

[54] **METHOD AND APPARATUS FOR ELECTROPHOTOGRAPHY**

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Related U.S. Application Data

[62] Division of Ser. No. 108,733, Jan. 22, 1971, Pat. No. 3,730,709.

[52] U.S. Cl. **355/3, 96/1 A, 117/17.5, 250/325, 340/173 PP**

[51] Int. Cl. **G03g 15/00**

[58] Field of Search **355/3, 17; 96/1 R, 1.3, 96/1.4, 1.5, 1 A; 117/17.5; 250/324, 325, 326; 340/173 PP**

[56] **References Cited**

UNITED STATES PATENTS

3,609,031 9/1971 Kinoshita 355/17
3,615,395 10/1971 Yamajii et al. 96/1.4

Primary Examiner—Robert P. Greiner

Attorney, Agent, or Firm—Bosworth, Sessions & McCoy

[57] **ABSTRACT**

In a method of electrophotography comprising the steps of applying a first electric field across a photosensitive element including a photoconductive layer manifesting persisting internal polarization and a highly insulative layer integrally bonded to one side of the photoconductive layer for depositing a charge of one polarity on the surface of the highly insulative layer, and applying a second electric field across the photosensitive element for depositing a charge of the opposite polarity concurrently with projection of a light image upon the photoconductive layer whereby to form a latent image on the surface of the highly insulative layer corresponding to the light image, a third electric field is applied across the photosensitive element for depositing a charge of the same polarity as the charge deposited by the second electric field for improving the contrast and then the latent image is developed to provide a visible image.

6 Claims, 7 Drawing Figures

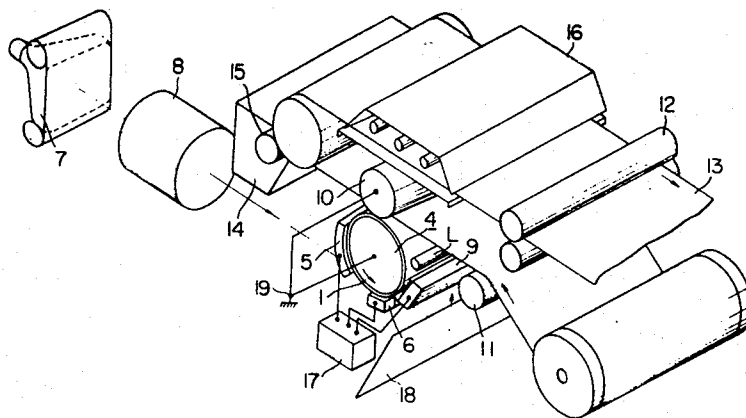


FIG. 1
PRIOR ART

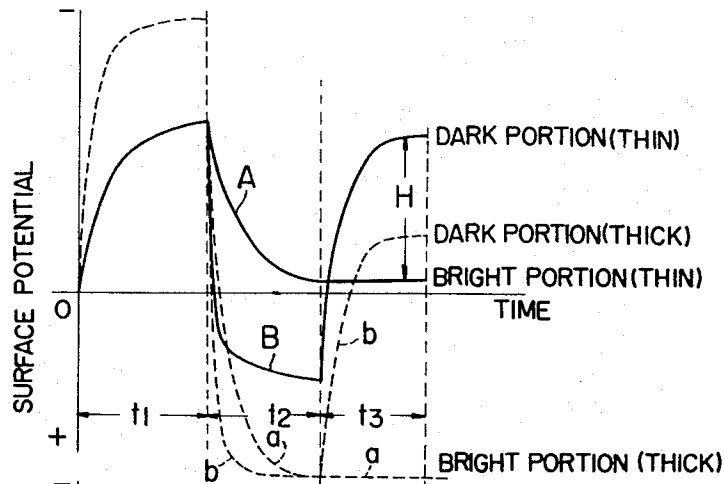


FIG. 2

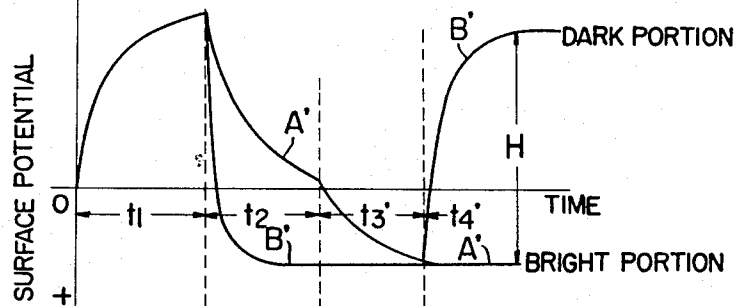
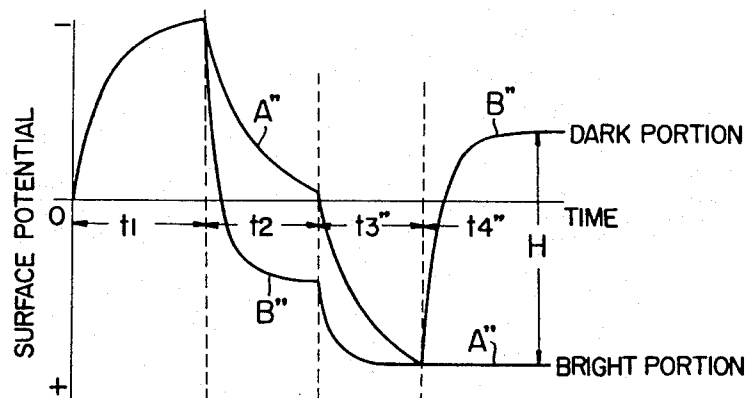
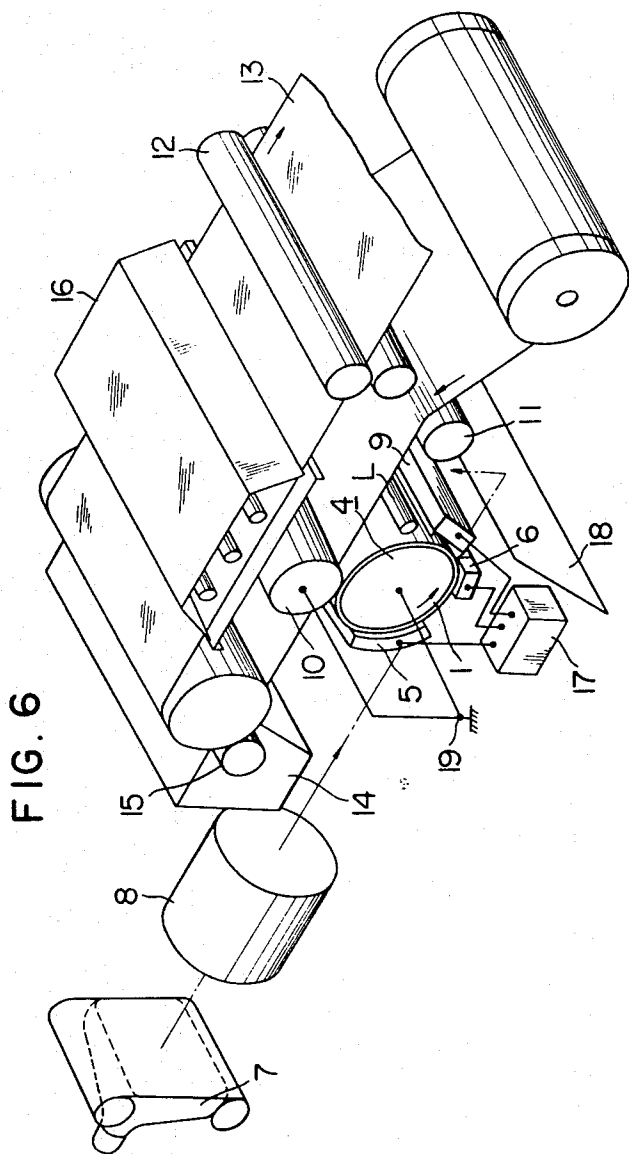
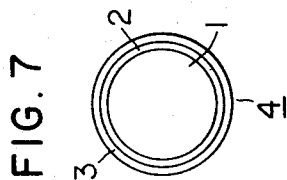
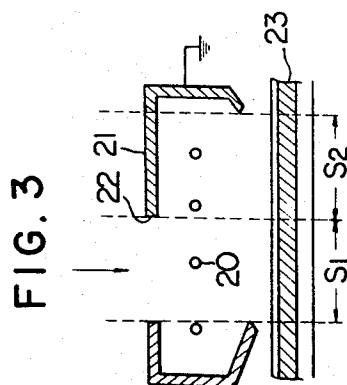
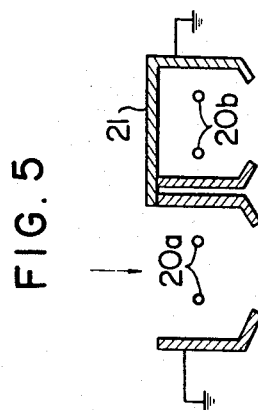


FIG. 4





METHOD AND APPARATUS FOR ELECTROPHOTOGRAPHY

This is a division of application Ser. No. 108,733, filed Jan. 22, 1971, now Pat. No. 3,730,709.

BACKGROUND OF THE INVENTION

This invention relates to a method and apparatus for electrophotography.

As disclosed in U.S. Pat. No. 3,457,070 dated July 20, 1969 and No. 3,536,483 dated Oct. 27, 1970 an improved method of electrophotography has recently been developed wherein an electrostatic latent image is formed by using a photosensitive element including a photoconductive layer having a property of trapping electric charges or manifesting persisting internal polarization and a highly insulative layer integrally bonded to one surface of the photoconductive layer, and wherein, in the first step, an electric field is applied by means of a corona discharge unit across the photosensitive element for depositing a charge of the same polarity as the minority carriers of the photoconductive layer on the surface of the highly insulative layer, and, in the second step, another charge of the same polarity as the majority carriers of the photoconductive element is then applied on the surface of the highly insulative layer concurrently with the projection of a light image whereby an electrostatic latent image corresponding to the light image is formed on the surface of the highly insulative layer. The latent image is characterized by not being erased by later irradiation of light, can be developed by any conventional developing method into a visible powder image and the powder image can be readily transfer printed on a recording medium, ordinary a paper. After cleaning the surface the photosensitive element can be used repeatedly.

Although the highly insulative layer acts also as a protective layer for the underlying photoconductive layer, the quality of the reproduced visible image is gradually deteriorated due to the spoilage of the highly insulative layer caused by the toner and scratches caused by the magnetic carrier for the toner.

For this reason, it is preferable to transfer print the electrostatic latent image onto an insulating receptor material such as a paper and then develop the transferred latent image with a conventional method.

It was found that, when applied to transfer print the latent image formed by the method described above, many of the known methods of transfer printing can not produce high quality prints by the reasons as follows.

According to one known method of transfer printing electrostatic latent image, an electric insulative recording medium is brought close to the latent image formed on a photoconductive element with a small air gap between the latent image and the recording medium and a charge is deposited on the rear surface of the recording medium by means of a corona discharge unit so as to electrostatically transfer the latent image from the photoconductive element to the recording medium. With this method, however, it is difficult to maintain uniform air gap so that it is impossible to transfer the latent image at high fidelities. In other words when the transfer printed latent image is developed with a conventional developing agent the developed visible image is not uniform thus resulting in a copy of poor quality.

According to another method of transfer printing a recording paper is superimposed upon the powder image formed on a photosensitive element and a roller supplied with a suitable voltage is rolled along the rear surface of the recording paper. However, when a powder image formed by the method of patents described above is transfer printed on a recording paper by this method, should the roller is operated in the absence of the recording paper, the roller would be brought into direct contact with the photosensitive element thus causing the breakdown of the highly insulative layer on the photosensitive element by the voltage impressed upon the roller.

This breakdown may be prevented by increasing the thickness of the highly insulative layer. However, increase in the thickness of the highly insulative layer decreases the capacitance thereof. As is well known in the art, in the above described method of forming electrostatic latent image, the electric charge trapped in the charge trapping levels in the photoconductive layer, or the phenomenon of persistent internal polarization is efficiently utilized so that where the thickness of the highly insulative layer is increased it is necessary to increase the voltages of opposite polarities applied across the photosensitive element during the latent image forming steps. In a high speed electrophotographic machine utilizing corona discharge, as the discharge capacity of the corona discharge electrode is limited, it is impossible to trap sufficiently large quantity of the charge in the photoconductive layer by the potential impressed across the photosensitive element during the first step. Thus it is impossible to obtain reproduced images of high contrast.

Furthermore, in the above described method of electrophotography, since a light image is ordinarily projected upon the photoconductive layer through the highly insulative layer, increase in the thickness thereof decreases the transmission and diffraction of the light. This also decreases the fidelity of the reproduced image.

As above described, since the latent image formed by the improved method of electrophotography utilizing two electric fields of the opposite polarities is not erased by later light irradiation the light image can be developed in the bright or under room light. For this reason, it is not necessary to perform the transfer step and the developing step in the dark or in a light tight compartment as in the conventional electrophotographic machines, so that when the latent image or the developed powder image is transfer printed onto a recording paper by utilizing a roller applied with a substantially high potential as above described, the roller is exposed and there is a danger of electric shock for the operator. Accordingly, the following method of transferring the latent image is suitable. Thus, an electric insulative recording paper is firmly pressed by means of a roller applied with a high potential against a latent image formed on a photoconductive element including a backing electrode while the potential difference between the recording paper and the photosensitive element is reduced to zero by short circuiting the transfer roller and the backing electrode of the element.

However, in the above described improved method of electrophotography, to obtain copies of high quality, it is necessary to select the polarities of the applied electric fields such that the latent image manifests a po-

tential of a polarity opposite to the polarity of the majority carriers in the photoconductive layer. If the recording papers are continuously or successively inserted between the photosensitive element and the transfer roller while they are pressed together and electrically short circuited each other as above described the transfer efficiency of the image to the recording paper would be low thus making it impossible to obtain reproduced copies of high quality.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to improve the method and apparatus for electrophotography described in the above described patents so as to improve the contrast of the latent image or the potential difference between portions of the latent image corresponding to bright portions of the light image and portions corresponding to dark portions of the light image.

Another object of this invention is to provide an improved method and apparatus for electrophotography which can reproduce copies of high contrast or intermediate tone at high speed.

According to this invention, in a method of electrophotography wherein a latent image is formed by the steps of applying a first electric field across a photosensitive element including a photoconductive layer manifesting persistent internal polarization and a highly insulative layer integrally bonded to one side of the photoconductive layer for depositing a charge of one polarity on the surface of the highly insulative layer, and applying a second field across the photosensitive element for depositing a charge of the opposite polarity on the surface of the highly insulative layer concurrently with the projection of a light image upon the photoconductive layer, a third step is added wherein a third electric field is applied across the photosensitive element for depositing a charge of the same polarity as the charge deposited by the second electric field on the surface of the highly insulative layer. The charge deposited by the third field is effective to increase the contrast of the latent image or the potential difference between portions of the latent image corresponding to bright portions of the light image and portions of the latent image corresponding to dark portions of the light image. The latent image formed in this manner can be developed on the photosensitive element and then transfer printed onto a recording paper, or transfer printed onto an electric insulative receptor material and then developed, all in the conventional manner, except that the latent image can be processed in the bright as above described. In the patented method, the purpose of the second electric field which is impressed concurrently with the light image is to selectively release the charge that has been trapped in the charge trapping levels in the photoconductive layer during the first step. Depending upon the type of the photoconductive material, there are many deep charge trapping levels or impurity levels in the material so that where materials containing such deep trapping levels are used, the releasing speed of the trapped charge in the second step is relatively low so that extremely high speed operation is not possible. Where such a material is used, or where a high speed machine is desired, it is advantageous to project uniform light upon the latent image to accelerate the release of the trapped charge, this technique being known in the art as the "post exposure."

The first, second and third electric fields are applied by means of corona discharge units, preferably disposed about a rotary cylinder carrying a photosensitive element. The light image is projected through the second corona discharge unit. The polarities of the charges deposited by the second and third corona discharge units should be the same but the intensity of the third electric field may be the same or higher than that of the second electric field.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a graph to show the variation of the surface potential at the time of forming a latent image according to a prior art method;

FIG. 2 is a similar graph showing the variation of the surface potential at the time of forming a latent image in accordance with the method of this invention;

FIG. 3 shows a sectional view of corona discharge units employed in the method of electrophotography shown in FIG. 2;

FIG. 4 shows a graph showing the variation of the surface potential at the time of forming latent images according to a modified embodiment of this invention;

FIG. 5 shows a sectional view of corona discharge units suitable for use in the modified embodiment shown in FIG. 4;

FIG. 6 shows a perspective view of electrophotographic apparatus embodying the invention; and

FIG. 7 shows an end view of the rotary drum and the photosensitive element utilized in the apparatus shown in FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the accompanying drawings, FIG. 1 is a graph to show the variation of the surface potential of the highly insulative layer wherein an electrostatic latent image is formed thereon by the steps of applying a first electric field across a photosensitive element including a photoconductive layer having a plurality of charge trapping levels, that is manifesting persistent internal polarization, and the highly insulative layer integrally bonded to one surface of the photoconductive layer for depositing a charge of one polarity on the surface of the highly insulative layer, and applying a second electric field across the photosensitive element to deposit a charge of the opposite polarity on the surface of the highly insulative layer concurrently with the projection of a light image upon the photoconductive layer. Curves depicted in FIGS. 1, 2 and 3 represent the case where the photoconductive layer is comprised by SeTe. However, when the photoconductive layer is made of photoconductors of different conductivity type the polarity of the surface potential is reversed, but the configurations of the curves are generally identical to those illustrated in the drawing.

In FIG. 1 solid line curves A and B represent the potential variations with time at bright portions and dark portions of the light image where the highly insulative layer is relatively thin (or having a large capacitance) whereas dotted line curves a and b corresponding potential variations where the highly insulative layer is relatively thick (or having a small capacitance).

During an interval t_1 , or the first step, in order to establish the persistent internal polarization in the photoconductive layer, a charge of the same polarity as the minority carriers in the photoconductive layer is depos-

ited on the surface of the highly insulative layer by means of a corona discharge unit, not shown. Thus, the surface potential of the highly insulative layer builds up gradually as shown by curve A. Then, during the second step indicated by interval t_2 , the polarity of the charge deposited by the corona discharge unit is reversed while at the same time the light image is projected upon the photoconductive layer, preferably through the highly insulative layer. The intensity of the charge deposited in the second step is selected to such a value that the deposited charge can be retained at portions corresponding to the bright portions of the light image by the charge that has been trapped in the first step.

However, when the charge of the same polarity as the majority carriers in the photoconductive layer is deposited by the corona discharge unit concurrently with the projection of the light image during the second interval t_2 , as shown by solid line curve B, at portions corresponding to the dark portions of the light image, the surface potential rapidly builds down because the charge that has been trapped in the first step is preserved and the photoconductive layer manifests an extremely high resistance at these dark portions. Accordingly, the polarity of the surface charge is rapidly reversed by a small quantity of charge deposited in the second step. Thus, the surface potential varies along a characteristic curve determined by the characteristics of the photoconductive layer and the corona discharge until a definite value is reached in a relatively short time. Whereas, at portions of the photoconductive layer corresponding to bright portions of the light image the charge that has been trapped is released and the capacitance is increased so that the build down of the surface potential at these bright portions is slow with the result that it takes a longer time for the surface potential before it can reach the same potential as that of the dark portions.

In order words, during the second step or interval t_2 , the surface potentials at bright and dark portions build down at different rates. After interruption of the second field and of the light image, the surface potentials at the bright and dark portions vary according to curves A and B included in interval t_3 . During this interval, at portions corresponding to dark portions of the light image, the charge trapped in the photoconduction layer in the first step increases to cancel the charge deposited on the surface of the highly insulative layer in the second step so that the effect of the charge deposited in the second step is decreased with the time elapsed as shown in FIG. 1. On the contrary, at portions corresponding to bright portions of the light image, the surface charge deposited in the second charge is preserved substantially unchanged. The difference H along the ordinate between curves A and B at the end of interval t_3 represents the contrast of the developed or reproduced image. For this reason it will be clear that where the build up of the surface potential at dark portions or the build down at bright portions is not large, the contrast of the reproduced image is low.

Although, in this method of electrophotography, it is possible to improve the contrast by increasing the interval t_2 during which the second field is impressed concurrently with the projection of the light image so as to cause the surface potentials at the bright and dark portions to assume the same value, such prolonged interval

t_2 decreases the image forming speed, which is of course objectional to high speed machines.

Where the highly insulative layer is made thicker, or to have larger capacitance, the build down speed of the surface potential at the bright portions can be increased during the second step and the potential of the latent image formed will have substantially equal potential as that of the majority carriers in the photoconductive layer. Accordingly, if it were possible to share a substantial potential across the photoconductive layer during interval t_1 for trapping a sufficiently large charge in the photoconductive layer, it will be possible to increase the contrast as shown by dotted line curves *a* and *b* shown in FIG. 1. As above described, when the capacitance of the highly insulative layer is decreased, it is impossible to carry out the method with a high speed machine utilizing a corona discharge unit of the conventional design. In addition, in such a case although it is possible to improve the contrast of the latent image or the image reproduced therefrom it is not possible to reproduce at a high fidelity an original of the intermediate tone. In other words, it is not possible to reproduce well defined patterns.

FIG. 2 shows a graph representing the variation in the surface potential according to the novel method of electrophotography of improved sensitivity. By the end of interval t_2 , or the termination of the second step, the same process steps as described above are followed so that the configurations of the curves representing the surface potential are the same as those shown in FIG. 1. According to this invention, a third step t'_3 is added in which the charge of the same polarity as the charge deposited in the second step is deposited. The variations of the surface potentials at portions of the highly insulative layer corresponding to the bright and dark portions of the light image are shown by curves A' and B', respectively.

FIG. 3 diagrammatically shows a construction of a corona discharge unit suitable for this purpose. The corona discharge unit comprises discharge electrodes in the form of fine metal wires 20 and a grounded inverted cup shaped counter electrode 21. Section S1 of the corona discharge unit is utilized to perform the second step whereas section S2 is utilized to perform the third step. A window 22 is formed through the top wall of the counter electrode 21 for projecting the light image upon the photosensitive element 23 through this window as shown by an arrow.

The variations in the surface potentials at portions of the highly insulative layer corresponding to the bright and dark portions of the light image during the third step or in interval t'_3 are shown by curves A' and B'. During interval t'_3 , as the charge that had been trapped in the photoconductive layer in interval t_1 has already been released during interval t_2 , when the charge of the same polarity is deposited after interval t_2 , the surface potential at portions corresponding to bright portions of the light image will approach the surface potential of the portions corresponding to dark portions of the light image. During interval t'_3 , at portions of the highly insulative layer corresponding to dark portions of the light image the charge that has been trapped in interval t_1 is still preserved so that in interval t_3 the surface potential is maintained at the same level established in the second interval t_2 .

After interruption of the applied field, or during interval t'_4 , the surface potential at the bright portions

manifests the same level as the potential at the end of interval t'_3 whereas the surface potential at dark portions builds up rapidly in the same manner as in interval t_3 shown in FIG. 1. Thus, by utilizing the corona discharge unit shown in FIG. 3 wherein the portion of the top wall of the counter electrode to the rear of winder 22 is closed the surface potential at the bright portions is shifted to the side of the same polarity as the majority carriers in the photoconductive layer thus increasing the potential difference H or contrast.

FIG. 4 is a graph showing the variations in the surface potentials appearing in a modified method of electrophotography wherein a modified corona discharge unit shown in FIG. 5 is employed. As shown by curves A'' and B'', by the end of the second interval t_2 the surface potentials at bright and dark portions vary in the same manner as in the interval t_2 shown in FIG. 2. In this embodiment, electrodes 20_a are used to apply the second electric field across the photosensitive element concurrently with the projection of the light image through these electrodes as shown by an arrow in FIG. 5 whereas electrodes 20_b surrounded by grounded inverted cup shaped counter electrode 21 are used to apply an electric field of the same polarity but higher than the second electric field during interval t''_3 or the third step, thus increasing the charge deposited on the surface of the highly insulative layer.

In this modified embodiment, if the charge deposited in the third step is controlled in a range capable of preserving the charge trapped in the photoconductive layer at portions corresponding to dark portions of the light image, in a manner similar to that described in connection with FIG. 2, after interruption of the deposition of the charge, that is during interval t'' shown in FIG. 9, variation in the surface potential of the same extent as that shown in FIG. 2 will occur at dark portions. However, since the surface potential has been increased in interval t''_3 , the point on curve B'' at which the variation in the surface potential stops is more negative than the corresponding point on curve B'' shown in FIG. 2.

On the other hand, at the end of interval t''_3 , the surface potential at bright portions is substantially the same as that at dark portions so that after interruption of the application of the field by electrodes 20_b, that is during interval t''_4 , the surface potential at the bright portions does not vary as shown by curve A'' in FIG. 4, thus maintaining the increased level. In this manner, by applying the second electric field concurrently with the projection of the light image and then applying in the dark the third field of the same polarity as the second electric field and having the same or higher potential, it is possible to increase the potential difference between dark and bright portions, thus increasing the contrast and sensitivity. This makes it possible to transfer the latent image onto a recording paper by using a transfer roller which is short circuited with the photosensitive element as above described. The latent image transferred onto the recording paper can be developed by any conventional developing method to obtain a copy of excellent quality.

Where a transparent backing electrode is applied to the photoconductive layer on the side opposite to the highly insulative layer (in which case this layer may be opaque) and the light image is projected onto the photoconductive layer through the transparent backing electrode, it is not always necessary to use a special co-

rona discharge unit as shown in FIG. 3 or FIG. 5. In this case, however, the polarity of the charge deposited in the first step should be the same polarity as that of the majority carriers in the photoconductive layer and the polarity of the charge deposited in the second step should be the same polarity as the minority carriers. The object of this invention can be accomplished by continuing the application of the second field after interruption of the projection of the light image or by re-applying the electric field of the same polarity as the minority carriers a short interval after interruption of the light image.

FIGS. 6 and 7 illustrate a preferred embodiment of the electrophotographic apparatus embodying the invention.

As shown, a photoconductive layer 2 is wrapped about an electroconductive rotary drum 1. The photoconductive layer 2 comprises a first layer of SeTe containing about 16 mol % of Te and vapour deposited to a thickness of 30 microns and a second layer of 1 micron thick which is formed by simultaneously vapour depositing a powder of SeTe containing about 16 mol % of Te and a powder of SeTe containing 40 mol % of Te, upon the first layer. The second layer contains a plurality of charge trapping levels thus manifesting intense persistent internal polarization. Then polycarbonate is applied on the second layer to a thickness of 10 microns to form a highly insulative layer 3. In the following description, the assembly of drum 1, photoconductive layer 2 and insulative layer 3 is termed a photosensitive drum 4.

It is to be understood that the invention is not limited to the particular photoconductive layer just described and that any photoconductive layer manifesting persisting internal polarization phenomenon may be used.

After charging the surface of the highly insulative layer to a potential of -1,500V by means of first corona discharge unit 5 connected to a source of supply 17, a positive charge is deposited on the surface of the highly insulative layer by means of a second corona discharge unit 6 while rotating the photosensitive drum 4 in the direction shown by an arrow. At the same time, the light image of an original 7 which is moved at the same speed as the peripheral speed of the drum 4 is projected upon the drum through a lens system 8, a reflective mirror 18 and the second corona discharge unit 6 as shown by a dot and dash line for 0.2 second and with a brightness of 1 lux at portions on the surface of the highly insulative layer corresponding to the bright portions of the original. As a consequence, the potential of the portions of the highly insulative layer corresponding to dark portions of the light image becomes -100V, whereas the potential of the bright portions becomes +200V. Thereafter a positive charge is deposited on the surface of the highly insulative layer by means of a third corona discharge unit 9 to deposit a charge of +300V at dark portions and a charge of +700V at bright portions.

By the reason described above a lamp L for post exposure may be provided to the rear of the third corona discharge unit 9 for increasing the contrast and the operating speed.

The latent image formed in this manner may be developed on the photosensitive drum and then transfer printed onto a recording paper. However, in order to prevent the spoil and damage of the highly insulative layer due to the toner and magnetic carrier as above

described, it is advantageous to transfer print the latent image onto an insulative receptor medium 13 coated with a thin layer of vinyl acetate and is fed between the photosensitive drum 4 and a transfer printing roller 10 which is rotated at the same peripheral speed as the photosensitive drum. The feeding of the receptor medium may be made either by the transfer printing roller, or a feed roller 11 in front of the transfer printing station or a tension roller 12 to the rear thereof. After erasing the latent image remaining on the photosensitive drum by means of an AC electric field, the photosensitive drum can be used repeatedly.

The latent image transfer printed onto the receptor medium 13 is then developed by any conventional developing device comprising for example a supply of developer 14 containing a developer admixed with about 2 percent, by weight, of a negatively charged toner and a rotating brush 15 and the developed image is then fixed by means of a heater 16 to obtain a permanent copy.

As above described, according to this invention the potential difference of the latent image between portions corresponding to dark and bright portions of the light image can be increased so that it is possible to increase the contrast and sensitivity thus producing at a high speed copies of improved quality.

According to the novel electrophotographic apparatus it is not only possible to increase the useful life of the photosensitive element but also decrease the physical dimensions of the apparatus because the latent image is not developed on the photosensitive element so that it is not necessary to use any means for cleaning the developer remaining on the photosensitive element after transfer printing. Further, as the drum 1 and transfer printing roller 10 are grounded by a conductor 19 and since it is not necessary to apply any transfer potential there is no danger of electric shock.

We claim:

1. An electrophotographic apparatus comprising a photosensitive element including a photoconductive layer manifesting persistent internal polarization and a highly insulative layer integrally bonded to one side of said photoconductive layer; a first corona discharge unit for depositing a charge of one polarity on the surface of said highly insulative layer; a second corona discharge unit for depositing a second charge of the opposite polarity on the surface of said highly insulative layer; an optical system for projecting a light image upon said photoconductive layer concurrently with the application of said charge of the opposite polarity by said second corona discharge unit whereby to form a latent image on said highly insulative layer correspond-

ing to said light image; a third corona discharge unit for depositing a third charge of the same polarity as said second charge whereby to increase the potential difference of said latent image between portions corresponding to the bright and dark portions of said light image; an insulative receptor material; means for transfer printing said latent image onto said receptor material; and means for developing said latent image transferred onto said receptor material.

2. The apparatus according to claim 1 wherein said photosensitive element is wrapped around the periphery of a rotary drum, said first, second and third corona discharge units and said transfer printing means are disposed about the periphery of said rotary drum in the order mentioned, and said optical system is disposed to project said light image through said second corona discharge unit.

3. The apparatus according to claim 1 which further comprises a source of light positioned between said third corona discharge unit and said transfer printing means for irradiating said latent image with uniform light.

4. The apparatus according to claim 1 wherein said second and third corona discharge unit is combined into an integral unit comprising an inverted cup shaped counter electrode, and a corona discharge electrode contained in said counter electrode and takes the form of metal wires arranged in parallel with the top wall of said counter electrode and applied with the same potential, said top wall of said counter electrode being provided with a window to project said light image through metal wires underlying said window.

5. The apparatus according to claim 1 wherein said second corona discharge unit comprises a cylindrical counter electrode and a corona discharge electrode contained in said counter electrode, said counter electrode serving to project said light image through said corona discharge electrode, wherein said third corona discharge unit comprises an inverted cup shaped counter electrode and a corona discharge electrode disposed in said cup shaped counter electrode and wherein said corona discharge electrode of said third corona discharge unit is supplied with a potential having the same polarity but higher than the potential applied to the corona discharge electrode of said second corona discharge unit.

6. The apparatus according to claim 2 wherein said transfer printing roller is rotated at the same peripheral speed as said rotary drum and said transfer printing roller and said rotary drum are maintained at the same potential.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,797,928 Dated March 19, 1974

Inventor(s) Koichi KINOSHITA and Masanori WATANABE

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

The Title should be corrected wherever it appears to read
--APPARATUS FOR ELECTROPHOTOGRAPHY--

On the first page, reference should be made to the corresponding Japanese application Serial No. 6603/70, filed January 24, 1970, from which priority is claimed.

The following sentence should be inserted at the end of the Abstract: --Apparatus is disclosed herein for carrying out this method.--.

Column 1, line 8, delete "method and".
lines 35 and 36, change "ordinary" to
--ordinarily--.
lines 40 and 41, change "image is gradually
deteriorated" to --images gradually deteri-
orates--.
line 45, correct the spelling of --receptor--.
line 48, correct the spelling of --found--.
lines 51 and 52, for "by the reasons as follows"
substitute --for the following reasons--.
line 54, change "image" to --images--.
line 63, after "maintain" insert --a--.

Column 2, line 1, after "printing" insert a comma.
line 6, before "patents" insert --the--.
line 8, for "should" substitute --if--.
line 15, after "However," insert --an--.
line 19, for "image" substitute --images--.
line 26, for "stps" substitute --steps--.
line 29, after "trap" insert --a--.
line 37, before "increase" insert --an--.
line 41, change "above described" to --described
above--.

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CERTIFICATE OF CORRECTION

Patent No. 3,797,928 Dated March 19, 1974

Inventor(s) Koichi KINOSHITA and Masanori WATANABE

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

- Column 2, line 45, change "the bright" to --bright light--.
line 60, change "photoson-" to --photocon- --.
- Column 3, line 6, before "each" insert --to--.
line 7, correct the spelling of --efficiency--.
line 49, correct the spelling of --receptor--.
line 51, change "the bright" to --bright light--;
change "in" (2nd occur.) to --In--.
- Column 4, between lines 10 and 11, insert --In the accom-
panying drawings:--.
line 22, before "latent" insert --a-- and change
"images" to --image--.
line 41, correct the spelling of --manifesting--.
line 42, change "the" to --a--.
line 47, correct the spelling of --deposit--.
lines 51 and 52, for "is comprised by" substi-
tute --comprises--.
line 61, before "corresponding" insert
--represent--.
- Column 5, line 40, change "order" to --other--.
line 47, change "photoconduction" to
--photoconductive--.
line 48, correct the spelling of --cancel--.
line 54, for "charge" (2nd occur.) substitute
--charging step--.
line 55, correct the spelling of --difference--.
- Column 6, line 2, change "objectional" to --objectionable--.
line 7, change "have" to --be--.
lines 7 and 8, "equall potential as" substitute
--equal to--.
line 63, for "is interval t_3 " substitute --in
interval t'_3 --.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,797,928 Dated March 19, 1974

Inventor(s) Koichi KINOSHITA and Masanori WATANABE

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

Column 7, line 6, change "winder" to --window--.
line 34, change "t" " to --t"₃--.
line 35, change "Fig. 9" to --Fig. 4--.
line 40, change "B" " to --B'--.

Column 8, line 56, correcting the spelling of --deposit--.
line 59, change "By" to --For-- and "reason"
to --reasons--.
line 67, change "the spoil" --spoiling--.

Column 9, line 2, correct the spelling of --receptor--.
line 6, correct the spelling of --receptor--.
line 13, correct the spelling of --receptor--.
line 27, correct the spelling of --According--.

Column 10, line 6, correct the spelling of --receptor--.
line 7, correct the spelling of --receptor--.
line 9, correct the spelling of --receptor--.
line 24, change "unit is" to --units are--.
line 27, change "and takes" to --in--.
line 28, delete "in"
line 29, change "applied with" to --having--.
line 30, after "tentia" and before the comma,
insert --applied thereto--.

Signed and sealed this 17th day of September 1974.

(SEAL)

Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents