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Sato

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[54] **ELECTROPHOTOGRAPHIC CHARGING METHOD**

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[73] Assignee: **Rank Xerox, Ltd.**, London, England

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[52] **U.S. Cl.** ..... **96/1 R**; 96/1 C; 250/324; 317/262 A; 355/17

[51] **Int. Cl.** **G03g**

[58] **Field of Search** ..... 355/3, 17; 250/324, 325, 250/326; 96/1 R, 1 C; 317/262 A

[56] **References Cited**

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3,730,709	5/1973	Kinoshita et al.	355/17

Primary Examiner—Richard M. Sheer

[57] **ABSTRACT**

A method of charging an electrophotographic surface which comprises charging a boundary portion of the surface with a greater electrostatic charge than that portion of the surface which is to be exposed and developed to form an image. The high boundary charge minimizes or eliminates the deposition of toner in image highlight and background areas in the image portion of the electrophotographic surface.

7 Claims, 5 Drawing Figures

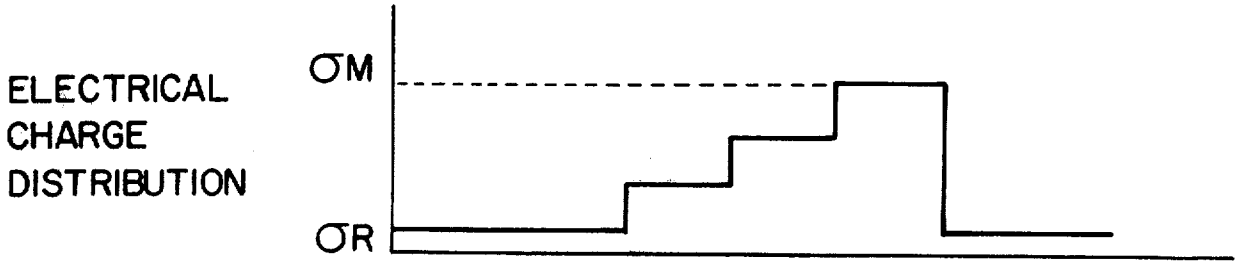


FIG. 1

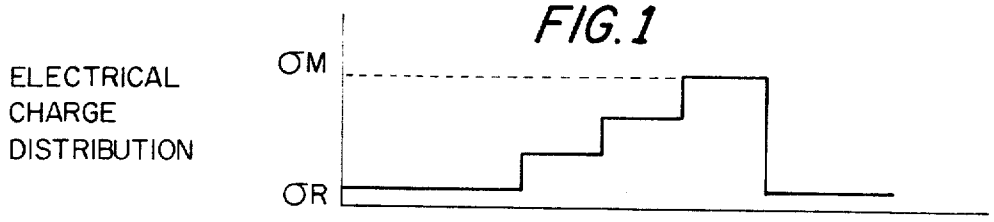


FIG. 2

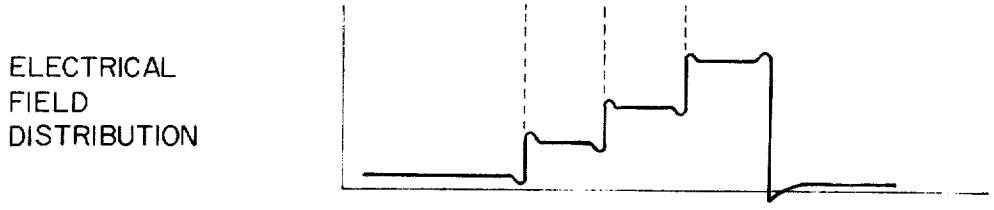


FIG. 3

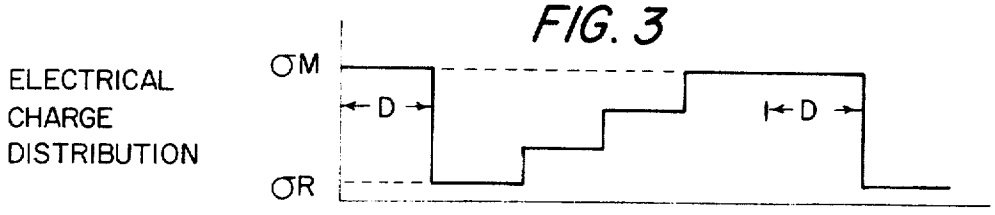


FIG. 4

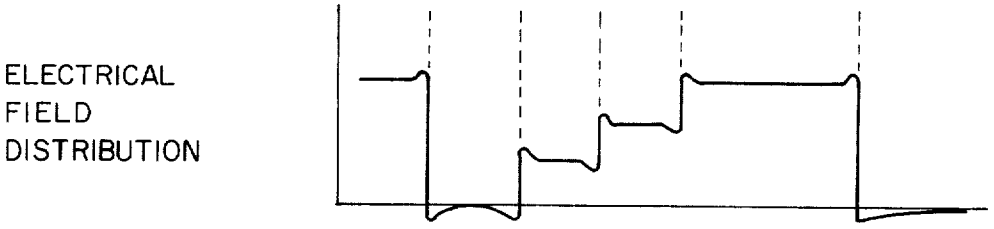
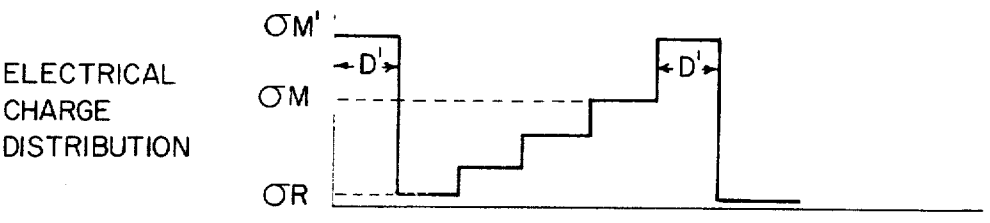


FIG. 5



ELECTROPHOTOGRAPHIC CHARGING METHOD

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to an electrostatic method of producing an image substantially free from background and highlight fog. More particularly, the present invention is directed to a method of charging an electrophotographic surface wherein at least a portion of the edge or boundary of said surface is supplied with a greater charge than the image portion of said surface.

In one conventional electrophotographic process, a photoreceptor in the form of a sheet of paper or the like having a photoconductive coating on one surface, is first electrostatically charged over said surface to a substantially uniform and predetermined potential. The charged surface is then exposed to a light image, causing the charge to be dissipated or discharged in the light struck areas in accordance with the light intensity. The resultant latent image may then be developed by immersing the sheet in a liquid developer comprising an electrically insulating vehicle carrying a suspension of fine toner particles. The toner particles deposit on the surface of the sheet in a density corresponding to the latent image charge pattern. Because the fully exposed portions of the photoconductive layer normally retain some residual charge, some toner deposits on the highlight and background areas of the image, resulting in a certain level of background fog. This fog is particularly undersirable in continuous tone images where photographic quality is desired. The purpose of the present invention is to minimize or eliminate this background and highlight fog.

Basically, the present invention accomplishes the foregoing objective by means of a particular charging method. A procedure described in Japanese Patent Publication No. 6387/1969 provides for uniformly charging the photoreceptor element, and then exposing the photoreceptor to a light image in a central area, while preserving the full charge in a border area of the photoreceptor. The effect of the fully charged border is to lower the electric field of the residual charge on the fully exposed portions of the latent image to essentially a zero value, thereby substantially eliminating any fog development in those areas. However, for effective operation, it is found that the fully charged border area must be at least about 25 percent of the area of the image portion. This is therefore excessively wasteful of both photoreceptor and toner, since the charged border develops to maximum density. The present invention embodies an improvement over the foregoing method. It is discovered that if the border portion is charged to a higher potential than that of the initial charge applied over the image area, background and highlight fog can be substantially eliminated with a substantially reduced area for the border portion, effecting a corresponding saving in photoreceptor and toner. It has been found that effective results can be obtained in the practice of the present invention utilizing a border area of only 10 percent of the image area. Even smaller border areas are effective with photoreceptors and operational conditions that will retain very large charge potentials in the border areas.

It is therefore one object of the present invention to provide an electrophotographic image that is substantially free of background and highlight fog.

Another object of the present invention is to provide an electrophotographic image substantially free of background and highlight fog by charging a non-image portion of the photoreceptor surface to an electrostatic charge potential substantially greater than the maximum charge potential of the image portion of the photoreceptor.

Other objects and advantages of the present invention will become apparent from the detailed descrition given hereinafter. It should be understood, however, that the detailed description, while indicating preferred embodiments of the invention, is given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description the invention presented hereinbelow is in conjunction with the accompanying drawings, wherein:

FIG. 1 is a graph illustrating an electrical charge distribution for an electrostatic latent image pursuant to conventional electrophotographic techniques;

FIG. 2 is a graph illustrating the electrical field distribution obtained from the charge distribution of FIG. 1;

FIG. 3 is a graph illustrating an electrical charge distribution of an electrostatic latent image wherein a charged and unexposed border portion having a width D is maintained at the periphery of the image area, and has the same electrostatic charge potential as the unexposed portions of the image area;

FIG. 4 is a graph illustrating the electrical field distribution obtained from the charge distribution of FIG. 3; and

FIG. 5 is a graph illustrating the electrical charge distribution of an electrostatic latent image obtained in accordance with the present invention, and wherein an unexposed border portion having a width D′ is maintained at the periphery of the image area, and said border portion has an electrostatic charge potential higher than that of the unexposed portions of the image area.

DETAILED DESCRIPTION

Referring to the drawings, in these graphical representations the ordinates depict electrostatic charge or field potential, and the abscissas depict a linear spatial section along the photoreceptor carring the charge. The stepwise pattern displayed in the graphs therefore denote varying latent image charge densities, or the inversely related intensity of light applied to the photoreceptor from the image exposure. The ordinate value σ M represents the initial electrostatic charge applied to the photoreceptor as well as maximum density image areas, and the ordinate value σ R represents the residual charge on the photoreceptor in image highlight or background areas.

FIG. 1 depicts the electrical charge distribution on a photoreceptor that had been uniformly charged to the value σ M, and then exposed to a four step light intensity image. FIG. 2 shows the electric field produced by the charge pattern of FIG. 1. It will be observed that there is a residual field in the highlight or background area corresponding to the residual charge value σ R. Therefore, when this image is developed, some toner deposits in the highlight and background areas as fog.

FIG. 3 shows an electrostatic charge distribution pattern wherein a photoreceptor is first charged to a uni-

form value σ M, and then a central image area is exposed to the light image while a border area D is masked from light. The border area D therefore retains the original charge σ M. The resultant electrical field is shown in FIG. 4. Because of the peripheral charged areas D, the residual charge σ R in the highlight and background areas produces substantially zero, or a slightly negative electrical field, as shown in FIG. 4. Therefore, when this image is developed, substantially no toner is deposited in the highlight and background areas. However, as explained above, to obtain this effect the border area D must be at least about 25 percent of the image area that it surrounds.

FIG. 5 depicts a charge pattern embodying the present invention. In this instance the image area is again surrounded by a charged unexposed border D', except the border is substantially smaller than that of FIG. 3, and may be as small as 10 percent of the image area, or less. At the same time, the electrostatic charge potential σ M' is significantly higher than that in FIG. 3. In this case the image area of the photoreceptor is charged to a uniform value of σ M, and the surrounding border area is charged to a much higher value σ M'. The image area is then exposed to a light image while the border area D' is masked, and thus the border area charge is greater than the charge in the maximum density portions of the image area. As a result, it is found that residual charge σ R in the highlight and background portions of the image produces a zero or slightly negative electrical field similar to that shown in FIG. 4. When this image is developed, the highlight and background areas of the image do not attract toner, and the resultant developed image is substantially free of fog in those areas. Thus it will be appreciated that by using a higher level of charge in the border areas, a smaller proportion of the photoreceptor surface is needed for the border.

The area D' is hereinabove designated a border area, indicating that it completely surrounds the periphery of the image area. This is not always necessary, and when desired the area D' may constitute only a portional of the border, as for example two opposite edge portions of the photoreceptor.

In charging the surface of the electrophotographic sheet according to the present invention, the image area of the photoreceptor can be first masked or shielded by a cover plate, while its border portions D' are charged to the level σ M'. The entire surface can then be exposed to a uniform charging source to bring the image area to the value σ M. This produces an electrophotographic sheet where the peripheral or border portions D are charged to a higher potential than the image area. Alternatively, the entire photoreceptor surface may be first uniformly charged to the value σ M, and then the portion corresponding to the image area can be shielded while the peripheral or border portions D are subjected to a greater charge σ M'. The photoreceptor can then be exposed to a light image in the image area, and developed in the usual manner.

The invention being thus described, it will be obvious to one skilled in the art that the same may be varied in many ways. Such variations are not to be regarded as departures from the spirit and scope of the invention, and all modifications as are embraced by the appended claims are contemplated as within the purview of the present invention.

What is claimed is:

1. In an electrophotographic method of forming an image substantially free of background and highlight fog, wherein an electrostatic charge is applied to a photoreceptor surface, an image area of said charged surface is exposed to a light image to form a latent electrostatic image, and said exposed surface is then developed, the improvement which comprises charging a portion of said surface outside of said image area with an electrostatic charge greater than the first-mentioned charge, and retaining the second-mentioned charge on said surface through at least a portion of the development.

2. In the method as set forth in claim 1, said portion comprising a border area around the entire periphery of the image area.

3. In the method as set forth in claim 1, said portion comprising at least a pair of opposite edge border areas of said image area.

4. In the method as set forth in claim 1, said portion of said surface is first charged with said second-mentioned charge, and then the entire surface is exposed to said first-mentioned charge.

5. In the method as set forth in claim 4, the image area of said surface is shielded while said portion of said surface is charged with said second-mentioned charge.

6. In the method as set forth in claim 1, the first-mentioned charge is first applied to said surface and then said second-mentioned charge is applied to said portion of said surface.

7. In the method as set forth in claim 6, the image area of said surface is shielded while said second-mentioned charge is applied to said portion of said surface.

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