Aug. 8, 1972 Y. MORADZADEH ET AL 3,682,678

METHOD OF DEVELOPING ELECTROSTATIC IMAGES

Filed Oct. 24, 1969 3 Sheets-Sheet 1

FIG. 1

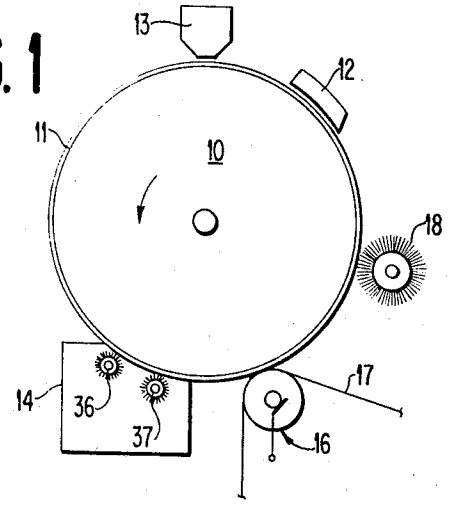


FIG. 2

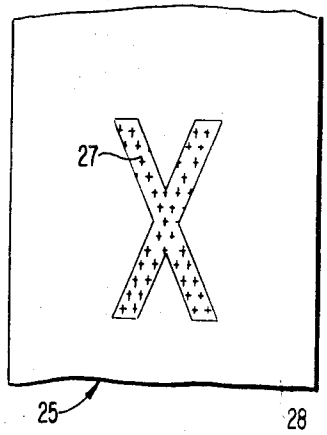


FIG. 3

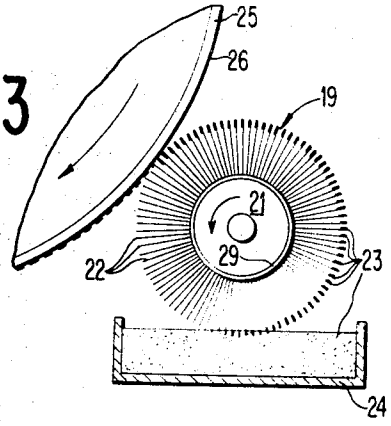


FIG. 4

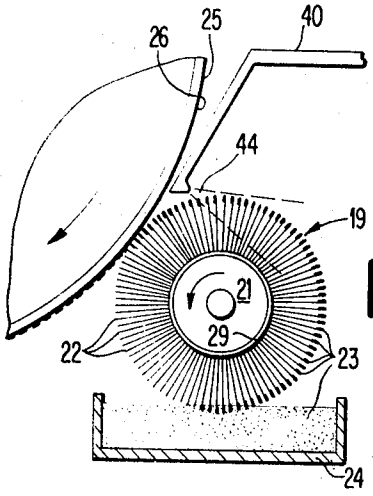


FIG. 5

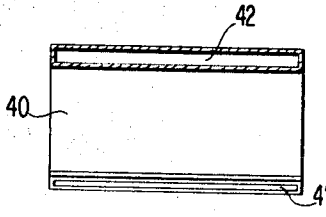


FIG. 6

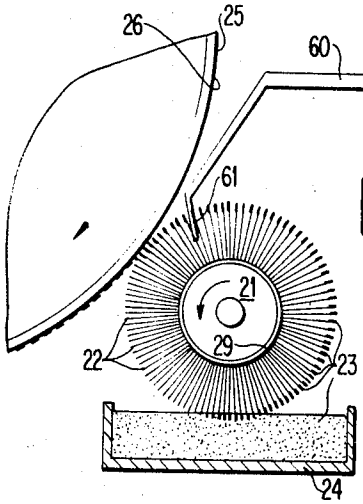
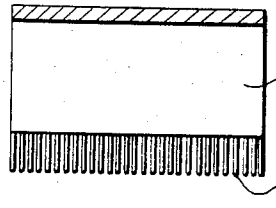


FIG. 7



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METHOD OF DEVELOPING ELECTROSTATIC IMAGES

Filed Oct. 24, 1969 3 Sheets-Sheet 2

FIG. 8

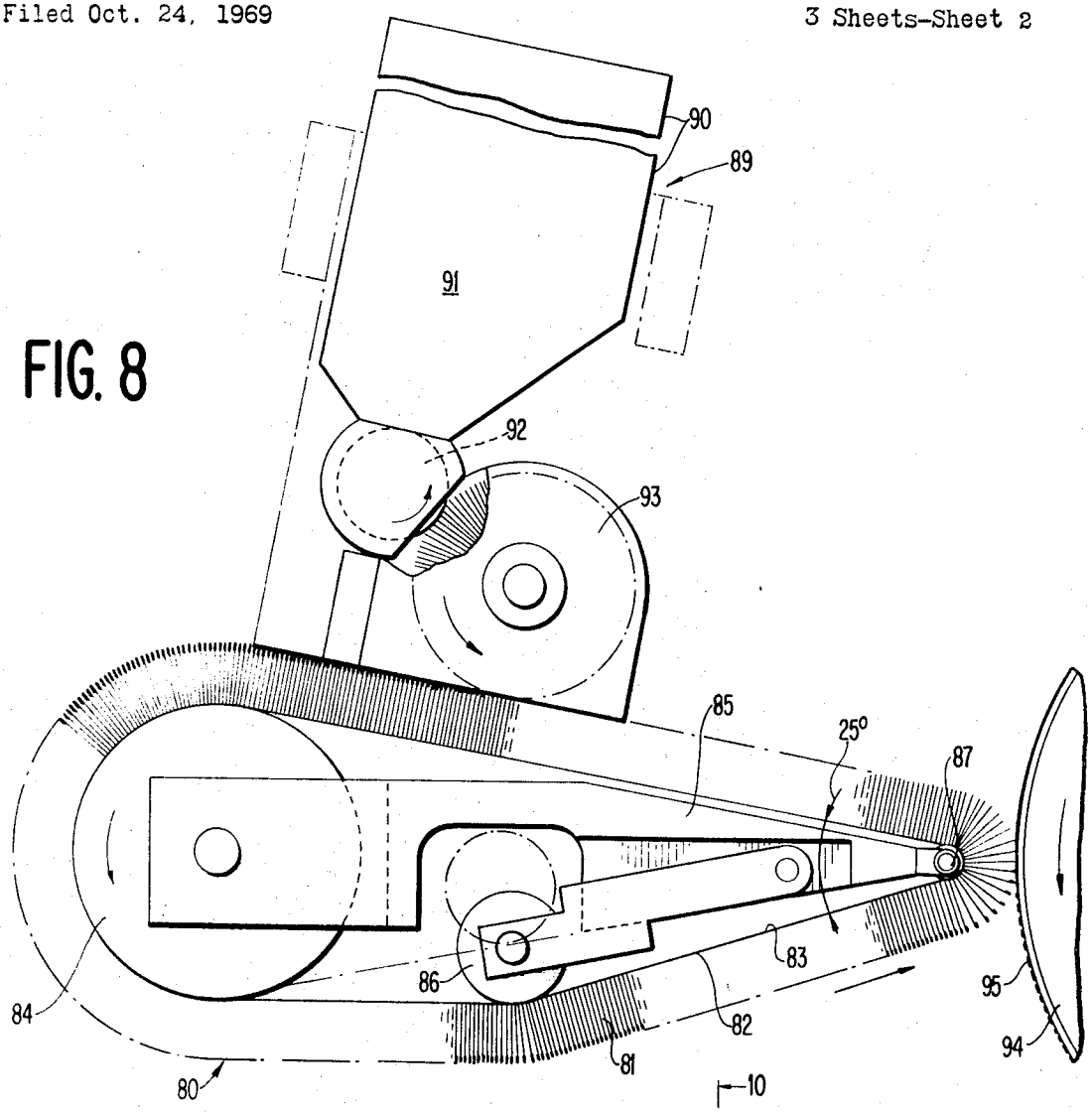
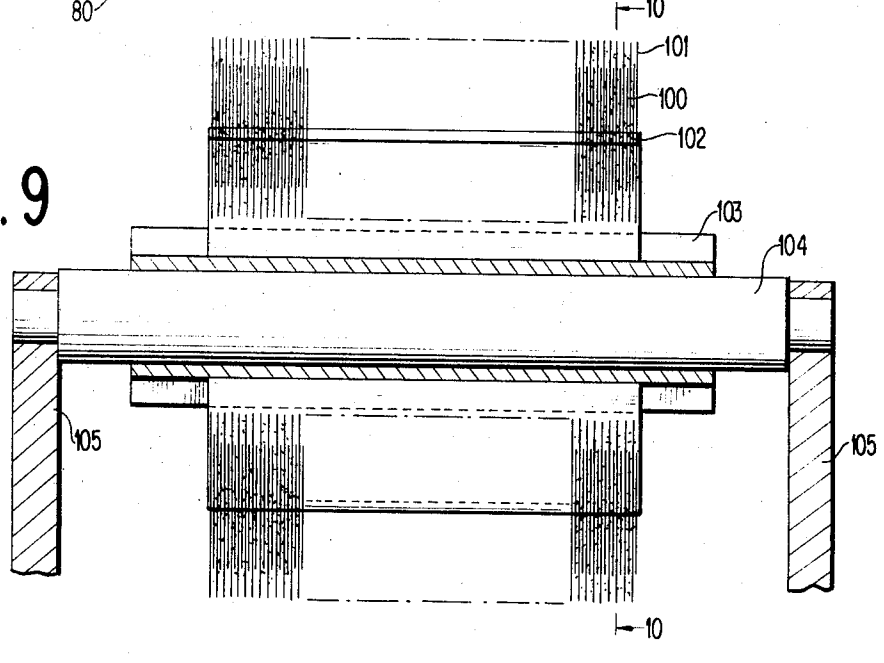


FIG. 9



METHOD OF DEVELOPING ELECTROSTATIC IMAGES

Filed Oct. 24, 1969 3 Sheets-Sheet 3

FIG. 13

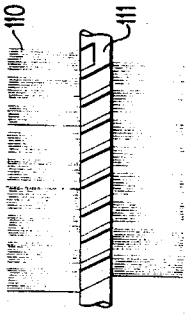


FIG. 12

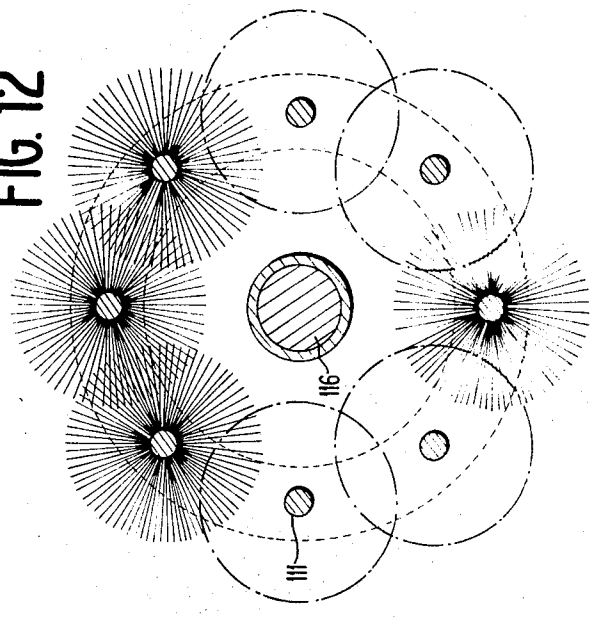


FIG. 10

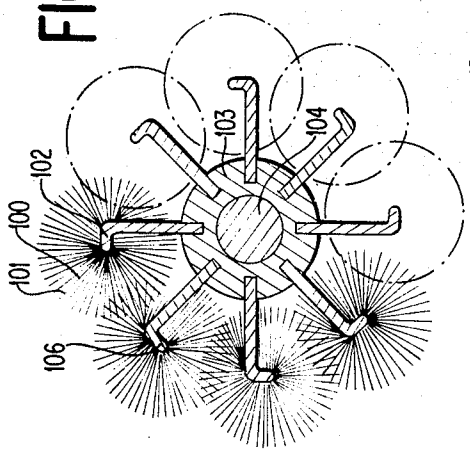
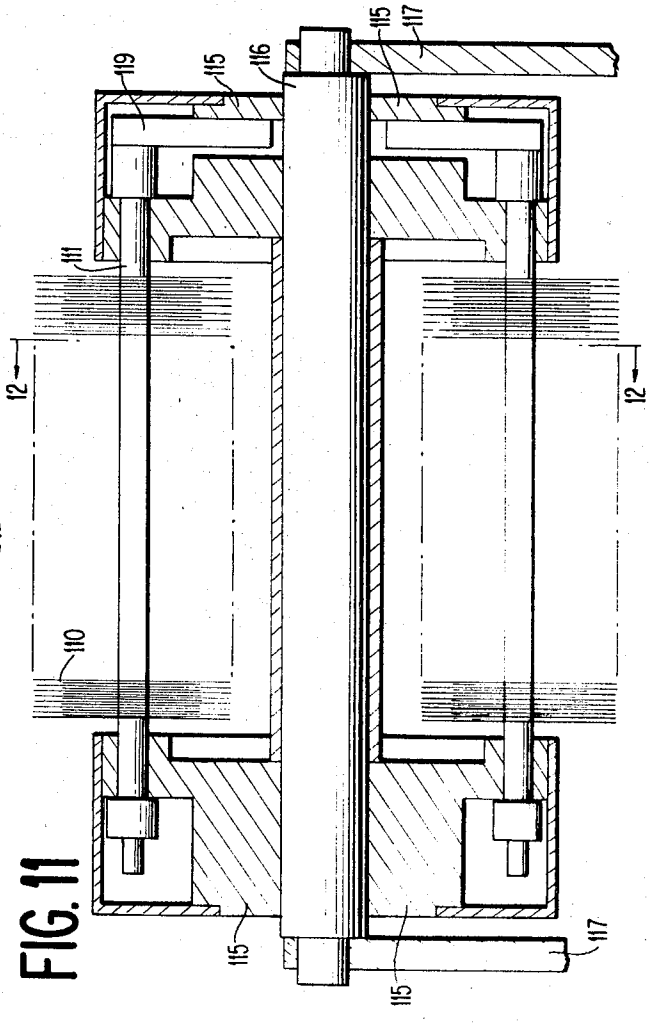


FIG. 11



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Patented Aug. 8, 1972

3,682,678

METHOD OF DEVELOPING ELECTROSTATIC IMAGES

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Filed Oct. 24, 1969, Ser. No. 869,081
Int. Cl. G03g 13/08
U.S. Cl. 117—17.5 9 Claims

ABSTRACT OF THE DISCLOSURE

Method and apparatus for fur brush development of electrostatic images on an insulating surface. Mechanical separators separate the fur brush fibers to present unmatted toner-carrying fur fibers for contact with an electroplate surface. Alternatively, the toner-carrying fur brush material may be elastically stretched over a mandrel through an angle sufficient to separate the fibers, to prevent matting, independent of humidity or wear conditions, to present unmatted fur fibers for contact with an electroplate surface.

FIELD OF THE INVENTION

This field of invention relates to improvements in electrostatographic development devices and, particularly, to development devices in which the development element is fibrous, such as a fibrous brush or belt.

BACKGROUND OF THE INVENTION

Fur brush development of electrostatic images on an insulating surface is well known in the prior art, as are the problems associated with the use of the fur brush. Some of these problems and one solution to them is presented in the patent of Greaves, U.S. 2,902,974, assigned to the assignee of this invention. The above patent discusses the problems associated with humidity changes when using fur brushes. One of these problems include change in charge on the brush due to the increase or decrease of humidity, and the above patent is directed toward a solution of that problem. Other problems, which are particularly serious, include brush fiber matting that arises with continued use of a fur brush, and is especially noted at high humidities. In a high humidity situation, the moist fibers of the fur brush tend to stick together, and coupled with the wear of the brush, continually rotated in the same direction, the degree of matting can reach such a point as to seriously impede or lower the quality of subsequent development. Fur brush development does, however, have some advantages in general electrostatic printing systems. A predominant advantage is that the toner is carried to an electroplate surface via soft brush fibers, as opposed to hard carrier particles. This appreciably reduces the wear on the electroplate surface. Fur brush development also allows toner to be uniformly carried across an area of the electroplate in a consistent manner, realizing more uniform images. However, the problems have in general tended to outweigh the advantages, with the result that fur brush development is not used commercially.

SUMMARY OF THE INVENTION

Thus, an object of this invention is to provide a fur brush development apparatus for use in development of electrostatic images on an insulating surface, that will not mat independent of humidity and wear conditions.

Another object of this invention is to provide means for separating the fibers on a fur brush developing apparatus, into individual fibers in an unmatted condition, for contact with an electroplate surface.

Another object of this invention is to provide, as desired, either mechanical means external to the fur brush itself, or mechanical means inherent in the brush itself, for maintaining fiber separation for carrying toner particles to an electroplate surface.

These and other objects of this invention are met by the method and apparatus for fur brush development of electrostatic images on an insulating layer.

In a preferred embodiment, an improved fur brush is utilized, the fur brush comprising a fur brush material having a base inner surface and a base outer surface, with the brush fibers extending outwardly from the base outer surface. The fur brush material is attached to a carrying means for carrying the brush material to and from a toner depositing station where toner is deposited onto the brush fibers, and into contact with an electroplate surface, the carrying means including a turning edge over which the base inner surface is elastically stretched to an angle sufficient to separate the fibers extending from the base outer surface. This separation of the fibers, which is preferably done just prior to contact of the brush fibers with the electroplate, brings unmatted brush fibers into contact with the electroplate, for uniform development.

In another embodiment, a separating means is physically located external to a rotating fur brush, between the fur brush and the electroplate surface. These separator means comprise a series of fingers arranged in a comb-like structure, extending into the pile of the brush, to physically separate the brush fibers by interfering movement of the fibers and the fingers relative to each other. The comb-like structure is located just before the point where the brush contacts the electroplate surface, thus assuring fiber separation. Thus, the electroplate surface continually has individual or essentially individual fibers contacting it, these fibers carrying toner particles from a toner source feeding the brush, resulting in a uniform development on the electroplate surface.

In still another embodiment, air jets are located to physically space the fibers by impinging an air stream into the fur pile. As with the mechanical series of fingers above, the air jets are located to inmpinge the stream just prior to the contact of the fur fibers with the electroplate surface.

These and other embodiments of this invention will best be understood in conjunction with the following drawings and general description.

IN THE DRAWINGS

FIG. 1 is a diagrammatic view of a continuously operating electrostatic printer employing brush development.

FIG. 2 is a view of the portion of the surface of an electroplate having a latent electrostatic image thereon.

FIG. 3 is a schematic showing one type of a brush developer apparatus.

FIG. 4 shows the brush developing apparatus of FIG. 3, including an air jet separator.

FIG. 5 shows the air jet separator of FIG. 4.

FIG. 6 shows the brush developing apparatus of FIG. 3, utilizing comb-like fingers as a brush fiber separator.

FIG. 7 shows the comb-like structure of FIG. 6.

FIG. 8 shows another embodiment of an image developing fur brush, being turned through a sharp radius to effectuate separation of the fibers.

FIG. 9 shows a cross-section of another embodiment of an image developing fur brush, comprising a series of individual fur brush elements.

FIG. 10 is a cross-section through AA of FIG. 9.

FIG. 11 shows another embodiment of a fur brush apparatus, showing a series of eight fur brush elements.

FIG. 12 is a cross-section through section AA of FIG. 11.

FIG. 13 shows the helical wrap of the fur strip ma-

terial about the individual shafts forming individual brush elements of FIG. 11.

GENERAL DESCRIPTION

Electrostatic printer

For convenience, the well-known type of electrostatic printer known as the xerographic printer, will be used to illustrate the principles of this invention. As will be made clear, the uses of this invention go beyond the narrow range of the xerographic printers per se, and are useful in the general field of electrostatic development of a latent image on an insulating layer.

Referring to FIG. 1, xerographic drum **10** having a photoconductive insulating layer **11** thereon, would be driven in a counterclockwise direction by conventional means (not shown) so that the incremental surface areas of the photoconductive insulator layer **11** would be acted upon in the following sequence:

(1) These surface areas would initially be charged positive by corona unit **12**.

(2) Charges surface areas corresponding to the light image projected from optical apparatus **13**, would be discharged so as to form a latent electrostatic image on layer **11**.

(3) Those surface areas depicting the latent electrostatic image would have applied thereto, toner particles by the brush type developing unit **14**.

(4) The developed image as depicted by the toner particles on the surface of photoconductive insulator layer **11**, would be transferred at station **16** onto a print receiving material **17**.

(5) Any residual toner remaining on the surface of the xerographic drum after the afore-mentioned transfer operation, would be removed by the cleaning brush **18**.

The electroscopic toner applied to the surface of the xerographic drum **10** by the brush type developer unit **14** may be a powder composition comprising one or more resins which are preferably thermoplastic in character, a plasticizer which is a solvent that can act upon the resin at a temperature below the melting point of the resin, and a pigment for imparting a desired color to the toner material.

Brush developing description

There is used in a brush development apparatus a soft fur brush to impart the required triboelectric charge to the toner particles. It is by the physical contact of the soft fur brush fibers with respect to the electroscopic toner particles that opposite triboelectric charges are imparted to these fibers and the toner particles. The triboelectric effect is one of contact electrification; a change in electrons takes place in two triboelectrically dissimilar materials, when these materials are initially brought into physical contact so that one material gains electrons lost by the other material. Thus, with a given combination of brush material and toner particles, the brush fibers may be charged positive, whereas the toner particles may be charged negative.

Referring to FIG. 3, the principle of brush developing as it is now understood in its simplest form may be explained. A suitable brush **19**, such as beaver for example, is secured to a rotatable drum or cylinder **21** which, in turn, is so positioned that the brush fibers **22** move through a mass of electroscopic toner material **23** in a source reservoir **24**, and also in physical contact with the charged surface of an insulating layer **26** of an electroplate **25**. Before proceeding any further it would be well to distinguish an electrophotoplate from an electroplate. The former is a member comprising a photoconductive insulating layer **11** (FIG. 1) on a conductive backing, whereas the electroplate is a member comprising an insulting layer, photoelectric or otherwise, on a conductive backing. Accordingly, it should be clear that the expression electroplate includes an electrophotoplate. Furthermore, insofar as the present invention is concerned, it should be clear that it is of no consequence how a latent electrostatic image is formed nor is it of any significance in what type of material this image is stored.

Referring once again to FIG. 3, the afore-stated physical contact between the brush fibers **22** and the toner particles **23** causes a triboelectric charge to be imparted to the toner particles so acted upon. The use of a fur such as beaver referred to hereinabove, as well as the use of a thermoplastic electroscopic toner such as described previously, causes for example, a negative triboelectric charge to be imparted to the toner particles and a positive triboelectric charge to be imparted to the brush fibers. Thus, as incremental areas of the insulating layer **26** having positively charged latent electrostatic images stored thereon are subjected to the negatively charged toner particles **23**, the charged particles will be caused to adhere to the positively charged surface areas so long as this force of attraction is great enough to overcome the force of attraction between the positive brush fibers and negative toner particles. As a result, the latent electrostatic images will be visibly defined by the pigmented toner particles.

Referring to FIG. 2, the latent electrostatic image **27** is shown to be defined by a positive electrical charge of approximately +600 volts. The background area **28** of the electroplate **25** could be at a +150 volt residual level. Thus, the various electrical charges produced must be such that the force of attraction between the negative toner particles and the positive fur fibers must be large enough to prevent toner transfer to the background area **28** and yet small enough to enable the latent electrostatic image area **27** to capture and hold a sufficient amount of toner so as to cause said image to be developed.

Humidity and wear conditions

When the relative humidity within the brush type developing unit is excessively high so as to bring about a so-called "wet" brush, the properties of the brush for development are no longer those of the ideal brush. The high humidity condition is conducive to matting of the brush, as the wet fibers tend to adhere to each other. Considering that the brush generally rotates in the same direction over an extended period of time, there is a further tendency due to wear for the brush fibers to take on a certain set. The combination of high humidity plus this set, and general wear upon the brush, results in a matted condition which in turn results in the failure to uniformly apply toner to the electroplate. This is caused by the brush no longer contacting the electroplate in a uniform manner, but rather in matted discrete areas, as opposed to the entire electroplate area.

If the humidity is brought under control, or to a lower value, the matted fur fibers will not necessarily separate, to retain the uniform spacing for uniform toner deposition as is desirable. While various means are available, such as that described in the aforementioned Greaves patent, to overcome some aspects of the humidity conditions, it is evident that it is a highly desirable that the brush fibers retain their initial separation to deliver a uniform deposition of toner particles upon the charge surface of the electroplate.

Air separating means

FIG. 4 and FIG. 5 show a fiber separation means, to separate the brush fibers on an image developing fur brush **21**, so as to present essentially individual fibers into contact with the electroplate surface. Utilizing the basic brush developer of FIG. 3, FIG. 4 further includes air separating means **40** which comprises at least one means for introducing a stream of air into the brush fibers to separate the brush fibers. In a preferred embodiment, this brush is located at that point just before the brush fibers **22** carrying toner particles **23** are to make contact with

the electroplate surface **26**. The air separating means is thus located after the depositing of toner particles onto the brush fibers, and prior to the brush contacting the electroplate surface. FIG. 5 shows a face view of the separator **40**, showing the air outlet orifice **41**, and the inlet orifice **42**. Thus, as shown in FIG. 4, a stream of air **44**, is directed upon the matted fibers to separate the fibers into individual fibers, or essentially individual fibers, which means groups of fibers of 2 or 3 or some small number, which could not be considered to be a matted condition. While the single large mouth orifice **41** is shown on air separating means **40**, it is clear that a series of individual air separating means, such as individual air jets, may be utilized in place of the large single orifice shown. Further, these air jets may be located to direct the stream of air into the fibers from the side of the brush, the top of the brush, or, if the base of the brush is porous, internal to the brush holding mandrel, to force a stream of air outwardly. The air jet means may also, if desired, incorporate a series of air jets located at different positions. Of course, it is necessary that the stream of air be sufficient and so directed as to separate the fibers, but insufficient to dislodge the toner particles from the fibers. Since the toner particles are adhered to the fibers of the brush by electrical charge, while it is possible that the stream of air may cause some displacement of the toner, it will not dislodge the toner from the fibers. Thus, the toner will be brough to the electroplate surface **26**, by separated fibers, in a uniform manner resulting in uniform development.

Mechanical separator

FIG. 6 shows the brush developing apparatus of FIG. 3, but including mechanical separating means, such as the series of fingers **60** arranged in a comb-like structure as shown in FIG. 7. These comb-like fingers **61** extend into the brush fibers to physically separate the fibers from the matted to an unmatted condition. The preferable location for this series of fingers is, as shown in FIG. 6, just prior to the point where the brush fibers contact the electroplate surface, and of course, after toner has been deposited onto the brush fibers. The spacing of the fingers must be such as to unmat the fiber, but as not to remove the toner particles from the fibers. For this purpose, a series of such fingers on a comb-like structure may be utilized to successively separate different areas of the fibers. This is similar to the air jet means of FIG. 4, which may incorporate a series of air jets located at different positions.

A further advantage to separation of the fibers just prior to the toner deposition onto the electroplate surface, is that after deposition the fibers will remain in a separated or unmatted condition. This allows subsequent toner deposition to occur in a more uniform manner, contributing further to uniform development.

Thus, as to the above embodiments, they may be summarized in the following manner: that in the type of apparatus disclosed, an apparatus for developing electrostatic images on an insulating layer, whereby electroscopic toner solid particles are deposited by use of an image developing fur brush onto the surface of an electroplate, which is used for storing an electrostatic image thereon, a separating means is used to separate the brush fibers on the image developing fur brush so as to present essentially individual fibers into contact with the electroplate surface, resulting in unmatted brush fibers carrying the electroscopic toner to the electroplate surface, independent of humidity and wear on the image developing fur brush. The separating means may comprise a mechanical means, such as a series of fingers in a comb-like structure extending into the pile of the brush, or an air separating means such as one or a series of air jets. The air jet stream, or the mechanical fingers, will interfere with the movement of the fibers and position of the fibers so as to effectuate fiber separation. The preferable location for this separating means is just prior to contact of the fibers with the electroplate surface.

"Stretched" fur brush—Preferred embodiment

While the prior embodiments have shown methods and apparatus for separating fur fibers in conventional brush configurations, the brush itself may be so designed as to inherently effectuate the fiber separation. As will be clear from the following illustrations, other means of toner application, as will as that shown in conjunction with FIGS. 3, 4, and 6, may be utilized. The method of applying the toner to the brush itself, in such apparatus as used for that purpose, do not constitute a part of this invention, and many such means and methods are known.

FIG. 8 shows a fur brush apparatus which will inherently, by its design, separate the fibers at the point of contact of the fur fibers with the electroplated surface. FIG. 8 shows image developing fur brush **80** comprising brush fibers **81** extending outwardly from the base outer surface **82** of the fur brush material, the fur brush material by its base inner surface **83** attached to a carrying means. This carrying means, in this embodiment, includes drive roll **84**, structure means **85**, tensioning roll **86**, and turning edge **87**. For purposes of this embodiment, the toner feed is generally designated as **89**, and comprises a toner bank **90** having electroscopic toner **91** therein, which is fed via a gravure roll **92** to a toner feed brush **93**. In this embodiment, the electroplate is in the form of a drum **94** having an insulating surface **95**.

In operation, toner **91** from toner bank **90** is fed via gravure roll **92** to toner feed brush **93**, where it is applied to fur brush fibers **81** as the fibers pass and contact the toner feed brush. The tensioning roll maintains a tension upon the base inner surface **83** of the fur brush material. The fur brush material, as shown by the arrows on the drive roll, which is driven by driving means not shown, is driven in a counterclockwise direction while the electroplate drum **94** is driven similarly in a counterclockwise direction. The tension roll **86** is used to maintain a tension upon the fur brush, within the elastic limit of the fur brush material. Thus the carrying means, which may include the drive roll, the structure member **85**, and turning edge **87**, carries the fur brush material carrying toner particles on the fibers into contact with the electroplate surface **95**. The carrying means includes the turning edge **87**, which may be an edge or a roller means. This turning edge has the property that as the base inner surface of the fur material is turned over the turning edge **87**, it is elastically stretched through an angle sufficient to separate the fibers extending from the base outer surface. The angle through which a particular fur material must be turned will be dependent to some extent on the nature of the fur and the depth of the pile. When using rabbit fur, for example, having a pile depth of 5/8", a 1/8" diameter turning edge is sufficient to separate the fibers as they are turned through an included angle of approximately 25°. In the preferred embodiment, the fur brush should be so located relative to the electroplate surface as to cause the fiber separation over the turning edge just prior to and during the time that the brush fibers are contacting the electroplate surface. This is the arrangement shown in FIG. 8.

This embodiment may be summarized as follows: the fur brush, for use in an apparatus for developing electrostatic images on an insulating layer by deposition of electroscopic toner solid particles via an image developing fur brush onto the surface of an electroplate, which is used for storing the latent image thereon, comprises a fur brush material having brush fibers extending outwardly from the base outer surface, where the fur brush material is in turn attached to a carrying means for carrying the bush material to and from a toner depositing station where toner is deposited onto the brush fibers, into contact with the electroplate surface. The carrying means includes a turning edge over which the base inner surface is elastically stretched through an angle sufficient to separate the fibers extending from the base outer surface. In this manner, unmatted fibers carrying toner par-

ticles are presented to the image bearing electroplate surface, resulting in uniform development. Again, as with the prior embodiments, the unmatted fibers would accept toner from a toner feed means in a more uniform manner than would matted fibers. Thus, a dual advantage is obtained of not only presenting unmatted fibers to the electroplate surface for more uniform development, but a more uniform toner pick-up is also achieved.

FIG. 9 shows another preferred embodiment of the "stretched" fur brush, which may be used with the toner feed apparatus of FIG. 8 or other known toner feed mechanisms. FIG. 10 shows a cross-section through AA of FIG. 9, showing individual brush configurations.

Referring to FIG. 9, a series of brushes 100 having individual brush fibers 101 is attached via the brush base inner surface to a blade support means 102. As shown in FIG. 10, the blade support means 102 is inserted into a blade support holder 103. Blade support holder 103 is in turn attached to a turnable shaft 104, which is supported by support means 105 (FIG. 9). The shaft 104 may be rotated by means not shown, but well known in the art.

As shown in FIG. 10, this particular embodiment is capable of carrying eight separate brushes.

In operation, as shaft 104 is rotated, the brushes individually and successively contact the electroplate surface, in the same manner as shown with the prior figures. The use of successive brushes often allows higher speed drum operation, but in any event, allows more uniform delivery of toner over the entire electroplate surface area. The edge angle 106 of the blade support 102 through which the fur brush material must be stretched, as before, depends upon the type of material and depth of pile. Thus the fibers are continually contacting the electroplate in a spaced, separated, unmatted condition, and are inherently maintained in such condition.

Further, while in the embodiment shown the individual brushes are not rotatable, these brushes may be made rotatable, resulting in eight independently rotatable brushes on a central rotatable shaft 104.

Thus, this embodiment is similar to that shown in FIG. 8 except that the carrying means to carry the fur brush material comprises at least one large support or mandrel 102, to which the base inner surface of the fur brush material is attached. The mandrel is of a diameter so that upon attaching the fur brush material, the fur brush material is elastically stretched through an angle sufficient to separate the fibers extending from the base outer surface of the fur brush material. The carrying means may comprise either a single brush, or a series of these mandrels concentrically arranged about a central holding means, such as shaft 104. Further, the individual mandrels are also capable of rotation, if desired.

FIG. 11 shows another embodiment of this invention. In this embodiment, the fur brush material having fibers 110 extending from the base outer surface of the fur brush material is attached to a mandrel 111. The fur brush material is in strip form, and is wound about the mandrel 111 in a helical pattern, as shown in FIG. 13. Again, the mandrel is chosen to be of such a diameter that in attaching the fur brush material to the mandrel, it is elastically stretched through an angle sufficient to cause fiber separation. The use of the helical wrap assures uniform coverage over the electroplate surface while allowing additional spacing between the fiber sets, which further inherently prevents matting between adjacent fiber sets. These fiber sets may be designated as 112, 113, 114, etc.

The mandrel 111 is supported by support means 115, which is in turn attached to a rotatable shaft 116. The shaft is in turn supported by structural members 117. Shaft 116 may be rotated by drive means not shown but well known in the art. The individual mandrels 111 may be in turn rotated via a rotating means 119, known in the art, and not shown in detail.

Referring to FIG. 12, which is the section through AA of FIG. 11, the structure is shown to have eight sets of brushes attached to mandrels, such as 111. As the brushes are rotatable, individually, it is clear that as they rotate they will interfere with each other as shown by the overlapping circle in FIG. 12, representing the outer diameter or circumference of rotation of the brush fibers. This further achieves brush separation. As the toner particles are charged opposite that of the brush fibers, any displacement of toner from this interfering action will only result in transfer of the toner from one brush to another, equalizing itself over a period of time in steady state operation.

Utilizing a toner feed mechanism as shown in conjunction with FIG. 8, or FIG. 3, toner is applied to the brush fibers, and in turn to the electroplate surface. The natural resiliency of the fibers, being stretched through the separating angle over the mandrel, will prevent matting, and present uniform toner deposition to the electroplate surface.

Thus, this embodiment differs from that of FIG. 9 in that the individual mandrels are rotatable, and the fur brush material is in strip form as attached to the mandrel in a helical wrap pattern as shown in FIG. 13. The interfering action will be common to the embodiment of FIGS. 9 and 10 if the individual fur brushes of FIG. 10 were rotatable. Further, it is clear that a series of such units may be utilized, although excellent development is achieved with individual units. The embodiment of FIGS. 9 and 11 clearly present more fiber area to the electroplate surface than the embodiment of FIGS. 8, or 3, 4, and 6. The interfering rotation of the brushes, especially in FIG. 11 allows a constant stirring of the toner into the fur by the individual brushes.

While this invention has been described with reference, for convenience, to the xerographic mode of development, it is clear that this image developing fur brush and separating means, may be utilized in any apparatus for electrostatic development of latent images. While it is generally assumed that the charges upon the toner are negative and the drum and fibers is positive, with the necessary differences of charge, the situation may be reversed for other types of toners and other types of apparatus. Further, the various types of toner feeds known in the art may be utilized beyond those specifically used for illustration above. Natural or synthetic furs may be utilized, synthetic furs generally being less hydroscopic than natural furs, and thus less prone to humidity conditions. Nonetheless, the avoidance of matting in any of the above techniques presents an advantage by simplicity and surety.

What is claimed is:

1. In the method of developing electrostatic images on an insulating layer whereby electroscopic toner solid particles are deposited by use of a toner-carrying image developing fur brush onto the surface of an electroplate having a latent electrostatic image thereon, the improvement comprising the additional step of:

separating the brush fibers on said image developing fur brush to present individual fibers into contact with said electroplate surface by introducing a stream of air into said brush fibers via at least one air separating means to separate said fibers,

whereby essentially individual brush fibers carrying electroscopic toner are presented to said electroplate surface independent of humidity and wear on said image developing fur brush.

2. In the method of developing electrostatic images on an insulating layer whereby electroscopic toner solid particles are deposited by use of a toner-carrying image developing fur brush onto the surface of an electroplate having a latent electrostatic image thereon, the improvement comprising the additional step of:

separating the brush fibers on said image developing fur brush to present individual fibers into contact

with said electroplate surface by carrying about a carrying means a fur brush material having a base inner surface and a base outer surface, said fur brush material having brush fibers extending outwardly from said base outer surface, to and from a toner depositing station where toner is deposited onto said brush fibers and into contact with said electroplate surface, said carrying means including a turning edge over which said base inner surface is elastically stretched through an angle sufficient to separate said fibers extending from said base outer surface,

whereby essentially individual brush fibers carrying electroscopic toner are presented to said electroplate surface independent of humidity and wear on said image developing fur brush.

3. The method of claim 2 including locating said turning edge relative to said electroplate surface so as to cause fiber separation just prior to said brush fibers contacting said electroplate surface.

4. In the method of developing electrostatic images on an insulating layer whereby electroscopic toner solid particles are deposited by use of a toner-carrying image developing fur brush onto the surface of an electroplate having a latent electrostatic image thereon, the improvement comprising the additional step of:

separating the brush fibers on said image developing fur brush to present individual fibers into contact with said electroplate surface by carrying about a carrying means a fur brush material having a base inner surface and a base outer surface, said fur brush material having brush fibers extending outwardly from said base outer surface, to and from a toner depositing station where toner is deposited onto said brush fibers and into contact with said electroplate surface, said carrying means comprising at least one mandrel to which said abse inner surface of said fur brush material is attached, said mandrel of a diameter to

elastically stretch said fur brush material through an angle sufficient to separate said fibers extending from said base outer surface,

whereby essentially individual brush fibers carrying electroscopic toner are presented to said electroplate surface independent of humidity and wear on said image developing fur brush.

5. The method of claim 4 including concentrically arranging a series of said mandrels of said carrying means about a central holding means.

6. The method of claim 5 including rotating via rotating means said holding means so as to bring brush fibers of successive carrying means into contact with said electroplate surface.

7. The method of claim 4 including wrapping said fur brush material in strip form to said mandrel in a helical wrap pattern.

8. The method of claim 4 including rotating said mandrel about its own axis.

9. The method of claim 8 including radially locating a series of mandrels on said carrying means to cause interfering movement between brush fibers of adjacent mandrels.

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