July 18, 1961 R. E. HAYFORD ET AL 2,992,758

POWDER CLOUD GENERATING APPARATUS

Filed May 26, 1958 2 Sheets-Sheet 1

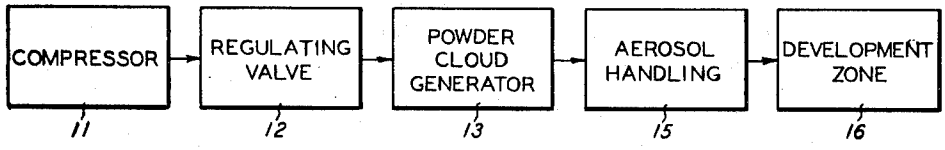



FIG. 1

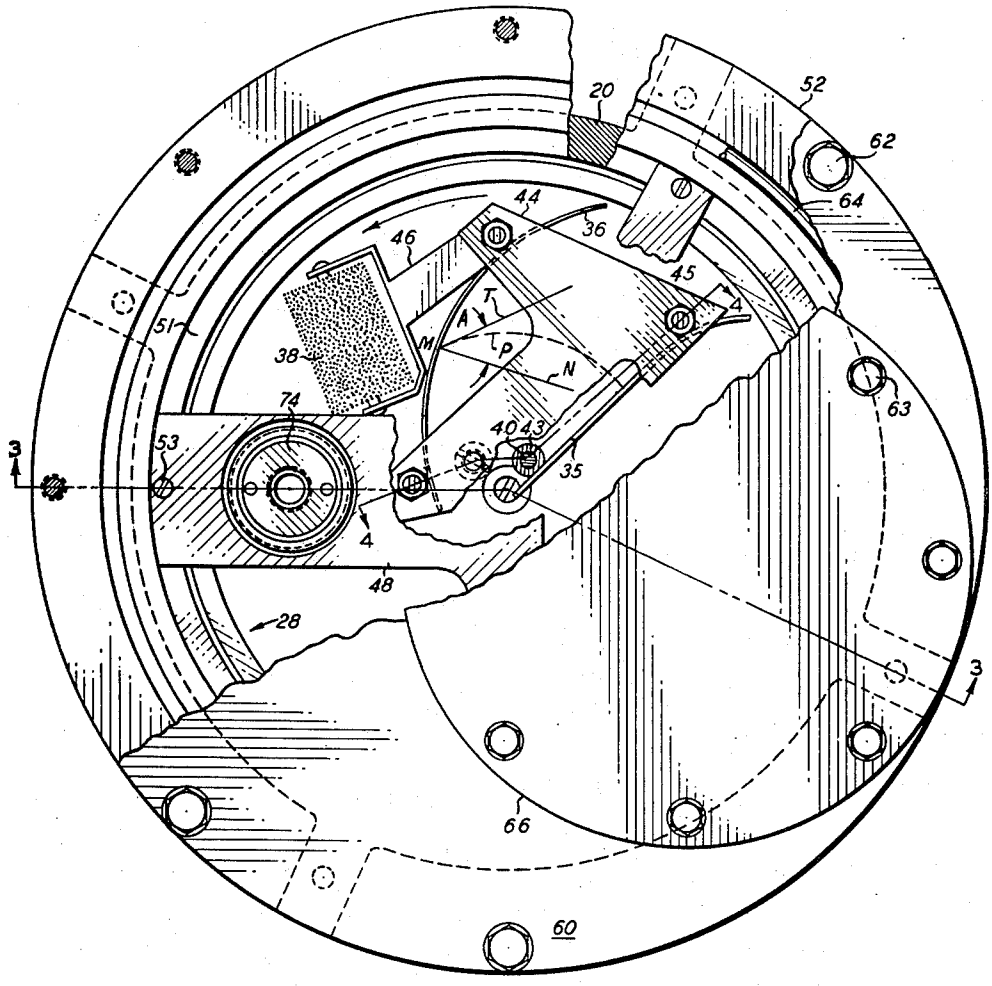



FIG. 2

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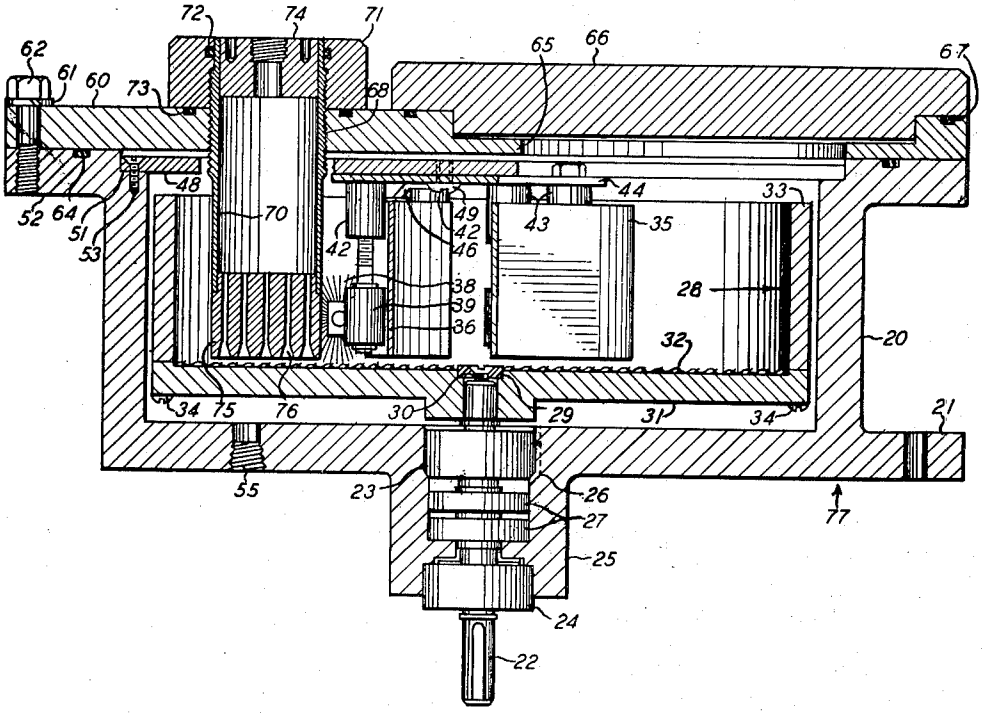



FIG. 3

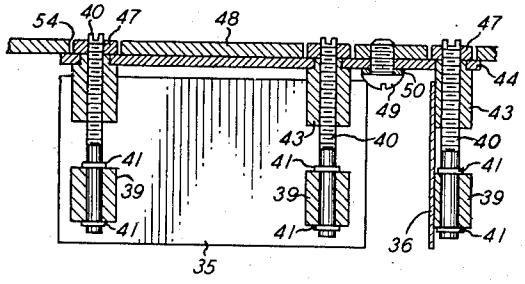



FIG. 4

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United States Patent Office 2,992,758 Patented July 18, 1961



2,992,758

# POWDER CLOUD GENERATING APPARATUS

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7 Claims. (Cl. 222—193)

This invention relates to the field of xerography and, particularly, to an improved powder cloud generator metering apparatus for powder cloud development of xerographically produced images. More specifically, the invention relates to improvements in powder cloud generators of the type disclosed in copending Hayford et al. application Serial No. 489,257, filed February 18, 1955, now Patent No. 2,862,646, issued December 2, 1958, of which this application is a continuation-in-part.

In the process of xerography, for example, as disclosed in Carlson Patent 2,297,691, issued October 6, 1942, a xerographic plate comprising a layer of photoconductive insulating material on a conductive backing is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the plate areas in accordance with the light intensity that reaches them, and thereby creates an electrostatic latent image on or in the photoconductive layer. Development of the latent image is effected with an electrostatically charged, finely divided material, such as an electroscopic powder, which is brought into surface contact with the photoconductive layer and is held thereon electrostatically in a pattern corresponding to the electrostatic latent image. Thereafter, the developed xerographic powder image is usually transferred to a support surface to which it may be fixed by any suitable means.

Two methods of image development are in common use. One is described in Walkup U.S. Patent 2,618,551, and is known as cascade development, and is in general use for line copy development. In this technique, the powder is mixed with a granular material, and this two-component "developer" is poured or cascaded over the plate surface. The function of the granular material is to improve the flow characteristics of the powder and to produce, on the powder, by triboelectrification, the proper electrical charge so that the powder will be attracted to the image. More exactly, the function of the granular material is to provide the mechanical control to the powder, or to carry the powder to an image surface and, simultaneously, to provide almost complete homogeneity of charge polarity. The other form of development is known as powder cloud development, and is in general use for continuous tone development. In this technique of development, a dispersion of electrically charged powder particles in an aeriform fluid is passed to the surface bearing the electrical image and particles are drawn from the aeriform fluid dispersion to form a powder image on the plate. This form of development is disclosed and described in Carlson U.S. Patent 2,221,776, wherein a rotating vane wheel or propeller is used to stir up powder in a chamber, thereby creating a cloud of particles for presentation to the electrostatic image. The vane or propeller in that patent may be connected to a terminal of a battery to impart charge to the powder particles.

Generally in powder cloud creating apparatus there is included a powder source, means to create a cloud of powder in aeriform fluid, means to convey the cloud to a surface carrying an electrostatic image, and means to electrostatically charge the powder in the cloud before it reaches the surface. Such devices, which include one or a number of the above elements, and which are used



to take powder from a source whether it be a mound of powder or whether it be in other shapes or forms and convert the powder to an aerosol of powder in aeriform fluid is herein, and generally in the art, referred to as a "powder cloud generator" or as a "cloud generator," as described in Hayford U.S. Patent 2,812,883, and in the above referred to copending Hayford et al. application, Serial No. 489,257.

An object in the art of xerography, as in any art concerned with image reproduction, is that of uniformly developing high quality copy. Means of obtaining this objective, while using powder cloud development, is through the uniform and constant presentation to the electrostatic latent image on a surface of a powder cloud of fine developer powder particles uniformly and densely dispersed throughout.

This invention is concerned with uniformly loading a powder support and uniformly dispensing the powder particles loaded into the support in the form of a powder cloud. The support of this invention is capable of delivering uniform dispersions of great quantities of powder in an aeriform fluid. Further, the device of this invention is able to operate over long periods of time and can produce continuous outputs which are sufficient for rapid processing in xerography.

The support is enclosed in a housing and rotated or moved in a substantially horizontal plane. At one point on the surface of the support is positioned raw or bulk developer powder particles. These particles are held in position by a first scraper or meter blade, which also acts to meter out a layer of powder to the surface of the support as it moves or rotates beneath the powder supply and first scraper. The powder is then again metered by a second scraper, excess powder being returned to the pile in front of the first scraper. The particular surface of the support is one which loads uniformly as it passes beneath the powder supply. An aeriform fluid is flowed into the housing at one point and powder in the aeriform fluid flows out of an output tube. An output orifice is connected within the housing to the output tube and is positioned at a distance above the surface of the support. Particles on the surface of the support are entrained in the flow of the aeriform fluid traveling from the housing out the output orifice and through the output tube, thereby creating at the output end of the output tube an aerosol of powder particles.

It is, therefore, the object of this invention to improve upon powder cloud generators so that a uniform and dense dispersion of powder particles in an aeriform fluid is created.

A further object of this invention is to provide a new powder cloud generator in which powder is uniformly loaded to a surface by means of a pair of meter blades and then entrained in the flow of an aeriform fluid out an output tube.

For a better understanding of this invention, together with other further objects thereof, reference is now had to the following description taken in connection with the accompanying drawings, and the scope of the invention will be pointed out in the appended claims.

FIG. 1 is a block diagram of elements which would generally appear in xerographic cloud creating apparatus for use in developing electrostatic images.

FIG. 2 is a top view of the powder cloud generator with parts broken away to show the internal structural elements of the device.

FIG. 3 is a cross-sectional view of the powder cloud generator taken along line 3—3 of FIG. 2, and

FIG. 4 is a detail sectional view of the mounting means for the meter blades taken along line 4—4 of FIG. 2.

Referring now with more particularity to the drawings, in FIG. 1 is shown a block diagram of elements which

compose cloud creating apparatus for development of electrostatic images. As is indicated in this diagram, compressed aeriform fluid is fed from compressor **11** to a powder cloud generator **13** through a regulating valve **12**, and the output of the powder cloud generator is fed through aerosol handling means **15** and then to the development zone **16** whereat developer particles are passed for development purposes to a surface carrying an electrostatic latent image.

The source of compressed or pressurized aeriform fluid may be any suitable source, such as, for example, an air pump or like pressure generating member or a suitable pressurized gas container. Such containers are readily available on the commercial market in the form of gas capsules of carbon dioxide or the like under pressure, in the form of bombs or the like of gas such as fluoro-chloroalkanes, which are available under the general family name of "Freon." Similarly, a suitable system may comprise a pump or generating means optionally in combination with a pressure chamber whereby fluctuations in pressure may be limited or avoided.

Regulating valve **12** is used to control the rate of flow of aeriform fluid from compressor **11** to powder cloud generator **13** and also to control the pressure of gas supplied to the powder cloud generator. The powder cloud generator, which is the next block in this diagram following regulating valve **12**, is used to create an aerosol of powder in air. It may be supplied with powder in what may be termed the raw or bulk form, that is, powder taken directly from a container and directly supplied in that form without treatment. It may also be supplied with powder which is first treated and then placed in position in the generator. The particular powder used is dependent on a number of factors such as other elements used in the cloud creating apparatus, the form of xerographic development, the desired quality of final copy, and the like. A more detailed discussion of powders will appear below.

The aerosol handling block **15** of the diagram appearing in FIG. 1 may represent any number of means and apparatus for imparting an electrostatic charge or deagglomerating the individual powder particles in the aerosol supplied from the powder cloud generator. Charging and deagglomeration of particles may be accomplished by turbulently flowing them through fine capillary tubes, such as disclosed in copending Ricker application Serial No. 353,520, filed May 7, 1953, now Patent No. 2,943,950. Charging may be accomplished by passing the aerosol of powder in air through a corona discharge zone, or the like.

The aerosol composed of charged particles in gas is next supplied, as indicated by the block diagram, to development zone **16**. Generally, this zone includes a means for expanding the aerosol to a cloud, and optionally this may be done by leading the air from tubes or the like to a larger area where the aerosol expands, creating the cloud of charged developer particles in gas. It is also feasible and sometimes desirable to use the particles in aerosol form without expansion.

In xerography in order to develop a true copy of the original image, it is generally desirable to develop against gravitational pull in that the electrostatic charges on the plate surface truly represent the pattern of the image projected to the plate surface, and allowing gravitational forces to operate in causing deposition of powder particles may result in a distorted reproduction. Also in causing the particles to deposit against the pull of gravity, deposition on the image bearing surface of agglomerates is reduced. This may be accomplished by positioning the plate with the image bearing surface facing downward and creating a cloud beneath it. In some instances particles deposited because of other forces may be removed during the development process through the use of such techniques as directing slight air currents or winds to the plate surface. Such winds or currents should be sufficient to remove particles not held in place due to electrostatic forces, but should be limited so that particles electrostatically held in place are not affected.

Reference is now had to FIGS. 2 to 4, inclusive, wherein is shown a preferred embodiment of a powder cloud generator **13** according to this invention. The flanged, cup-shaped body or casing **20** has mounting lugs **21** formed integrally therewith for supporting the unit on a structural element (not shown) of the xerographic machine and an air inlet opening **55** for connection to a source of aeriform fluid under pressure. The shaft **22**, which may be driven by any suitable power means (not shown), is journaled in double sealed bearings **23** and **24** mounted in the hub **25** of the body or casing **20**. A groove **26** extends along the bored wall of the hub **25** to permit equalization of pressure on both sides of the bearing **23**, while the bore opening in the hub **25** is sealed by seals **27** positioned between the bearings **23** and **24**.

A cup-shaped powder carrier element **28** is rotatably positioned in the casing **20** and is secured against a shoulder of the shaft **22** by means of the washer **29** and a screw fastener **30**. The powder carrier element **28** consists of a rigid backing plate **31**, the upper surface of which is faced with a skin or support **32** having numerous interstices in the surface thereof for carrying powder particles, suitable materials for the skin or support **32** being more fully described in above referred to copending Hayford et al. application Serial No. 489,257. A shell **33** is fastened by screws **34** to backing plate **31** to retain powder on the backing plate.

First and second meter blades or scrapers **35** and **36**, respectively, are adjustably positioned over the skin or support **32** in the powder carrier element **28**, for metering powder across the surface of the powder carrier element **28**, and brush **38** is spring mounted by means of brush carrier **46** against the surface of the skin or support **32** to agitate powder particles deposited on the surface thereof. To accomplish this, bearing blocks **39**, which rotatably carry adjustment screws **40** positioned by retaining rings **41** are fastened as by soldering to meter blade **35**. Internally threaded blocks **43** are secured by soldering to the plate **44**. The meter blade **35** is secured to the plate **44** by threading the adjustment screws **40** into the blocks **43**.

The assembly of the meter blade **36** to the plate **44** is similar to the assembly of meter blade **35** to the plate **44**, except that the brush carrier **46** to which brush **38** is rotatably secured, is supported on the shoulder of block **42**, block **42** being similar to blocks **43**, except that its undercut portion is longer than the undercut portion on blocks **43**. By means of the adjustment screws **40**, the meter blades **35** and **36** can be adjustably positioned relative to the surface of the skin or support **32**, and the position can be maintained by locking the adjustment screws **40** against further movement by nuts **47**.

The plate **44**, carrying the meter blades **35** and **36** and the brush **38**, is fastened by machine screw **49** and lockwasher **50**, to yoke **48** secured by fasteners **53** to the shoulder **51** formed in the flange **52** of the body or casing **20**. Apertures **54** in the yoke **48** permit access from the top to the nuts **47** and adjustment screws **40**.

The open end of the casing or body **20** is closed by the cover plate **60** held in position by lockwashers **61**, and bolts **62**, and sealed by O-ring gasket **64** held in an annular recess in the upper face of the flange **52**. The cover plate **60** secured to the body or casing **20** forms a housing, generally designated **77**, which surrounds and encompasses the internal elements. The cover plate **60** is provided with an opening **65** located so that powder material may be supplied to the powder carrier element **28** in front of the meter blade **35**. A closure plate **66** for the opening **65** seats at its periphery on a gasket **67** held in an annular recess in the upper surface of the cover plate **60**, and is secured by lockwashers **61** and bolts **62** and **63**.

The cover plate 60 is also provided with a threaded opening 68 receiving an externally threaded hollow cylinder 70 adjustably secured by locking nut 71 and sealed by gaskets 72 and 73 held in annular recesses in the locking nut 71 and cover plate 60, respectively. A bored output tube 74 adapted to be secured to a discharge conduit (not shown) is fastened in the upper portion of the hollow cylinder 70, while a pick-up tube 75, in which a relatively large number of output orifices 76 are formed, is secured in the bottom portion of the hollow cylinder 70.

As has been previously pointed out, an object of this invention is to meter controlled amounts of developer powder particles to a surface and to pass this powder from the surface in an aerosol of powder in air to create a uniformly dense and constant powder cloud output. To accomplish this, a reserve or supply of developer powder is placed on the skin or support 32 of the powder carrier element 28 through the opening 65 and after the closure plate 66 is secured, air inlet opening 55 is connected to a source of high pressure air. The surface of the skin or support 32 is one that tends to draw powder with it and thereby becomes coated with powder when it moves beneath the powder supply or powder reserve. As the powder carrier element 28 is rotated by means of shaft 22, a small quantity of powder carried by the support is permitted to pass under the meter blade 35 while the remainder of the supply of powder is retained against the face of the meter blade.

Generally the meter blade or scraper 35 is curved to best retain powder; that is, it is desirable to form this blade to avoid movement of powder past the edges of the blade. It is also desirable to form the blade curved in shape so that the larger mass of powder congregates at that area over the flat surface of the powder carrier element 28, which will pass under output orifices 76 where powder will be removed. Whether the meter blade or scraper 35 is curved, as shown, or straight, the portion of the meter blade positioned over the annular surface portion of powder carrier element 28 which passes under the center of pick-up tube 75 should be tangent to a radius of the powder carrier element 28 so that the powder carried on the above described annular surface portion will strike the blade at right angles causing powder to remain positioned adjacent to the blade over this annular surface portion of the powder carrier element. The lower edge of retaining scraper or meter blade 35, which is similar to the lower edge of meter blade 36, is preferably straight, that is, it is not indented, and it is preferably spaced apart from the flat bottom surface of powder carrier element 28.

Allowing too little powder to pass beneath the meter blade creates too thin an aerosol of powder particles, whereas allowing too much powder to pass under the meter blade will create too dense an aerosol of powder particles. Denseness is a desirable feature of an aerosol; yet, when an aerosol of powder in gas is too dense, fine grain development is detrimentally affected in that the aerosol tends to be a presentation of bulk powder including agglomerated powder to the output zone rather than a compressed cloud of powder particles in gas. The density of powder in gas or of the aerosol is a factor which relates to the particular use the aerosol is to be put to. For example, in the development of line copy of normal printed pages, it is quite proper and not unpleasing to the eye to develop with larger sized particles or particles of smaller sizes which are less deagglomerated than in the case of the development of continuous tone images wherein it is desirable to develop with deagglomerated and individual particles and smaller sized particles. In line copy work, then, the meter blades or scrapers may be adjusted to allow passage of a greater quantity of particles to the surface being loaded, whereas when developing fine grain continuuos tones, it is desirable to pass a lesser quantity of powder particles beneath the meter blades or scrapers. Spacing of the meter blades or scrapers from the surface being loaded relates to the particular surface material and to the particular powder particles being used. Adjustment of both meter blades 35 and 36 with respect to the skin or support 32 is done by means of the adjustment screws 40 and nuts 47.

It has been found that, for a fixed setting of the meter blade 35 with respect to the skin or support 32, the amount of powder metered by the blade will vary. To obtain satisfactory coverage of powder particles over the surface of the skin or support 32, a relatively large supply of powder must be retained in front of the meter blade 35. As the support passes under the supply of powder, the powder particles will not be metered uniformly due to the variation in the quantity of powder particles retained by meter blade 35 during the operation of the device.

To obtain fine control of the powder metered, the powder is re-metered by meter blade 36 which is positioned several thousandths of an inch closer to the skin or support 32 than meter blade 35. If a relatively large supply of powder is permitted to build up in front of meter blade 36, the efficiency of this blade will decrease. To prevent a build-up of powder in front of meter blade 36, the blade is mounted so that powder removed by this blade is returned to the powder supply in front of meter blade 35. This is accomplished by mounting the meter blade 36, whether a straight blade or curved, as shown, so that the angle of incidence A, of the moving powder particles striking the blade, is an acute angle as indicated in FIG. 2. The angle of incidence A is defined as the angle formed by the line T tangent to the path of movement P of a powder particle on the surface of powder carrier element 26 and a line N perpendicular to the meter blade 36 at the point O of incidence of the moving powder particle on the meter blade 36. The resultant force, which is at an angle to the blade, is composed of a vector force normal to the blade and a vector force tangent to the blade. The latter force will cause the excess powder particles, removed by the meter blade 36, to pass off the inner edge of the blade from where it will be returned by movement of the power carrier element 28 to the front of the meter blade 35. Whether the meter blade or scraper 36 is curved, as shown, or straight, the meter blade or scraper must be positioned at an angle to the radius of the powder carrier element 28, and specifically in regard to a curved blade, it is preferred that no portion of the blade facing meter blade 35 should be tangent to a radius of the powder carrier element so that all powder particles striking this blade strike it at an angle other than normal. In this respect it is noted that the powder carrier element is rotated at a low speed so that the centrifugal force acting on the powder particles is insignificant.

Thus it is apparent that meter blade 36 must be positioned to perform two functions, that is, the meter blade 36 must be positioned behind the first meter blade 35 to meter the desired amount of powder particles to the annular surface portion of powder carrier element 28 which passes directly under pick-up tube 75, and the meter blade 36 must be positioned so that all excess powder particles are projected onto a second annular portion of powder carrier element 28 to be returned to the powder supply in front of meter blade 35. If the meter blade 36 is not positioned to perform this latter function, the excess powder particles would pile up in front of this blade to the extent that after a short period of operation the entire powder particle supply would be retained by meter blade 36 in lieu of meter blade 35. If this is permitted to occur, meter blade 36 in effect becomes the sole metering blade in the system since it would then perform the same function as meter blade 35, while meter blade 35 would become useless. It is apparent then, that, in an apparatus constructed in accordance with the instant invention, meter blade 36 is not a

mere duplication of meter blade **35**, since each meter blade must perform different functions.

The brush **38** causes agitation of powder particles deposited on the covering **32** which have passed by meter blade **36**. Brush **38** is mounted on the brush carrier **46** so that a slight tension exists between the brush fibers and the surface of the skin or support **32** causing the brush to rotate as a result of the movement of the powder carrier element **28**. Rotation of the brush **38** causes the brush bristles to rotate against an flick away powder particles from the surface of the support. The brush **38** should be so positioned and should be of such size so as to stir up any powder particles on that portion of the covering which passes beneath the output orifices **76**. The layer of metered powder on the covering is then picked up by the output orifices and discharged through the outlet plug **74**.

The pick-up tube **75** is positioned in the casing so that the openings of the output orifices are adjacent but spaced an appreciable distance from the surface of the skin or support **32**. With this arrangement there is established a zone of pressure, between the output orifices and the support, which is relatively low in pressure as compared to the average pressure existing throughout the enclosure due to the introduction of the compressed air or other gas through inlet opening **55**. With such an arrangement the powder particles are literally sucked from the support **32** and are carried along in the stream of fluid passing out through the output orifices **76**.

The speed of movement of a loaded surface beneath the output orifice is dependent upon a number of factors such as the particular surface material being loaded, the particular developer powders being used, the gas flow and gas pressure supplied to the device, the use desired of the output, and the like. For a generator constructed along lines of the embodiment shown in FIGS. 2 and 3, it has been found that revolving the powder carrier element at a rate of 1 to 5 revolutions per minute and preferably at 3 revolutions per minute tends to give optimum outputs. It is to be understood, of course, that the output of powder in gas tends to increase as the revolutions per minute of the powder carrier element increases. If it is, therefore, desired to continue receiving a dense cloud with more gas pressures and lower gas flows, a dense cloud may be obtained with more revolutions per minute.

The principle of operation of the powder cloud generators being described herein is one of flowing gas into an enclosure having an output tube. Since the output tube is the only exit for the gas flow, the gas being flowed into the device leaves through the output tube. The output orifice attached to the output tube is closely spaced to the loaded surface and the gas rushing out the output orifice entrains into its stream the powder particles carried by the loaded surface positioned beneath or substantially beneath the output orifice. The operation of the device when operating properly removes completely all loaded powder from the loaded surface. As an aid to the complete removal, the brush stirs up the powder particles so that they may more easily become entrained in the gas flow rushing out the output orifice. Thus it is clear that increasing the speed of rotation of the powder carrier element will increase the powder particles passed beneath or substantially beneath the output orifice, and thereby create a denser cloud. Increasing gas flow in the device of this invention will tend to decrease denseness of cloud, in that all particles are entrained in lower gas flow rates and the same amount of particles for a larger flow of gas will create a thinner aerosol of powder particles.

Certain features relating to the developer material are pertinent in operating the powder cloud generator and pertinent in developing electrostatic images. In general, particles should be grossly smaller than the output tube diameter, and it may be stated that finer sized particles in the absence of undue agglomeration may reveal a print or picture more pleasing to the eye than larger sized particles. Thus, a convenient particle size which results in extremely high quality copy contemplates particles of sub-micron size having average diameters in the order of 0.1 micron. From the point of view of composition of the developer particles, prints or pictures may be produced with a variety of types of finely divided electroscopic powders as disclosed in the Carlson patent. However, as the art of xerography has progressed, it has been found preferable to develop images with a powder formed of any of a variety of pigmented thermoplastic resins that have been specifically developed for the purpose. A number of such developing materials are manufactured and marketed by Haloid Xerox Inc., of Rochester, New York, and are specifically compounded for producing dense images of high resolution and to have characteristics to permit convenient storage and handling.

The amount of developer particles placed in front of the meter blade or scraper **35** is dependent on the amount of continuous use desired of the powder cloud generator and also on the shape and size of the meter blade, which determines how much this meter blade will retain.

While the present invention as to its objects and advantages, as has been described herein, has been carried out in specific embodiments thereof, it is not desired to be limited thereby, but is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. A powder cloud generator including an enclosure having an inlet conduit for a compressed aeriform fluid, an inlet means for powder material and an output means for a powder cloud; a powder carrier means, including a substantially flat support for powder particles, rotatably journaled in said enclosure with said support rotatable in substantially a horizontal plane in closely spaced relation beneath said output means, meter means, including adjustable positioning means secured in said enclosure and positioned over said support, a first meter blade connected to said adjustable positioning means and positioned above said support to retain a supply of powder particles on said support against said first meter blade, and a second meter blade connected to said adjustable positioning means and positioned above said support between said first meter blade and said output means in the path of rotation of said powder carrier means, said second meter blade being further positioned so that the angle of incidence of the powder particles carried by said support, as it is rotated, with said second meter blade is an acute angle, whereby excess powder particles are directed along said support for return to said first meter blade as said support is rotated.

2. A powder cloud generator including an enclosure having an inlet conduit for compressed aeriform fluid, an inlet means for powder material and an output means for a powder cloud; a powder carrier means, including a substantially flat support for powder particles, rotatably journaled in said enclosure, said output means including a pick-up tube having at least one output orifice therein adjacent to but spaced above said support, meter means, including adjustable positioning means connected to said enclosure and positioned over said support, a first meter blade conected to said adjustable positioning means and positioned above said support to retain a supply of powder particles on said support and to permit a metered quantity of a powder material on said support to pass beneath said first meter blade, a second meter blade connected to said adjustable positioning means and positioned between said first meter blade and said pick-up tube above and in closely spaced relation to said support in the path of rotation of said powder carrier means, said second meter blade being further positioned at an angle to the path of powder material carried by said support as it

is rotated, and a brush connected to said meter means in contact with the top surface of said support and positioned between said second meter blade and said pick-up tube.

3. A powder cloud generator including an enclosure having an inlet opening for compressed aeriform fluid, an inlet means for powder material and an output means for a suspension of powder material in an aeriform fluid; a powder carrier means journaled in said enclosure, said powder carrier means including a rotatable substantially flat support positioned in said enclosure in a horizontal plane below said output means, and metering means including a first meter blade and a second meter blade mounted inside said enclosure with said first meter blade and said second meter blade positioned in closely spaced relation above said support to meter a uniform quantity of powder material onto the surface of said support as it rotates therebeneath, said first meter blade being further positioned to retain a supply of powder material on the surface of said support and said second meter blade being positioned between said first meter blade and said output means in the direction of rotation of said support to deflect excess powder material striking the second meter blade whereby the excess powder material is carried by said support to be re-metered by said first support.

4. A powder cloud generator including wall means forming an enclosure, said wall means including a removable wall to permit a quantity of powder material to be supplied to the interior of said enclosure, a vertical shaft journaled in the bottom wall of said enclosure, a circular flat support positioned within said enclosure and connected to said shaft for rotation therewith in substantially a horizontal plane, said enclosure having an inlet opening for compressed aeriform fluid, and an output means for a suspension of powder material in aeriform fluid with one end of said output means positioned in closely spaced relation above said support; and metering means including a first meter blade and a second meter blade connected to said enclosure with said first meter blade and said second meter blade positioned in closely spaced relation above said support to meter a uniform quantity of powder material onto the surface of said support as it rotates therebeneath, said first meter blade being positioned to retain a supply of powder material on the surface of said support and said second meter blade being positioned between said first meter blade and said output means in the direction of rotation of said support to deflect excess powder material whereby the excess powder deflected by said second meter blade is carried by said support to be re-metered by said first support.

5. A powder cloud generator including an enclosure having an inlet opening for compressed aeriform fluid, an inlet means for a powder material, and an outlet means; a powder carrier means, including a support, rotatably journaled in said enclosure, said support being arranged to receive a supply of powder material as it moves in substantially a horizontal path beneath said inlet means, a support means positioned in said enclosure and connected thereto, a first meter blade connected to said support means and positioned above and in closely spaced relation to said support to retain a supply of powder material on the surface of said support while permitting a metered quantity of powder material on said support to pass therebeneath as said support is rotated, a second meter blade connected to said support means positioned in closely spaced relation above said support between said first blade and said outlet means in the direction of rotation of said support to re-meter powder material on said support as it rotates and to deflect excess powder material whereby the excess powder material may be carried by said support to be metered by said first meter.

6. A powder cloud generator including an enclosure having an inlet opening for compressed aeriform fluid, an inlet means for a powder material, and an outlet means for powder material and aeriform fluid; a powder carrier means, including a support positioned in closely spaced relation beneath said outlet means, rotatably journaled in said enclosure, said support being arranged to move in substantially a horizontal path, adjustable support means positioned in said enclosure and connected thereto, a first meter blade connected to said adjustable support means in spaced relation above said support and positioned to retain a supply of powder material on said support while permitting a small quantity of powder material to pass beneath said first meter blade as said support is rotated, a second meter blade connected to said support in spaced relation above said support intermediate said first meter blade and said outlet means in the path of movement of said support to limit the supply of powder material on the portion of said support passing beneath said outlet means and to deflect excess powder on said portion of said support passing beneath said outlet means to prevent it from being discharged through said outlet means before it is re-metered by said first blade.

7. A powder cloud generator including an enclosure having an inlet conduit for compressed aeriform fluid, an inlet means for powder material, and an outlet means for a powder cloud; a powder carrier means, including a circular disc for supporting powder material, rotatably journaled in said enclosue, said outlet means including a pick-up tube having at least one output orifice therein closely spaced above said circular disc, meter means including a first meter blade and a second meter blade connected to said enclosure with said first meter blade and said second meter blade positioned in closely spaced relation above said circular disc, at least a portion of said first meter blade being positioned tangent to a radius of said circular disc and said second meter blade being positioned at an angle to a radius of said circular disc, said second meter element being positioned intermediate said first meter blade and said pick-up tube in the path of movement of said circular disc, and a brush connected to said meter means positioned to contact the top of said circular disc, said brush being positioned intermediate said second meter blade and said pick-up tube in the path of movement of said circular disc.

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