frequent replenishment or replacement of developer, for example, after only a few times of development, to warrant uniform image quality, possible degradation of image quality by blocky toner or fragments accumulated on the inner wall of the casing and subsequently blown off or sputtered to adhere the image carrying member, disturbances in the cloud caused by a fan resulting in differential toner density in the cloud, a long time period to develop, and poor maneuverability

Therefore, it is an object of the invention to provide an improved developing apparatus which overcomes all of above mentioned disadvantages.

In accordance with the invention, there is provided a developing apparatus for electrophotography which comprises a housing having an opening in the top wall thereof and an inclined sidewall, said opening being adapted to support an insulating member carrying an electrostatic latent image, a flow control plate arranged opposite said sidewall in spaced relationship therewith, said plate having an upper end terminating adjacent said top wall of the housing to define an exit, a rotor arranged below the flow control plate and having a plurality of projections spaced apart along the periphery thereof, said rotor having a length substantially greater than the diameter thereof, said rotor having a horizontal shaft which is adapted to be driven for rotation, a space within and at the bottom of said housing for receiving a supply of developer, said rotor being positioned and the supply being in amount such that at least part of the projections are immersed in said developer when the rotor stands still, said rotor acting upon rotation to agitate the developer and throw it against opposing surfaces of said sidewall and said flow control plate, and fan means operative to direct a flow of the developer through a flow channel defined between said opposing surfaces and then through said exit so as to travel across said opening.

For better understanding of the invention, several embodiments thereof will be described with reference to the drawings, wherein:

FIG. 1 shows a schematic vertical section of one embodiment of the developing apparatus according to the invention,

FIG. 2 is a similar view to FIG. 1 of a modification of the apparatus shown therein,

FIG. 3 is a schematic section of another apparatus of the invention, illustrating an alternate arrangement of the louver used in the apparatus of FIG. 2,

FIG. 4 is a similar view to FIG. 3, but illustrating another embodiment of the invention,

FIG. 4*a* is a section along the line A—A shown in FIG. 4, and

FIG. 5 is a schematic section of a preferred embodiment of the invention.

Referring to the drawings, and particularly to FIG. 1, the developing apparatus show comprises a housing 1 generally in the form of an inverted pyramid frustum. The housing 1 may be made from any suitable material, and has a top wall 2 in which is formed an opening 3 for receiving an insulating member, shown as a plate 4, carrying an electrostatic latent image. The member 4 is placed in the opening 3 with its image side facing down. The housing 1 has a pair of inclined sidewalls 5, which terminate in a curved bottom 6 which defines together with the lowest part of the sidewalls 5 a space or tub 7 for developer 8. The sidewalls 5 may have a suitable angle of inclination with respect to the vertical and the sidewall. It will be appreciated that the housing 1 is closed by a pair of end plates (not shown). Closely spaced from the bottom 6 of the housing 1 is located therein a rotor 10 having a rotary shaft 11 which extends horizontally and is supported by bearings (not shown) secured in the end plates. The shaft 11 extends externally of the housing 1 for coupling with suitable motor means (not shown). The rotor 10 carries a plurality of radially extending blades 12 which are equiangularly spaced apart along the periphery of the rotor 10. The rotor has a length substantially greater than the diameter thereof, and is positioned in the space 7 so that at least part of the blades 12 is immersed in a supply of developer charged into the space 7 through a suitable inlet or conduit (not shown) provided in the lower part of the sidewall 5. As is well known, the developer used in powder cloud technique comprises a mixture of toner and particulate carrier having a particle size from about 20 to 300 meshes, the particle size of the toner being substantially less than that of the carrier. As a result, when a predetermined amount of developer is charged into the developer space 7, the volume occupied by the developer mixture does not vary greatly as the toner component is consumed by application to electrostatic images to be developed. The carrier may comprise any conventional carrier used in the prior art electrophotography, such as glass beads and iron powders, metal powder being preferred for reason of durability.

Above the rotor 10 is arranged a flow control plate 15 which is inclined to the vertical and which is fixed to the end plates of the housing by conventional fittings. The flow control plate 15 is located opposite one of the inclined sidewalls 5 of the housing, which is the left-hand sidewall in the example shown, over substantially the whole extent thereof. Thus the flow control plate 15 has a width equal to the spacing between the end plates of the housing, and has an upper end 16 adjacent one end of the opening 3 in the top wall 2, the end 16 being turned back round to define an exit 17 together with the latter for a flow of developer, as will be described later. The lower end 18 of the flow control plate terminates short of the other of the sidewalls 5 to define a return passage 19 of developer to the space 7. In this manner, the flow control plate 15 divides the interior of the housing into a cloud generating chamber 20 and a developer chamber 22. Preferably, the opening 3 extends across the pair of end plates of the housing in order to facilitate to keep the lower surface of the image

member 4 flush or level with the inner surface of the top wall 2 of the housing.

In operation, the shaft 11 is driven by an external motor to rotate the rotor 10 in the direction indicated by an arrow at a high speed such as 1,000 to 3,000 r.p.m., whereby the blades 12 take up developer 8 and throws it against the opposing surfaces of the flow control plate 15 and the left-hand sidewall 5. Because a continued rotation of the rotor 10 with the blades 12 scrambles the mixture of toner and carrier powders within the space 7, sufficient agitation is provided to charge the toner particles by triboelectrification. The polarity of charge on the toner powder is made opposite to the polarity of the charge on the image member 4. The mixed particles of toner and carrier form agglomerates by electrostatic attraction, but when they strike the flow control plate 15 and the left-hand sidewall 5, the agglomerates are broken into pieces and the toner particles are separated from the larger and heavier carrier particles, which then fall back to the bottom or space 7 to be subjected to further agitation with the remainder of the toner. The blades 12 on the rotor 10 extend substantially the length thereof and creates, by rotation, an airstream indicated by an arrow which serves to carry the mixture particles towards the opposite walls 5 and 15 and also to carry the charged toner particles freed from the carrier as a suspension along a channel 24 defined by the opposing surfaces of the left-hand sidewall 5 and the flow control plate 15. As shown, the channel 24 has a relatively broad inlet aperture adjacent the rotor 10 for the ease of generating the airstream, and is narrowed gradually upwardly to the minimum width at the exit 17, from where the powder cloud, i.e. the airstream carrying the charged toner in suspension, flows out into the developing chamber 22. The expansion and concomittant diffusion of the powder cloud in the chamber 22 produces a uniform density or concentration of toner in the cloud as the latter moves past the surface of the image member 4 horizontally. While it is not intended that operation of the invention be limited to any theory, it is believed that the airstream or flow of powder cloud produced according to the invention has more of the nature of a laminar flow than a turbulent flow that would be produced when a powder cloud is created by a toner-carrying airflow wreathed or curled up directly from a bottom situated fan. It is considered that the choice of a length of the rotor 10 substantially greater than the diameter thereof assists in the formation of an airstream having a weblike cross section. It is believed also that such an airstream is best guided by an inclined surface to provide a top horizontal flow where the space requirements are imperative. The flow in the developing chamber 22 is substantially horizontal for the most part of the powder cloud, thereby forming a virtual electrode in front of the lower surface of the image member 4. Thus charged toner is attracted imagewise onto the latent image areas on the member 4, thereby developing the latent image. It will be appreciated that because the flow is across the surface of the member 4 and there is no substantial vertical component of motion towards this surface except for the electrostatic interaction, the developed toner image will be a faithful reproduction of the original. After travelling across the developing chamber 22, the airstream proceeds along the opposite or right-hand sidewall 5 to pass through the passage 19 to return into the space 7, under the influence of suction produced by the rotation of the bladed rotor 10.

Thus, according to the invention, a powder cloud is generated in the chamber 20 and circulated through the developing chamber 22 to the developer space 7. It is found that the quality of development achieved according to the invention is excellent in that the development reproduces varying potentials on the latent image. In addition, the developed image had a good stability.

The flow control plate 15 may have any suitable inclination, but an angle of inclination in the range from about 30° to 60° with respect to the vertical proved satisfactory in that the flow achieved maintained the nature of a laminar flow, even though this does not mean of course that the flow is completely laminar. The flow control plate 15 may be made from any suitable material having a smooth surface, and in one example brass was used satisfactorily. Furthermore, the plate 15 may be adjustably attached to the end plates of the housing as by pivotal mounting.

FIG. 2 shows a modification of the apparatus shown in FIG. 1, by additional provision of a louver 26 and a choke member 28. The louver 26 consists of a plurality of strips 27 arranged between the lower end portion of the flow control plate 15 and the rotor 10 and extending horizontally to be secured at opposite ends to the end plates of the housing 1. Their purpose is to provide surfaces against which combined toner-and-carrier particles can be flung in order to improve the separation between the toner and carrier and to minimize the carrier residue in the powder cloud. The arrangement and size of these strips can be varied extensively, as illustrated by one alternate arrangement shown at 29 in FIG. 3. In addition, the louver 26 may comprise rods, wires or screen as desired. The configuration, size, spacing and inclination of the members constituting the louver depend upon the construction of the blades 12, the number of revolutions of the rotor 10, the amount of developer supplied and other factors, but the choice should be made such that carrier particles cannot pass through the louver in the direction of airstream through the channel 24 and that toner does not accumulate on the louver members. The louver members can also be adjustably located. Preferably the louver 26 is located close to the rotor 10 to allow the developer to strike it with an increased impact, thereby facilitating the separation between the toner and carrier. This increases the amount of powder cloud formed. The choke member 28 is an elongate rib extending across the width of the housing 1 or perpendicularly to the sheet of the drawing adjacent the end of the opening 3 nearer the exit 17. The member 28 functions to slow down and deflect slightly the generally horizontal flow from the exit 17 in order to remove the differential concentrations of developed image across the opening 3 that may be produced as a result of vertical component of motion imparted to the charged toner.

It should be also noted that "fogging" may also occur as a result of mirror effect in the uncharged or nonimage areas on the member 4 because the charged toner induces mirror images of opposite polarity behind these areas, which induce an attraction on the charged toner. According to this invention, such a mirror effect is avoided conveniently by the horizontal speed of the toner.

In FIG. 3 which shows an alternative form of louver, the channel 24 defined by the flow control plate 15 and an inclined sidewall 5' of the housing has a constant height throughout its length, which can be satisfactorily employed when the airstream produced has a sufficient speed for the intended purpose. In this instance, the flow control plate 15 has a horizontally extending lower end portion 15*a*, the length of which can be adjusted t0 vary the amount of flow produced.

FIG. 4 shows another embodiment of the invention which incorporates a crossflow fan 30 to draw the airstream through the channel 24 and across the developing chamber 22 for circulation around a flow control plate 32. In this embodiment, the housing 34 is in the form of a box having an inclined sidewall portion 35, a vertical sidewall portion 36, a top wall 37 having an opening 3 formed therein, a vertical sidewall 38, and a bottom wall 39. As before, the bottom wall 39 defines with the lowest parts of the walls 35 and 38 a space 7 for developer. The flow control plate 32 has a portion 40 opposite the sidewall portion 35 of the housing 34, a generally vertically extending portion 41 including a semicircular recess 42 near the top thereof, and a horizontal portion 43 interconnecting the portions 40 and 41. The free end of the portion 40 is turned back to provide a guide 44 for the airstream. A similar guide 45 is formed at the top end of the vertically extending portion 41. Between the horizontal portion 43 of the flow control plate 32 and the bottom of the housing 34 is located the rotor 10 which may be similarly constructed as before. The louver 29 shown in FIG. 3 is located near the rotor 10 between

the portions 40 and 35. The fan 30 is positioned adjacent the recess 42.

The operation of the apparatus shown in FIG. 4 is generally similar to the previous description given in connection with the apparatus of FIG. 1. Thus where the rotor 10 is provided with axially extending blades 12 as in FIG. 1, the rotation of the rotor 10 is effective to create an airstream through the channel 24 to carry toner in suspension, which is charged and freed from carrier by the process mentioned previously. The outlet flow from the exit 17 is directed horizontally to travel across the surface of the image member 4, and such horizontal flow is aided by the suction created by the crossflow fan 30. In addition, the fan 30 helps eliminate or reduce a speed differential across the length of the image member 4, which would give rise to a variation in the cloud density. A part of the toner may fall down from the main body of the powder cloud moving along the image body 4, onto the back of the flow control plate 32, which therefore can be used as a reservoir for toner, and an opening (not shown) may be provided in the portion 43 for toner supply to the space 7.

Alternatively, the rotor 10 in this embodiment may have projections such as rods or narrow strips in place of the blades 12, the function of these projections being to scramble the developer mixture and to throw it against the portions 35 and 40 and the louver 29. The airstream which carries the toner freed from the carrier is produced in this instance by the fan 30.

As shown in FIGS. 4 and 4*a*, a pair of curved guide plates 46 may be provided centrally in the channel 24 in transversely spaced relationship with each other and with the end plates 39 of the housing 34. The guide plates 46 are more closely spaced from each other at their end nearer the louver 29 than at the opposite end, thereby resulting in a flaring cross section, even though the both end portions are substantially parallel to the longitudinal axis of the channel 24. The purpose of the guide plates 46 is to provide a speed reducing effect, by diffusion, upon the central part of the flow, indicated by an arrow, in order to achieve a more uniform speed profile in the transverse direction across the channel 24. As indicated by pivots 47 in FIG. 4*a*, the guide plates 46 may be pivotally mounted to allow for proper adjustment of the flow through the channel.

FIG. 5 shows a preferred embodiment of the invention. The apparatus comprises a housing 50 of generally V-shaped cross section with rounded corners. Such housing can be supported in a box-shaped enclosure or on a horizontal base by suitable means such as struts so as to assume the position shown. The housing 50 includes a top wall 51 in which a rectangular opening 52 is formed so as to receive an electrostatic latent image carrying member 53. To place the member 53 flush with the inner surface of the top wall 51, it is preferred that the opening 52 extends the full width of the top wall 51 so that the member 53 placed therein may rest on top of the end plates (not shown) of the housing 50. Suitable tension can be maintained in the member 53 by using a rigid support against which it is held firmly. The housing further includes a pair of inclined sidewalls, left-hand side at 55 and right-hand side at 56, which are joined together by a rounded bottom wall 57 and which are also joined with opposite ends of the top wall 51 by rounded corners 58 and 59, respectively. Within the housing 50 is placed a flow control plate 60, which may be secured at its lateral ends to the end plates (not shown) of the housing 50. The flow control plate 60 includes a portion 61 opposite to and spaced from the inclined sidewall 55 of the housing 50 to define a flow channel 62 therebetween. The upper end 63 of the portion 61 is curved in a similar configuration to the curved corner 58 and is turned back to run parallel to the top wall 51, thereby defining an exit 54. The lower end of the portion 61 is curved upwardly, at a position over the bottom 57 of the housing 50, to form a return flow control portion 64 having a turned-back top end 65. Between the bottom wall 57 and the flow control plate 60 is located a rotor 66 mounted on a rotary shaft 67 and having a plurality of projections in the form of blades 68 attached around the periphery thereof. A louver 69 of the form shown in FIG. 3 is arranged adjacent the rotor 66 in the flow channel 62. A pair of guide plates 70 of the form shown in FIG. 4*a* are disposed in the channel 62 beyond the louver 69 as viewed in the direction of airstream passing therethrough. In the particular example shown, such airstream is produced by the blades 68 upon rotation of the rotor 66. A crossflow fan 71 is positioned in the return path 72 defined between the portion 64 of the flow control plate 60 and the sidewall 56 of the housing 50.

The apparatus shown in FIG. 5 operates in the similar manner as mentioned before. Developer comprising toner and carrier particles is charged (not shown) in the space defined by the bottom wall 57 and the lowest parts of the sidewalls 55, 56 in an amount in relation to the position of the rotor 66 such that part of certain lower blades or projections 68 on the rotor 66 is immersed into the bulk of developer when the rotor 66 stays at rest. Upon rotation of the rotor 66 in the direction indicated by an arrow, the blades 68 take up and throw the developer particles against the louver 69 as well as the opposing surfaces of the flow control plate 60 and the sidewall 55, as mentioned previously, thereby agitating the mixture particles to charge the toner to the desired polarity and separating the latter from the carrier. Charged toner particles are carried by the airstream produced by the rotating blades 68 to pass through the louver 69 and then through the guide plates 70 to flow out of the exit 54. Thereafter the airstream carrying the charged toner in suspension travels across the lower surface of the image member 53 horizontally, thereby developing the electrostatic latent image thereon, and is guided by the end 65 of the flow control plate 60 into the return path 72. This portion of the flow is aided by the suction created by the crossflow fan 71. The airstream completes its circulation by passing through the path 72 and being drawn by the rotating blades 68.

Alternatively, the rotor 66 may be provided with rodlike projections instead of blades 68, as mentioned above in connection with FIG. 4. In this instance, the airstream for conveying the toner cloud will be produced by the fan 71 or any other suitable fan located in the path of such stream. Conveniently, the fan 71 can be used in association with another crossflow fan (not shown) which is partly or half exposed in the flow channel 62 at a position short of the exit 54, as viewed in the direction of circulation of the airstream.

The upwardly open space partially enclosed by the flow control plate 60 may be used as a reservoir for supply of toner, and carrier if necessary, and an opening (not shown) may be formed in the flow control plate 60 which can be opened and closed by manual operation. This is advantageous in saving the space within the apparatus and recovering toner that falls down intermediate the flow path along the member 53. However, it should be noted that such reservoir is not primarily for use as a source of toner (and carrier as required) that supplies toner to the developer space above the bottom wall 57 every time a single member or a few members 53 have been developed. Instead, the invention contemplates that a supply of toner and carrier once charged in the developer space below the rotor be such as would be sufficient in amount to develop a number of image members 53. The reservoir mentioned above is intended therefore to store a large quantity of toner (and a given amount of carrier as required) which can be subdivided into given amounts of supply to the developer space.

In one example, the housing 50 measured 400 mm. in axial length or across rounded corners 58 and 59, and 500 mm. in height taken between top wall 51 and bottom 57. The length of the opening 52 was 200 mm., and the lateral width or the distance between the end plates was 260 mm. In the developer space above the bottom wall 57 was charged 4.5 kg. of developer, of which 10 percent by weight was toner. The rotor 66 was formed by an aluminum cylinder having axial length corresponding to the lateral width of the housing and a diameter of 60 mm. Eight blades 68 having a width of 15 mm. were mounted spaced around the periphery of the rotor at an angle

of inclination of 55 degrees with respect to the radius of the rotor. The rotor 66 was positioned so that upon rotation at 3,000 r.p.m., it experienced a countertorque by developer between 1.8 and 3.8 kg./cm. of axial length. The velocity of the air stream produced was measured as 60 cm./sec. at the exit, and the speed differential across the length of the opening 52 was nearly 10 cm./sec. The speed differential was removed by the crossflow fan 71 which was operated at a relatively low speed. The apparatus was operated until the supply of toner in the developer space exhausted after 150 image members had been developed. The developing time required for individual image members varied with decreasing amount of toner present in the developer, but remained between 5 and 10 seconds. However, it was noted unexpectedly that the quality of developed images remained uniform throughout the entire run. The developed images had a resolution in excess of 20 lines per millimeter on the average.

While the rotational speed of the rotor was as high as 3,000 r.p.m. in the above example, it can be reduced down to 1,000 r.p.m. or less with a corresponding increase in the developing time. A lower rotational speed of the rotor may be desirable in certain applications, since this reduces the amount of heat that is produced by friction of blades or projections on the rotor with the developer, thereby minimizing the risk that the toner may be fused with the carrier to lower the toner efficiency.

While the invention has been described with reference to particular embodiments, it should be obvious that various changes and modifications are possible to those skilled in the art, so that it is intended that the invention be solely limited by the appended claims.

What is claimed is:

1. A developing apparatus for electrophotography comprising a housing having an opening in the top wall and an inclined sidewall, said opening being arranged to support an insulating member carrying an electrostatic latent image, a flow control plate positioned within said housing and being inclined in a manner similar to the inclined said sidewall and being arranged in spaced relationship to said sidewall, said flow control plate extending within said housing from the lower end to the upper end thereof and cooperating with said side plate to from an inclined flow passageway, the upper end of said flow control plate terminating adjacent to said top plate of said housing and defining an exit from the passageway formed between said sidewall and said flow control plate, the upper end of said flow control plate at the exit being bent inwardly into said housing away from said sidewall and extending therefrom in the direction of said top wall, a rotor arranged below the lower end of said flow control plate and having a plurality of projections spaced apart along the periphery thereof, said rotor having a length substantially greater than the diameter thereof, said rotor having a horizontal shaft arranged to be driven for rotating said roter, a space within and at the bottom of said housing for receiving a supply of developer, said rotor being positioned and the supply being in such an amount that at least part of said projections are immersed in said developer when said rotor is at rest, said rotor acting upon rotation to agitate the developer and throw it against the opposing surfaces of said sidewall and said flow control plate for passage upwardly through the passage formed therebetween to the exit adjacent the top wall of said housing, and fan means operative to direct a flow of developer through the passageway defined between the opposing surfaces of said side plate and said flow control channel and to flow across said opening in said top wall.

2. A developing apparatus according to claim 1, in which a choke member is arranged in said exit adjacent one end of the opening.

3. A developing apparatus according to claim 1, in which said projections are formed by blades extending the length of the rotor, whereby the rotor is operable as said fan means to produce an airstream.

4. A developing apparatus according to claim 3, wherein the developer comprises toner and carrier particles, and further including a louver positioned in said flow channel adjacent said rotor, whereby upon rotation of the rotor developer is flung against the louver which separates toner from carrier particles, the louver allowing toner particles to be carried therethrough as a suspension in said airstream and further conveyed through the flow channel and the exit to provide a powder cloud travelling across the opening.

5. A developing apparatus according to claim 1, in which another fan means is located adjacent the top wall of the housing near the end of the opening remote from said exit, said another fan means acting to draw the powder cloud moving across the opening, whereby a substantially uniform travelling velocity of the powder cloud is maintained over the length of the opening.

6. A developing apparatus according to claim 1, in which another fan means is located in said channel intermediate between said exit and said rotor.

7. A developing apparatus according to claim 1, in which said space is broad enough to receive an initial supply of developer in an amount sufficient to develop a number of latent image members without additional supply.

8. A developing apparatus according to claim 1, in which the housing is V-shaped in cross section with rounded corners, the top bar of the V-shape constituting the top wall of the housing and the bottom corner of the V-shape defining the space for receiving a supply of developer, said flow control plate being arranged opposite one sidewall of the V-shaped housing and having a contiguous portion extending opposite the other sidewall of the housing, thereby defining a second space below said opening whereby to receive developer that falls down intermediate the travelling path across said opening.

9. A developing apparatus according to claim 8, in which said portion of the flow control plate defines together with said other sidewall of the housing a return path for said flow, and further including another fan means located in said return path for drawing said flow horizontally across said opening.

10. A developing apparatus according to claim 1, in which a louver is positioned in said flow channel adjacent said rotor, whereby upon rotation of the rotor developer is flung against the louver.

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