Method of making color images.

Method of making color images wherein a preselected density (Dmax) is obtained by controlling the apparent surface voltage level initially established on the photoconductive surface of an electrophotographic member or other photoconductive member and varying the obtainable Dmax to obtain fine adjustment by selectively varying grossly varying the apparent surface voltage. The apparent surface voltage level is determined by the corona output level of a corona generating device that is used to charge the photoconductive surface.

**FIG. 1**
This invention relates generally to method of making color images, and more particularly obtaining a preselected optical density (Dmax) by controlling the apparent surface voltage level on the photoconductive surface of an electrophotographic member or other photoconductive member and allowing for fine Dmax adjustments with a relatively course adjustment of the apparent surface voltage and without consideration of any tonal degradation, the Dmax factor requirements varying with different color toners and different photoconductors.

In an electrophotographic imaging process, preferable but not mandatory is the use of an electrophotographic member described in the U.S. Patent 4,025,339 or the U.S. 4,269,919. This member has high speed and high resolution capability.

Electrophotographic color imaging involves the charging of the photoconductive surface of an electrophotographic member to an apparent surface voltage employing a corona generating device to apply said predetermined charge to said surface. The charged surface is exposed to radiant energy projected through a color separation transparency whereby a latent electrostatic image is formed on the photoconductive surface. A particular toner is applied to that latent electrostatic image to render the same visible.

Each of the different color toners which may be employed in producing a color image has individual, non-linear characteristics especially in the higher density portions which are particular to the toner establishing a relationship between the density gradation and the apparent surface voltage.
established on the photoconductive surface. The invention uses this relationship for the different toners employed to obtain and vary the desired density. The desired Dmax density varies with each of the different color toners which may be employed.

Heretofore, in the attempt to obtain the desired Dmax density of the color image produced, one would vary either the exposure intensity or the duration or both. However, it was not possible to obtain consistent and repeatable results in the desired Dmax density.

The advantages desired are to reduce the variables to be achieved in the process, to obtain consistent and repeatable imaging results.

Accordingly, the invention provides a method of incrementally varying the color Dmax of each toner image to a valve particularly corresponding to each color toner employed by selectively varying the apparent surface voltage applied to the photoconductive surface.

The preferred embodiments of this invention now will be described, by way of example, with reference to the drawings accompanying this specification in which:
FIGURE 1 is a diagram illustrating the process of making color images according to the invention and
FIGURE 2 is a chart illustrating the apparent surface voltage density relationships for different toners.

The invention herein provides a method of making color images, wherein a preselected Dmax density is obtained by coarsely controlling the apparent surface voltage level (ASV) on the photoconductive surface of an electrophotographic member.

Referring to Figure 1, there is diagrammatically illustrated the process of making color images according to the invention. A photoconductive member 10 having a downwardly facing photoconductive surface 12 is mounted on a carriage 14. In step 1, the carriage 14 is located at a home position over the exposure station. A corona generating device 16 is provided adjacent the copyboard 20. A source of radiant energy 18 is disposed beneath the copyboard 20. A color separation transparency 22 is mounted on the copyboard 20. An apparent surface voltage (ASV) sensor 24 is provided adjacent to the corona generating device 16. The other functional stations include a toning station 26 and an image transfer station 28. The carriage 14 moves in a predetermined path and the photoconductive surface 12 is transported to and past the functional stations.

Step 2 of Figure 1 illustrates the photoconductive surface being transported over the corona generating device 16 and ASV sensor 24. A measurement signal 25 is provided from the ASV sensor 24 to a control unit 30. Feedback control responsive to the measurement signal 25 from the ASV sensor 24 and the operator input
corresponding to the desired density are provided to the
corona generating device 16.

The control unit 30 can be provided for manual
or automatic operation. The control unit 30 will be
generally described hereinafter.

Referring now to Figure 2, a chart illustrating
the general relationship between the level of the apparent
surface voltage for one color toner, say, cyan. Generally,
in a color imaging process, four toners having the colors
of yellow, magenta, cyan and black are employed to form
the composite color image. Each of the color toners has
a separate curve corresponding to density in relation to
the apparent surface voltage established on the photo-
conductive surface 12. Additionally, a toner of one color
and hue can be provided separately with varying density
ranges, as illustrated in Figure 2 with three curves, in
order to provide the desired density requirements of
the user.

Step 3 of Figure 1 illustrates the photoconductive
member 10 returned to the home position over the exposure
station. The photoconductive surface 12 is provided in
intimate contact engagement with the color separation
transparency 22 that is mounted on the copyboard 20. The
photoconductive surface 12 is exposed to a predetermined
intensity of radiant energy from source 18 through the
color separation transparency 22 for a fixed period of time.
A latent electrostatic charge image is thereby formed on
the photoconductive surface 12 corresponding to the image
carried by the color separation transparency 22.
Step 4 of Figure 1 illustrates the photoconductive surface 12 being transported over the toning station 26. The latent electrostatic image carried by the photoconductive surface 12 is developed or toned with a toner of the proper color. A selected one of the toning units is energized causing a selected color toner to be applied to the photoconductive surface 12 causing the selected color toner particles to be deposited whereby the latent electrostatic image is rendered visible.

Step 5 of Figure 1 illustrates the photoconductive surface 12 carrying the toner image thereon disposed over the transfer station 28. The toner image is transferred to a receptor member.

The color separation transparency 22 for the next color cycle is installed and the process, Steps 1 through 5, is repeated with the different transparency 22 and corresponding toner color. The process is repeated for each of four transparencies and toner colors to produce the composite color proof.

The method of the invention provides for the fine adjustment of the density by controlling the level of the apparent surface voltage established on the photoconductive surface 12. The ASV is established on the photoconductive surface 12 by translating the surface 12 in close proximity to the corona generating device 16. The corona generating device 16 produces a corona discharge field or output level proportional to high voltage from a high voltage power supply applied to the corona generating device 16. The ASV sensor 24 can be an electrometer that measures the ASV or charge level on the photoconductive
surface and provides a measurement signal which is proportional to the signal 25 which is proportional to the ASV level.

The control unit 30 includes programmable memory capable of storing the non-linear characteristics for each of the color toners employed relating the density gradation relative to changes in the apparent surface voltage of the photoconductive surface 12. The control unit 30 is provided with the measurement signal 25 from the ASV sensor 24. The operator provides an input corresponding to the desired or selected density for the particular color toner. The control unit 30 determines the ASV level required from the desired density input and the characteristics of the particular color toner that are stored in the memory thereof. The control unit compares the measurement signal 25 with the predetermined ASV level and deactivates the corona generating device 16 when the measured signal 25 equals the predetermined ASV level.

The operator uses a densitometer and measures the optical density of the color desired to be produced in the color image for each of the color toners. This densitometer measurement comprises the operator input corresponding to the desired or selected density for the particular color toner.

The method herein is applicable for production of images wherein only a black toner is employed.
CLAIMS:

1. In an electrophotographic color imaging process wherein the photoconductive surface of an electrophotographic member is charged by a corona generator to a predetermined apparent surface voltage corresponding to a selected optical density, exposed to an image pattern forming a latent image thereof, and toned with a color toner having a particular color density characteristic, characterized by incrementally varying the maximum color density (Dmax) of each toner image to a value particularly corresponding to each color toner employed by selectively varying the apparent surface voltage applied to the photoconductive surface.

2. The method according to claim 1 characterized in that a substantially greater degree of change in the apparent surface voltage is effected to provide an incremental change in maximum color density (Dmax) for any selected color toner.
## DOCUMENTS CONSIDERED TO BE RELEVANT

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<tr>
<th>Category</th>
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The present search report has been drawn up for all claims.

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**CATEGORY OF CITED DOCUMENTS**

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**EXAMINER**

SCHAFFER

**VIENNA**

22-12-1983