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[54] **ELECTROPHOTOGRAPHIC TRANSFER METHOD**

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[52] **U.S. Cl.** ..... **317/262 A**

[51] **Int. Cl.** **G03g 15/00,** H01t 19/00

[58] **Field of Search** ..... 317/262 A, 4; 355/3, 15, 355/17; 250/323–326

[56] **References Cited**

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[57] **ABSTRACT**

A method and means for efficiently transferring a toner image from a transfer member to a transfer sheet by means of a corona discharge wherein an alternating voltage biased with a DC voltage is used to produce the corona discharge to simultaneously neutralize an electrostatic force which is set up between the transfer member and the transfer sheet, thus making it easier to separate the transfer sheet from the transfer member. The voltage is supplied to the corona discharge means by a transformer whose primary winding is connected to an AC source and whose secondary winding is connected to an AC source and the corona discharge means. An oscillator may also be connected to the primary winding of the transformer to improve the DC wave form.

4 Claims, 3 Drawing Figures

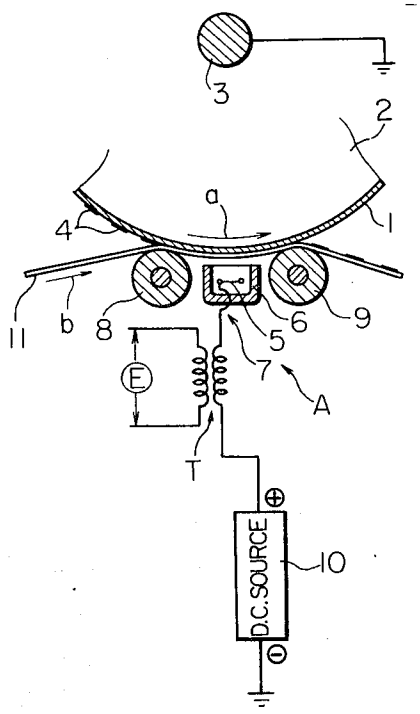


Fig. 1

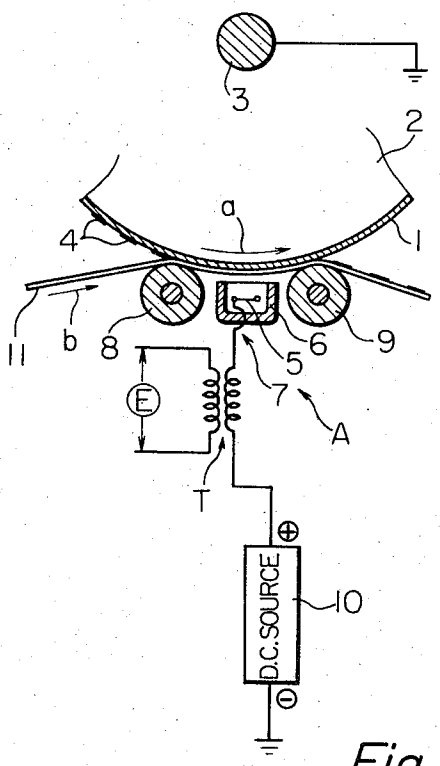


Fig. 3

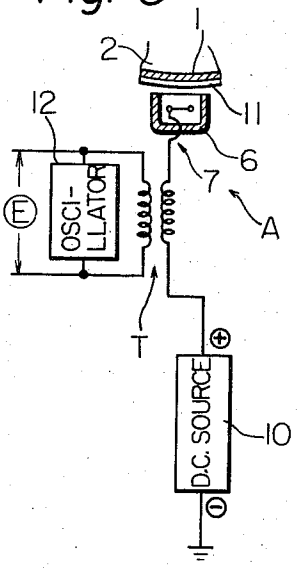
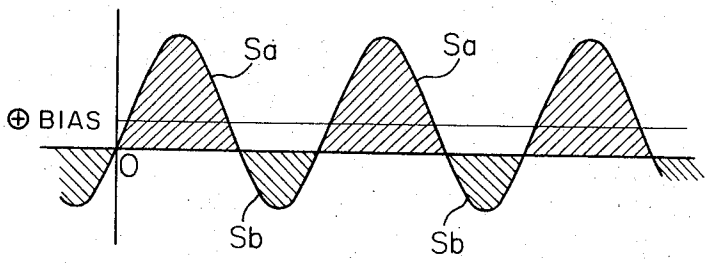


Fig. 2



ELECTROPHOTOGRAPHIC TRANSFER METHOD

BACKGROUND OF THE INVENTION

The present invention relates to electrophotographic image transfer and more particularly to a method and means for improving the separation of the transfer sheet from the transfer drum after toner transfer.

In electrophotography, such a xerography wherein a transfer member having a photoconductive surface is supplied with a charge layer and exposed to light to form a latent image thereon, and the latent image is developed by toners and the toner image is transferred to a transfer sheet, when transferring the toner image, the transfer member is brought into contact with the transfer sheet and a corona discharge is started from the rear side of the transfer sheet to transfer the toner image from the transfer member to the transfer sheet.

Hitherto, the corona discharge used in such a transfer was usually effected by applying a high DC voltage to a wire or a needle-like electrode in order to generate an uniform voltage whose polarity depends on the charged polarities of the toners and the layer of photoconductive material.

However, in the case of starting a corona discharge through the application of high DC voltage like this, an electrostatic force is set up between the transfer member and the transfer sheet and the force makes the transfer sheet difficult to separate from the transfer member after the transfer has been effected.

SUMMARY OF THE INVENTION

The invention provides an electrostatic transfer method wherein an efficient transfer is effected by applying an alternating voltage biased with a DC voltage for neutralizing the electrostatic force which is the cause of the attraction between the transfer member and the transfer sheet to make it easy to separate the two.

For a better understanding of the invention as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic cross sectional view of a transfer device in which the present invention is incorporated.

FIG. 2 illustrates an example of a waveform of the biased AC voltage.

FIG. 3 is a cross sectional view as in FIG. 1 of an embodiment using a wave form shaping oscillator in the corna discharge input circuit.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1, a transfer member 2 consisting of a drum (in the figure, shown with a portion broken away) having a layer of photoconductive material 1 on its outer surface is supported by a grounded shaft 3 so as to rotate in the direction of arrow a. The layer of photoconductive material 1 may be of a material whose charging polarity is positive such as selenium or selenium sulfide. However, the layer of photoconductive material may be made of one of such materials as cadmium sulfide, zinc oxide, poly-N-vinylcarbazole and the like. Also, a sheet provided with those layers may be mounted over the surface of the drum instead of mounting those layers directly upon the drum. Further, this layer of photoconductive material 1 may be, for instance, on an electrostatic recording sheet.

The transfer member 2 is applied with a charge layer upon the surface of the layer of photoconductive material 1 at a position not shown in the figure during the rotation in the direction of arrow a and then exposed to light through a copy image to form an electrostatic latent image. The latent image is then developed as a toner image and the layer of photoconductive material 1 is brought into a transfer position A shown in the Figure.

In the transfer position A, a charging device 7 consisting of a wire electrode 5 stretched within a frame 6 is positioned facing transfer member 2 and on each side of this charging device 7, transfer rollers 8 and 9 are mounted in pressure contact with the transfer member 2. The electrode 5 may also be a needle-like electrode.

The wire electrode 5 is connected to the secondary winding of transformer T and the primary winding of the transformer is connected to an alternating current source. The secondary winding of the transformer is connected to a positive pole of a DC source 10 whose negative pole is grounded.

The wire electrode 5 is supplied with an AC voltage E whose effective voltage is substantially the same as the corona starting voltage and a DC voltage whose magnitude is substantially one half of the AC effective voltage. The resultant wave form is biased to the positive side as, for instance, shown in FIG. 2.

In FIG. 1, the transfer sheet 11 is fed between transfer member 2 and transfer roller 8 in synchronism with the rotation of transfer member 2 and pressed by both rollers 8 and 9 so as to come into pressure contact with transfer member 2. Sheet 11 is applied with a corona discharge from the rear side through wire electrode 5 and proceeds in the direction of arrow *b*.

During the positively biased portion of the applied voltage, i.e., a cycle portion S*a* wherein the DC voltage is added upon the alternating voltage, a corona discharge of reverse polarity with that of the image forming toners is started to effect an efficient transfer. Further in the negatively biased portion of the applied voltage, i.e., a cycle portion S*b* of reverse polarity wherein the DC voltage is deducted from the AC voltage, a corona discharge is started between transfer member 2 and transfer sheet 11 to such a degree as to neutralize the electrostatic force induced between transfer member 2 and transfer sheet 11 during the positive cycle portion.

More particularly, during the negative cycle portion *sb*, since the AC voltage is decreased by the DC voltage, the toners which were attracted to transfer sheet 11 through the corona discharge during the positive cycle portion S*a* will not be repelled but rather either the charge upon the transfer member 2, overcharged through the corona discharge during the positive cycle portion S*a*, or the residual charge at the time of forming the toner image, will be neutralized whereby the subsequent separation of transfer sheet 11 from the transfer member 2 may be effected easily without the need for any additional separating force or means.

Further, the magnitude of applied voltage S*a* and S*b* may be controlled through the selection of the capacities of the transformer T and the DC source 10. So that if these are made variable the voltage may be adjusted thereby. It is mainly determined by the charging char-

acteristics of toners which of S*a* and S*b* is made larger or whether the polarity of the DC bias voltage is made positive or negative. However, the absolute value of the DC bias voltage is preferably slightly less than one half of the effective value of the AC voltage and is preferably larger than 500 volts.

Further, as shown in FIG. **3**, when a wave form shaping device such as an oscillator **12** is mounted on the AC side of the transformer, the control of wave forms of S*a* and S*b* may be improved.

In accordance with the method of the present invention, not only an efficient transfer is effected but also the separation of a transfer sheet from a transfer member is effected easily through the utilization of a biased AC voltage whereby the electric power for the charging device becomes very cheap. Further, a sheet like member may used as the above-mentioned transfer member.

While the invention has been described with reference to the structure disclosed herein it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purpose of the improvements defined in the following claims.

What is claimed is:

1. In an electrophotographic device of the type comprising:

a. a transfer member having a photoconductive surface;

b. means for producing a toner image on said photoconductive surface;

c. means for bringing one surface of a transfer sheet into contact with said toner image on said photoconductive surface at a transfer station; and

d. charging means at said transfer station for creating a corona discharge adjacent the opposite surface of said transfer sheet when brought into contact with said photoconductive surface to facilitate the transfer of said toner image thereto;

wherein the improvement comprises:

e. means for supplying a DC biased AC voltage to said charging means for creating said corona discharge to facilitate the separation of said transfer sheet from said photoconductive surface.

2. A device as in claim **1** wherein the effective value of said AC voltage is substantially that of the corona discharge starting voltage and the effective value of said DC voltage is approximately half of that of said AC voltage.

3. A device as in claim **1** wherein said voltage supplying means comprises a transformer whose primary winding is connected to an AC source and whose secondary winding is connected to said charging means and a DC source.

4. A device as in claim **3** further comprising an oscillator connected to said primary winding.

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