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Estandarte

[11] **3,819,262**

[45] **June 25, 1974**

[54] **CLEANING MEANS FOR AN OVERCOATED PHOTOCONDUCTIVE SURFACE**

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[73] Assignee: **SCM Corporation,** New York, N.Y.

[22] Filed: **July 13, 1972**

[21] Appl. No.: **271,504**

[52] **U.S. Cl.** **355/15,** 15/1.5, 96/1.4

[51] **Int. Cl.** **G03b 15/00**

[58] **Field of Search** 355/15; 96/1.4; 15/1.5

[56] **References Cited**

UNITED STATES PATENTS

3,355,289	11/1967	Hall et al.	96/1.4
3,438,706	4/1969	Tanaka et al.	96/1.4
3,637,306	1/1972	Cooper	355/15

OTHER PUBLICATIONS

"Nonoptical Electrostatic Reproduction" by Y. Moradzadeh et al., IBM Technical Bull., Vol. 8, No. 4, September, 1965, pg. 491–492.

"Reduction of Toner–Filming in Electrophotography" by N. Crooks et al., IBM Technical Bull., Vol. 12, No. 12, May, 1970, pg. 2,094.

"Removal of Electrostatic Images by Coronas" by T. F. Ceicel, IBM Tech. Bull. Vol. 12, No. 12, May 1970, pg. 2,116.

"Discharge of Unwanted Potentials on Photoconductive Insulating Plates and Dielectric Surfaces" by F. A. Hawn, IBM Tech. Bull., Vol. 12, No. 12, May, 1970, pg. 2,277.

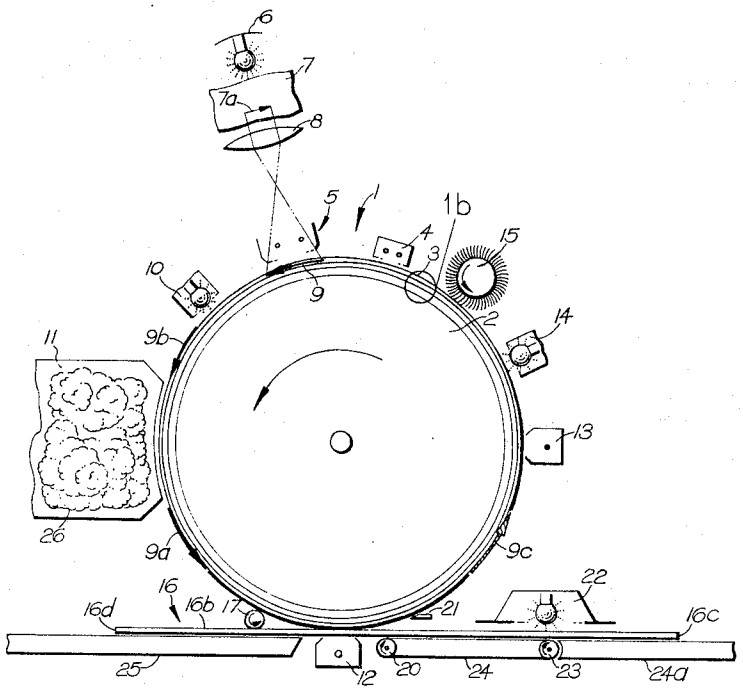
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Attorney, Agent, or Firm—Armand G. Guibert; Milton M. Wolson

[57] **ABSTRACT**

An electrophotographic apparatus and process incorporating an overcoated photoconductor element, an erasing light being utilized after transfer of the toned image to copy paper. The erasing light is used for improvement of image quality by the elimination of image ghosting and edging effect.

3 Claims, 2 Drawing Figures



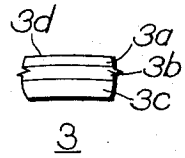

3d
3a
3b
3c
3

Fig-1b

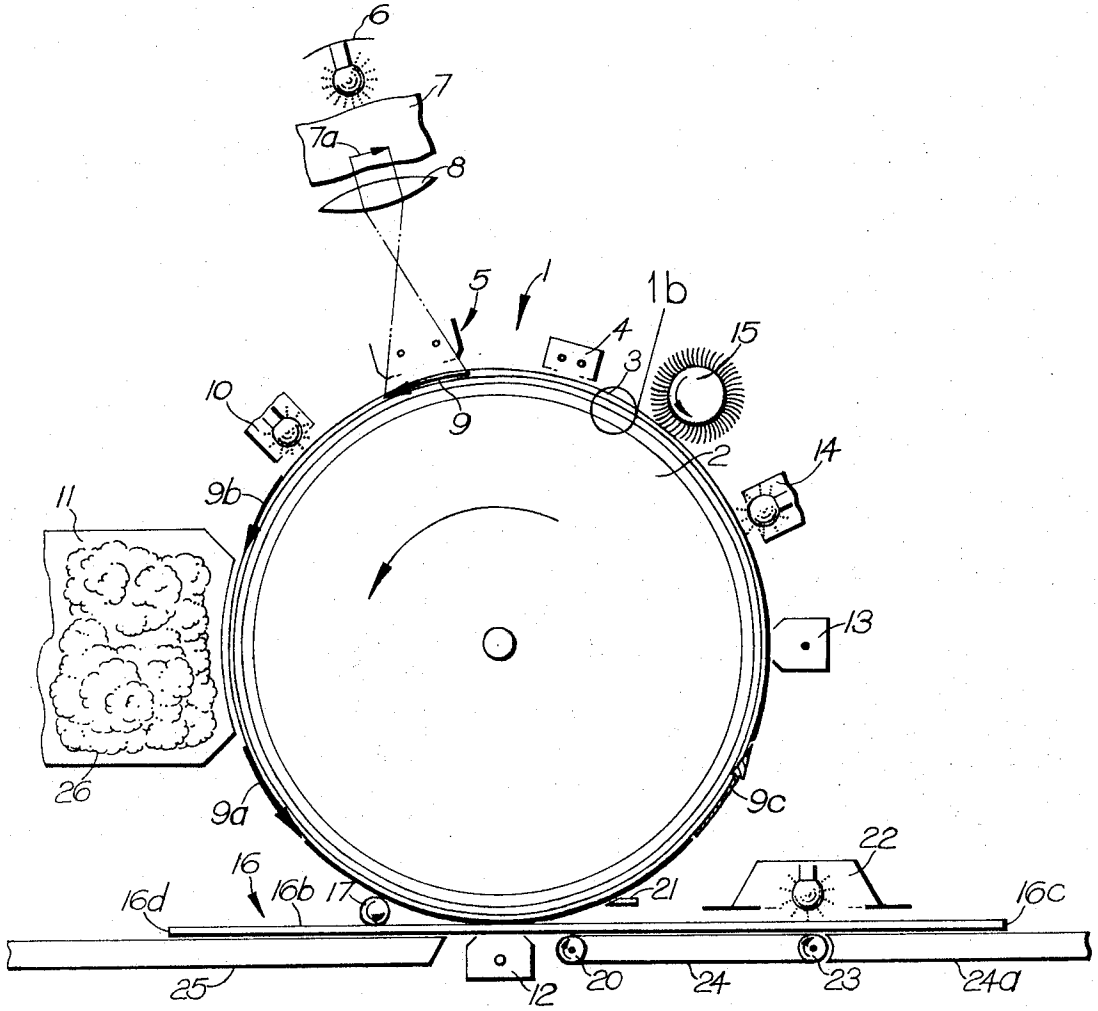

6
7
7a
8
5
1
1b
4
3
15
10
9
2
14
11
9b
13
26
9a
9c
22
16
16d
16b
17
21
16c
25
12
20
24
23
24a

Fig-1a

CLEANING MEANS FOR AN OVERCOATED PHOTOCONDUCTIVE SURFACE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to electrophotographic processes, and more particularly to methods of obtaining clean background areas (sometimes referred to as obviating "image ghosting") and uniform fill of latent image areas (also referred to as elimination of "edging effect") on an overcoated photoconductor element and ultimately on the developed image on the copy page. The improvement is applicable to such systems using either dry or wet development techniques well known in the art.

2. Description of the Prior Art

The edging effect problem has previously been solved by use of development electrodes and/or screening techniques as discussed on pages 274–279 of "Xerography and Related Processes," edited by John H. Desauer and Harold E. Clark, The Focal Press, London and New York, 1965, but these have certain disadvantages such as reduction of exposure latitude. The solution to the image ghosting problem has been traditionally attempted by use of a discharge lamp and rotating brushes for cleaning the toned image from the drum as described on pages 470, 503 of the above-mentioned publication. Though illumination completely dissipates charges on selenium photoconductors, it does not have this effect with overcoated photoconductors, as is known (page 458 of the above-mentioned publication). A discharging or erasing corona alone has been used to solve image ghosting problems with overcoated photoconductor elements as disclosed in the Japanese Patent Gazette, Nov. 17, 1967, Patent Publication No. 23910/1967, entitled "Electrophotographic Process" and invented by Tanaka et al., but this alone has not been completely satisfactory.

Accordingly, there is a need in the art for a simple apparatus and method of eliminating both image ghosting and edging effect on electrographic copies made with systems based on overcoated photoconductor elements, and thus to improve the image quality therein.

BRIEF SUMMARY OF THE INVENTION

An object of the invention is a simple method and apparatus of the overcoated photoconductor type for producing electrographic copies in which both image ghosting and edging effects are eliminated, thus producing images of greatly improved quality.

A further object is to provide an improved method of cleaning the surface of an overcoated photoconductor element.

The invention concept resides in an electrophotographic apparatus having an overcoated photoconductor element; means depositing a layer of charged particles on a surface of the photoconductor element; means for exposing the charged surface to a light image; means for toning the exposed surface; a copy sheet; means bringing the copy sheet into momentary contact with the toned surface; and means transferring the image from the toned surface to the copy sheet, in combination with a light source illuminating the toned surface subsequent to transfer of the image.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be described with reference to the drawing, in which:

FIG. **1***a* shows the apparatus according to the invention including production of a latent image on an overcoated photoconductor element, toning of the latent image, transfer of the toned image to a suitable copy paper, and finally the neutralization of the electrostatic charges of the latent image by means including an erasing light; and

FIG. **1***b* shows a cross section of a photoconductor element of FIG. **1***a*.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The electrophotographic process presented herein can be used with either dry toner or wet toner. For purposes of illustration, I will show only how the dry toning technique will apply to this invention. FIG. **1***a* shows an electrophotographic apparatus using an appropriate dry toning technique to produce an image on a copy sheet **16** fed along a drum **2.** The electrophotographic process deposits a latent image **9** on an overcoated photoconductor element **3** formed on the surface of drum **2.** Photoconductor element **3** used in this invention (better shown in FIG. **1***b*) is comprised of a conducting support **3***c*, a photoconductor layer **3***b*, and an insulating layer or "overcoat" **3***a*. Such elements are known in the art (U.S. Pat. No. 3,457,070, for instance). Prior to formation of latent image **9,** element **3** is given a uniform surface charge by subjecting it to a discharge from a corona source **4** (well known in the art), element **3** being maintained in the dark. Although not critical at this point, element **3** must be illuminated only when so indicated in the description, as will be evident. A subsequent charging and exposing sequence, described below in detail, results in formation of latent image **9** — actually an electrostatic charge pattern **9***b* — on outer surface **3***d* of photoconductor element **3** (see FIG. **1***b*). Latent image **9** is later developed by applying an appropriate toner material to charged surface **3***d* and the toned image **9***a* then transferred to a sheet of copy paper **16,** which may be plain or bond paper. The residual pattern remaining on surface **3***d* is then removed by action of an erasing corona **13,** a mechanical brush **15** and, according to the invention, an erasing light **14,** as will be described.

Referring still to FIG. **1***a*, corona charging source **4** is employed to apply a uniform precharge in the positive or in the negative to surface **3***d* of photoconductor element **3.** For purposes of this description, however, corona charge unit **4** will be assumed to apply positive charges. Photoconductor element **3,** shown in FIG. **1***b*, may be comprised, for example, of a top insulator **3***a* made of Mylar (T.M.), which also acts as a protective coating, a photoconductor material **3***b* made of cadmium sulfide held in a binder such as cellulose acetate, and a conductive backing **3***c* such as metal foil for allowing uniform distribution of charges. Other structures for photoconductor element **3** may be found in previously-mentioned U.S. Pat. No. 3,457,070.

Next, an original pattern **7***a* is projected through lens **8** and a transparent imaging corona source **5.** Simultaneously, a negative corona discharge from corona source **5** (polarity opposite to that of corona unit **4**) is applied on the surface **3***d* of precharged insulating layer

3a. A preliminary, medium contrast latent image 9 of original pattern 7a is then obtained by virtue of changes in the surface potentials in accordance with the light and dark areas of original pattern 7a, the amount of discharge being controlled by the time and intensity of the discharge from corona source 5 alone in the light areas. In the dark areas, these factors together with the strength of the trapped negative charge in the photoconductor layer 3b at or near its border with insulating layer 3a determine the amount of decrease in the precharge. The discharge in the dark areas is thus less than in light areas because the photoconductor layer 3b under the latter areas becomes conductive and allows the previously trapped negative charges to flow out to conductive backing 3c. Contrastingly, layer 3b under the dark areas remains nonconductive and the trapped negative charges cannot flow out, preventing much dissipation of the positive precharge in dark areas of surface 3d. Note further, that after exposure to pattern 7a, trapped negative charges in the dark areas significantly reduce the surface potential in such areas because of contribution by these charges to the external field.

Then, surface 3d of insulating layer 3a is uniformly illuminated by light source 10, and thereby a reversed, high contrast latent image 9b of the original pattern 7a is formed on surface 3d of insulating layer 3a. The reason for the reversal and charge pattern intensification ("contrast amplification"), as theorized in the previously-referenced Japanese Gazette Publication, is that further exposure to light does not result in a great change in surface potential in the areas of surface 3d which were previously exposed to light from pattern 7a, but the same is not true for those areas which were then dark. In this latter case, the previously trapped negative charges flow out to the conductive backing 3c since photoconductor layer 3b now shows a low resistivity because of illumination by post-flooding light source 10. The related positive charges on outer surface 3d, unaffected by the light, will hold only a few of the negative charges near the border with insulating layer 3a and the field exerted by the outer surface charges will be predominant such that the surface potential of the dark areas increases markedly and to a value considerably greater than that of the light areas.

Latent image 9b is then developed in station 11 by known techniques such as either aerosol or magnetic brush toning. The developer is mainly composed of charged colored particles, as is known, attracted towards the latent image to form a visible image 9a.

The developed image 9a is next brought into contact with sheet 16 for purposes of transferring the image. In this respect, note that light source 6 is timed to come on in relation to the feeding of copy sheet 16 such that once a toned or developed image 9a has been obtained, it will make contact with paper 16 in time to locate the image on paper 16 in proper reference to leading edge 16c. Similarly, light 6 must go off when the trailing edge 16d of paper 16 passes a certain point. Though not shown, such photographic projection control techniques are well known in the art, examples being found in U.S. Pat. Nos. 3,343,450 and 3,345,925. Sheet 16 is fed on a platform 25 which guides paper 16 to a pick-up roller 17, driving sheet 16 such that it makes contact with and is attracted to charged photoconductor element 3 on drum 2. As sheet 16 moves along in contact with drum 2, the developed image 9a is transferred to sheet 16 by means of a transfer corona source 11 which sprays positive charges (opposite in polarity to that of toner particles 26 onto the back 16a of sheet 16 thus pulling toner particles 26 from photoconductor surface 3d towards surface 16b of transfer sheet 16. After the toner transfer, sheet 16 is separated from drum 2 by, say, an air blade 21 and then leading edge 16c is caught by a vacuum conveyor 24, thus moving sheet 16 towards a fusing station 22 upon clockwise rotation of drive rollers 20,23. Since dry toner has been utilized in the embodiment described, fusing of the image can be done simply by an infrared light source or other known fixing device. Once the image is fused, sheet 16 is sent out of the machine via an exit platform 24a.

As drum 2 continues its counterclockwise rotation, the residual image 9c on photoconductor element 3 passes a station containing a DC or an AC erasing corona 13, which will actively neutralize the residual charge pattern of image 9c on surface 3d by spraying a negative charge toward that surface. If any part of the system is at less than optimum efficiency, however, uniformity of large image areas (dark areas) and cleanliness of background areas (light areas) on paper 16 will remain significantly good because of the presence of an erasing light 14, which uniformly illuminates the entire area of photoconductor element 3 previously exposed to corona source 13. This illumination by an erasing light 14 effectively places the entire area at a neutral energy state by allowing trapped charges in the border area between photoconductor layer 3b and insulating layer 3a to flow out to conductive backing layer 3c. The effect of the negative charge from erasing corona 13 as modified by illumination from erasing light 14 is that any residual electrostatic charge pattern on photoconductor element 3 will be neutralized. This eliminates image ghosting and edging effect and improves image quality.

To insure that dark toner particles will not build up undesirably on photoconductor element 3, it is passed through a cleaning station containing a brush 15 having a counter-rotating motion along the surface of drum 2. In the electrophotographic process using a dry toning technique, the material of brush 15 could be of a soft animal fur material.

In summary, I have described herein an electrophotographic apparatus and method with which images of improved quality are achieved with photoconductor elements of the overcoated type. In this apparatus, an appropriate dry toner is applied to an image generated on an overcoated photoconductor element 3 formed on a drum 2, and transfer of toned image 9a to either a plain or bond paper sheet 16 is accomplished by a transfer corona 12. After image transfer is completed, the residual image on photoconductor element 3 is then neutralized or effectively eliminated by use of an erasing light 14 with improvement in image quality by cleanliness of the background area and uniformity of shade tone in large image-fill areas.

While a particular embodiment of the invention has been shown and described, modifications such as omission of post-flooding light 10 or erasing corona 13 or cleaning brush 15 are envisioned, and it is intended in the claims to cover all such modifications which fall within the spirit and scope of the invention.

What is claimed is:

1. An electrophotographic apparatus having an overcoated photoconductor element; means depositing a layer of charges on a surface of the photoconductor el-

ement, said deposited charges having a first polarity; means exposing said charged surface to a light image comprising a transparent corona source spraying on said charged surface charges of a polarity opposite to said deposited charges and means for projecting a light image through said transparent corona source simultaneously with said spraying of oppositely polarized charges thereby producing a preliminary latent image, and a light source for uniformly illuminating said medium contrast latent image to thereby obtain a final, higher contrast latent image; means applying a toner to said exposed surface; a copy sheet; means for bringing said copy sheet into momentary contact with the toned surface; and means transferring the image from said toned surface to said copy sheet; in combination with a further light source illuminating the toned surface subsequent to transfer of the image and an erasing corona source spraying charges of a polarity opposite to said deposited charges on said toned surface subsequent to transfer of said image.

2. Apparatus as defined in claim **1,** wherein said toned surface is on the periphery of a drum having a particular direction of rotation and said source of erasing corona appears prior to said further light source in said direction of rotation.

3. Apparatus as defined in claim **2,** further including means contacting said toned surface and operating to remove physically the residue of said toner subsequent to said transfer, said residue removing means appearing after said further light source in said direction of rotation.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,819,262 Dated June 25, 1974

Inventor(s) Adolfo Umadhay Estandarte

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 60, after "of", delete "post-flooding light 10 or erasing corona 13 or"

Column 6, line 4, after "image", insert -- and prior to illumination by said further light source --

Delete lines 5-9 (Claim 2)

line 10, change "3" to -- 2 -- and "2" to -- 1 --

Signed and sealed this 7th day of January 1975.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.

UNITED STATES PATENT OFFICE

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.