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Kurokawa et al.

[11] **3,834,810**

[45] **Sept. 10, 1974**

[54] **ELECTROSTATIC LATENT IMAGE TRANSFERRING APPARATUS FOR USE IN ELECTROPHOTOGRAPHY**

[75] Inventors: **Junji Kurokawa; Toshio Watanabe; Tomiaki Asami,** all of Tokyo, Japan

[73] Assignee: **Kabushiki Kaisha Ricoh,** Tokyo, Japan

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[21] Appl. No.: **416,732**

[30] **Foreign Application Priority Data**

Nov. 21, 1972 Japan 47-116212

[52] **U.S. Cl.** ..... **355/3 R,** 96/1 R, 355/17

[51] **Int. Cl.** **G03g 15/22**

[58] **Field of Search** ..... 96/1.4, 1.5, 1 E, 1 R; 355/3 R, 16, 17

[56] **References Cited**

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Primary Examiner—Robert P. Greiner
Assistant Examiner—Kenneth C. Hutchison
Attorney, Agent, or Firm—Cooper, Dunham, Clark, Griffin & Moran

[57] **ABSTRACT**

An electrophotographic apparatus for transferring electrostatic latent images comprising a photosensitive drum consisting of a layer of photosensitive material on a conductive body; an insulating roller normally disposed in contact with said photosensitive drum for the purpose of transferring an electrostatic latent image formed on said layer of photosensitive material to an interposable electrostatic transfer paper consisting of a conductive paper support with an image receiving dielectric layer thereon; at least one set of paper feed rollers disposed in front of and one set disposed to the rear of said insulating roller (the rollers disposed on the side of said dielectric layer consisting of an insulating material while the rollers disposed on the side of said paper support consist of a conductive material) for feeding the electrostatic transfer paper in between said insulating roller and photosensitive drum; and a low-voltage DC power source having one terminal with the same polarity as that of the electric charge to be impressed on the photosensitive layer by corona discharge, and electrically connected with said conductive body of the photosensitive drum, while the other terminal has the opposite polarity and is electrically connected with said conductive feed rollers, said conductive feed rollers being grounded through the chassis of the apparatus and said photosensitive drum being insulated relative to the chassis of the apparatus.

6 Claims, 5 Drawing Figures

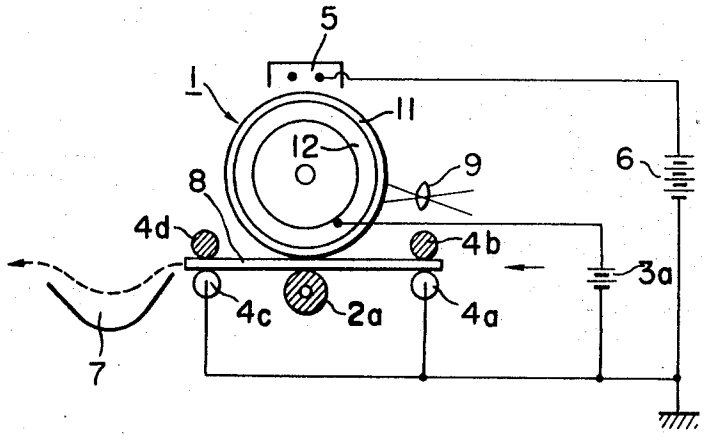
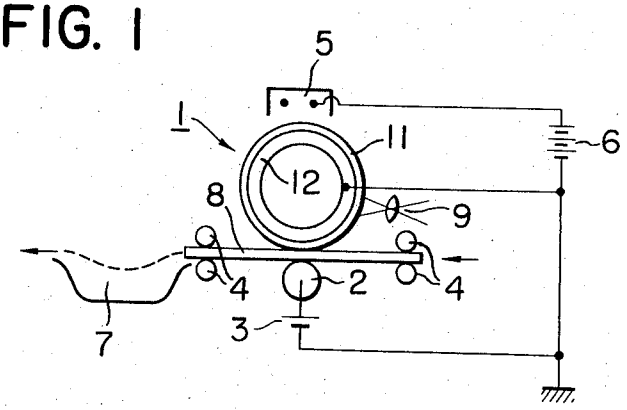
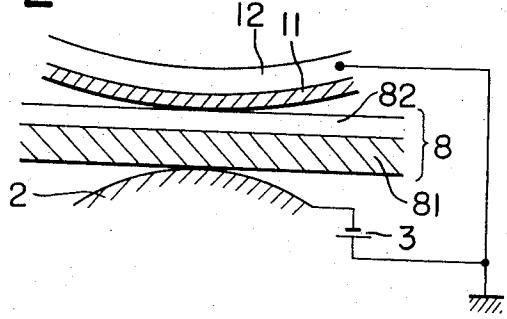


FIG. 1



PRIOR ART

FIG. 2



PRIOR ART

FIG. 3

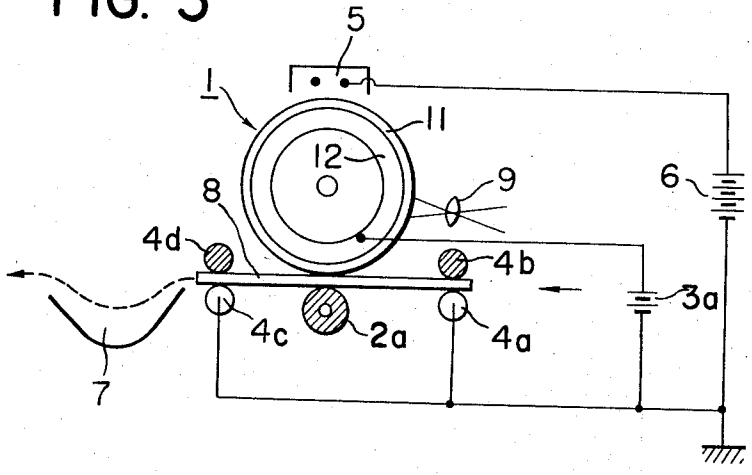
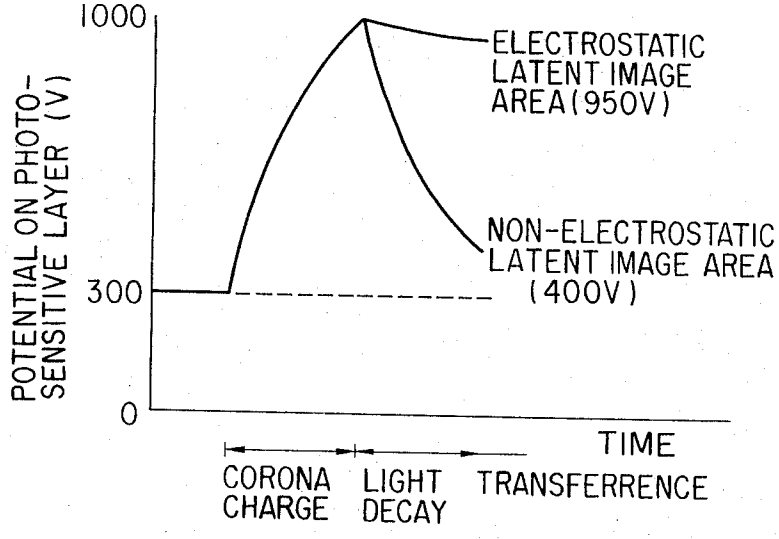


FIG. 4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POTENTIAL ON PHOTO-SENSITIVE LAYER (V)
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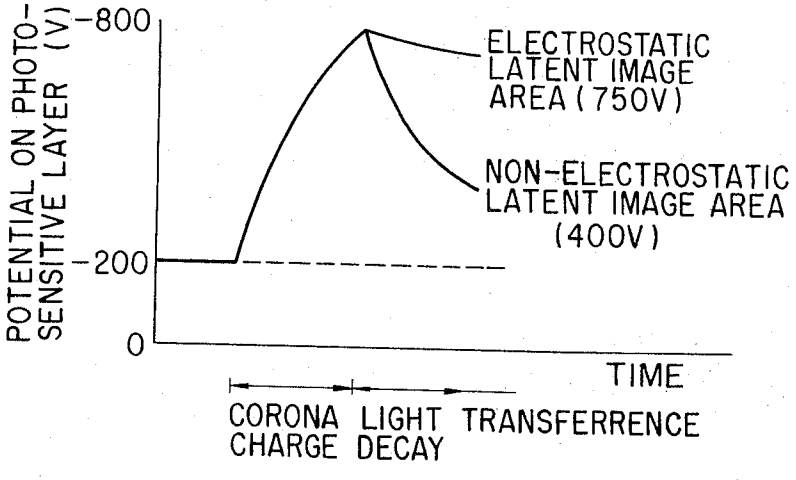
NON-ELECTROSTATIC LATENT IMAGE AREA (400V)
TIME
CORONA CHARGE
LIGHT DECAY
TRANSFERRENCE

FIG. 5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NON-ELECTROSTATIC LATENT IMAGE AREA (400V)
TIME
CORONA CHARGE
LIGHT DECAY
TRANSFERRENCE

ELECTROSTATIC LATENT IMAGE TRANSFERRING APPARATUS FOR USE IN ELECTROPHOTOGRAPHY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus for transferring electrostatic latent images for use in electrophotography.

2. Description of the Prior Art

In an electrophotographic copying press employing the electrostatic latent image transferring method wherein an electrophotographic sensitive body is electrified by the conventional method (namely, corona discharge deposition; exposing it to light to form thereon an electrostatic latent image; transferring said latent image onto an electrostatic recording paper and developing the thus transferred image to obtain the intended image) it is desirable that the photosensitive body be permanently durable. In copying presses of this type, inasmuch as the surface of the photosensitive body never comes in contact with the developer, or cleaner or the like, there is little chance of the durability of the photosensitive body being affected by any mechanical external force. However, if a high voltage is repeatedly applied to the layer of photosensitive material at the time of corona discharge in an attempt to enhance the transfer of the electrostatic latent image when utilizing only the electric field produced by the photosensitive layer, the body will have its life remarkably shortened, give rise to dielectric breakdown and become rapidly unfit for use. To cope with this problem, it has been usual in the prior art to utilize the effect of the electric field produced by the electrostatic latent image at the time of transferring thereof together with the effect of another electric field applied to the photosensitive layer from the outside of the foregoing electric field so as to make it possible to perform transference even when the electrostatic latent image has a low potential to avoid as far as possible the use of a high potential charge on the photosensitive material.

FIG. 1 in the drawings is illustrative of the general electrostatic latent image transferring apparatus utilizing the foregoing synergetic effect. Photosensitive drum **1** consists of a photosensitive layer **11** and a conductive body **12.** Conductive roller **2** is for transferring the electrostatic latent image formed on the photosensitive layer **11** to the electrostatic transfer paper **8** which consists of a dielectric layer and a conductive paper support. A low-voltage DC power source of **100-500V** is connected to the roller **2.** Two sets of rollers **4** supply the electrostatic transfer paper **8** between the roller **2** and the photosensitive drum **1** for transferring the electrostatic latent image thereto and further sending it to a developing section **7.** A corona discharger **5** having a high-voltage DC power source **6** of **6-8KV** and an optical system **9** are appropriately disposed about drum **1.** In FIG. **2** the transferring section of the apparatus shown in FIG. **1** is shown on an enlarged scale. The dielectric layer **82** of the electrostatic transfer paper **8** is in contact with the photosensitive layer **11** of the photosensitive drum **1,** while the conductive paper support **81** is in contact with the transferring roller **2.** In this connection, the surfaces of the photosensitive drum **1** and the transferring roller **2** are ordinarily in contact with each other, but, when an electrostatic transfer paper **8** is inserted between them, the photosensitive surface of drum **1** and the dielectric surface of electrostatic transfer paper **8** come in contact with each other and the electrostatic charge forming the electrostatic latent image is transferred from the drum **1** to the paper **8** by virtue of the electric field working therebetween. However, actual use of this apparatus in electrostatic transferring is accompanied with various problems such as follows:

1. When there is no electrostatic transfer paper interposed, the transferring roller **2** and the surface of photosensitive layer **11** come in direct contact with each other and an electric field of several hundred volts works on the photosensitive layer, causing partial dielectric breakdown of the photosensitive layer. Although this trouble can be avoided by impressing the voltage on the transferring roller **2** only when an electrostatic transfer paper has been inserted, yet inasmuch as the applicable electrostatic transfer papers may be of various sizes, when a relatively narrow transfer paper is inserted, the widthwise margin of the transferring roller **2** comes in direct contact with the surface of photosensitive layer **11** and this direct contact area of the photosensitive layer becomes electrically vulnerable, resulting in a shortened life for the photosensitive layer.

2. In the case where an electrostatic transfer paper **8** is sent in the direction of the arrow in FIG. **1** by means of the feed rollers **4,** transference is effected and the fore end of said transfer paper reaches the developing section **7** while the rear end thereof is still in contact with the transferring roller **2.** Since the paper support **81** is conductive, electric current runs through the base imparting a uniform electric potential thereto, and, in the fore end portion of the transfer paper, there take place a bias development on this occasion and the image comes to disappear. Even when the feed rollers **4** are grounded through the chassis of the apparatus (not shown herein), there will appear an inverse potential of several tens of volts on the paper support **81.** On the other hand, as the potential of the electrostatic transfer paper subsequent to transference is 100 volts at the most in the image area thereof, an image obtained through development will show low concentration just in the fore end portion thereof.

The foregoing troubles incident to the conventional apparatus are attributable to the fact that transferring roller **2** is conductive and a voltage is applied to this conductive transferring roller and through it to the conductive support for the electrostatic transfer paper.

The object of the present invention is to make up for the foregoing defects of the prior art and to provide an improved apparatus for transferring electrostatic latent images which comprises a photosensitive layer free of dielectric breakdown and accordingly of permanent durability.

SUMMARY OF THE INVENTION

The present invention involves an apparatus for transferring electrostatic latent images suited for use in electrophotography, which comprises a photosensitive drum consisting of a photosensitive layer on a conductive body; an insulating, rather than conductive, roller normally disposed in contact with said photosensitive layer for the purpose of transferring an electrostatic latent image formed on said photosensitive layer to an interposable electrostatic transfer paper consisting of a

conductive paper support and a dielectric layer; at least one set of paper feed rollers disposed in front of and one set disposed in the rear of said insulating roller (the rollers disposed on the side of said dielectric layer consisting of an insulating material while the rollers disposed on the side of said paper support consist of a conductive material) for feeding the electrostatic transfer paper in between said insulating roller and photosensitive drum; and a low-voltage DC power source having one terminal with the same polarity as that of the electric charge of the corona discharge to be imparted to the photosensitive layer, and electrically connected with said conductive body of the photosensitive drum, while the other terminal has the opposite polarity and is electrically connected with said conductive feed rollers, said conductive feed rollers being grounded through the chassis of the apparatus and said photosensitive drum being insulated relative to the chassis of the apparatus. In this connection, the chassis of the apparatus according to the present invention means a device for supporting the parts necessary for the apparatus, namely, the photosensitive drum, transferring roller, feed rollers, low-voltage DC power source and so on, which may further include the frame, electrifier, optical system, developing device, fixing device, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic representation of an apparatus for transferring an electrostatic latent image in accordance with the prior art.

FIG. 2 is a diagrammatic representation of the transferring section — on an enlarged scale — of the apparatus shown in FIG 1.

FIG. 3 is a diagrammatic representation of an apparatus for transferring electrostatic latent images according to the present invention.

FIG. 4 is a curve showing the change of surface potential on the selenium layer in Example 1, and

FIG. 5 is a curve showing the change of surface potential on the organic photoconductive layer in Example 2.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings for further elucidation of the present invention, FIG. 3 is a diagrammatic representation of an apparatus embodying the present invention. The photosensitive drum 1 is insulated relative to the chassis of the apparatus (not shown in the drawing) and this drum is charged with a voltage in the range of 100–500V having the same polarity as that of the electric charge of the corona discharge by means of a low-voltage DC power source 3*a* at the time of transferring. The entire transferring roller 2*a* or at least the surface thereof coming in contact with the photosensitive layer 11 of the photosensitive drum 1 consists of an insulating material such as rubber, resin or the like. Accordingly, when no electrostatic transfer paper has been interposed, no voltage is set up on the photosensitive layer, and even when an electrostatic transfer paper has been interposed, only the portion of the photosensitive layer coming in contact with said transfer paper is charged with voltage, so that the troubles of the prior art are avoided. In this context, when roller 2*a* consists of rubber, the closeness of surface contact between the electrostatic transfer paper and photosensitive layer can be furthered. In at least one set of the feed rollers, 4*a*, 4*b* or 4*c*, 4*d*, the surface of the roller disposed on the support side of the electrostatic transfer paper 8 consists of a conductive material, such as metal or conductive rubber, and is grounded through the chassis of the apparatus. The rollers 4*a* and 4*d* on the support side of transfer paper 8 when conductive function as one electrode at the time of image transference to the electrostatic transfer paper and act to impress an external voltage by means of the low-voltage DC power source 3*a*. The rollers 4*b* and 4*d* on the side of the dielectric layer are all insulated relative to the chassis of the apparatus, so that they never exert any harmful influence electrically upon the electrostatic transfer paper and the rollers 4*a* and 4*c* on the support side. The corona discharger 5 is so devised that, even when the photosensitive layer is in a state of low potential, the discharger is provided with a high-voltage power source 6 having a potential far greater than that of said photosensitive layer, and therefore no influence is exerted upon the corona discharge, thereby permitting proper electrification of the photosensitive layer without hindrance. Further, inasmuch as one of the terminals of the low-voltage DC power source 3*a* has the same polarity as the polarity of the electrical charge of the corona discharge, such a power source can be taken out of a part of the high-voltage DC power source used for the corona discharge. In this case, inasmuch as the support side of the electrostatic transfer paper is always grounded by means of the conductive feed rollers 4*a* and 4*c*, no influence will be exerted thereby at the time of development and a satisfactory image will be obtained.

Some examples of particular embodiments of the present invention are as follows:

EXAMPLE 1

In the apparatus shown in FIG. 3, the photosensitive drum 1 employed may consist of a metal drum having a diameter of 70 mm provided with a 25μ thick photosensitive layer of selenium. When this selenium layer of the drum is imparted with +300V potential by a low-voltage DC power source 3*a* and a corona discharge of +7.0 KV is effected by rotating the drum at a velocity of 40 r.p.m., the apparent surface potential of the photosensitive drum becomes 1000V as shown in FIG. 4. When this photosensitive layer is exposed to light subsequent thereto, the potential becomes 950V for the electrostatic latent image area and 400V for the non-electrostatic latent image area, while onto the electrostatic transfer paper an electrostatic charge is transferred having a surface potential of 100V and 0V respectively, and the developed area produces a satisfactory image.

Moreover, the selenium layer is electrified by corona discharge to the extent of a potential of only 700V in effect, and even when it comes in direct contact with an insulating transferring roller 2*a*, the electric field acting on the selenium layer is trifling, so that the durability of the selenium drum is remarkably improved.

EXAMPLE 2

Except for employment of a drum provided with an organic photoconductive layer consisting of poly-N-vinyl-carbazole in lieu of the selenium drum employed in Example 1 and application of a corona discharge of −6.0KV upon charging −200V on said drum, the same operation as in Example 1 can be repeated. The apparent surface potential on the organic photoconductive

drum on this occasion will be −800V as shown in FIG. 5. As the residual potential of this organic photoconductor at the time of light decay is greater than that of selenium, application of a high external electric field at the time of image transference is attended with the transfer of the electric charge of the non-electrostatic latent image area and tends to give rise to a stained ground on the electrostatic transfer paper, but in the case of the present apparatus, application of a low potential of −200V can bring on a satisfactory result. To be precise, the transferred potential on the electrostatic transfer paper will be 90V and 0V for the electrostatic latent image area and the non-electrostatic latent image area, respectively.

Further, general organic photoconductive layers become unfit for use because of the increase of spots of dielectric breakdown after repeated use of several thousand times under the condition of more than 900V in surface potential (negative potential). In the case of the present apparatus, however, inasmuch as the organic photoconductive layer is to be used by applying −600V, the durability of the organic photoconductive drum has ben improved accordingly.

What is claimed is:

1. An electrostatic latent image transferring apparatus for use in electrophotography, comprising: a photosensitive drum consisting of a photosensitive layer and a conductive body; an insulating roller disposed in contact with said photosensitive layer for transferring an electrostatic latent image formed by corona discharge and illumination on said photosensitive layer to an interposable electrostatic transfer paper consisting of a conductive paper support with an image receiving dielectric layer thereon; at least one set of paper feed rollers disposed in front of and one set disposed to the rear of said insulating roller, the feed rollers disposed on the side of said dielectric layer having an insulating surface and at least one of the feed rollers disposed on the side of said paper support having a conductive surface, for feeding the electrostatic transfer paper in between said insulating rollers and said photosensitive drum; and a low-voltage DC power source having one terminal with the same polarity as that of the electric charge of the corona discharge applied to the photosensitive layer and electrically connected with said conductive body of the photosensitive drum and the other terminal having an opposite polarity and electrically connected with the surface of said conductive feed roller, said conductive feed rollers being grounded through the chassis of the apparatus and said photosensitive drum being insulated relative to the chassis of apparatus.

2. A transferring apparatus according to claim **1**, wherein said photosensitive layer of the photosensitive drum consists of selenium.

3. A transferring apparatus according to claim **1**, wherein said photosensitive layer of the photosensitive drum consists of poly-N-vinylcarbozole.

4. A transferring apparatus according to claim **1**, wherein the voltage of said low-voltage DC power source is in the range of 100–500V.

5. A transferring apparatus according to claim **1**, wherein both of said feed rollers on the side of said paper support are conductive.

6. A transferring apparatus according to claim **1**, wherein the surfaces of said insulating feed rollers comprise rubber.

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