

United States Patent

Young

[15] 3,640,249

[45] Feb. 8, 1972

[54] TRANSFER APPARATUS

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[22] Filed: Oct. 29, 1969

[21] Appl. No.: 872,175

[52] U.S. Cl. 118/637, 117/17.5, 355/3

[51] Int. Cl. B05b 5/02, G03g 13/00

[58] Field of Search 118/637; 117/17.5; 96/1, 1 A, 96/1 C, 1 SD, 1.4; 95/1 A; 355/3

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2,889,758	6/1959	Bolton	118/637 X
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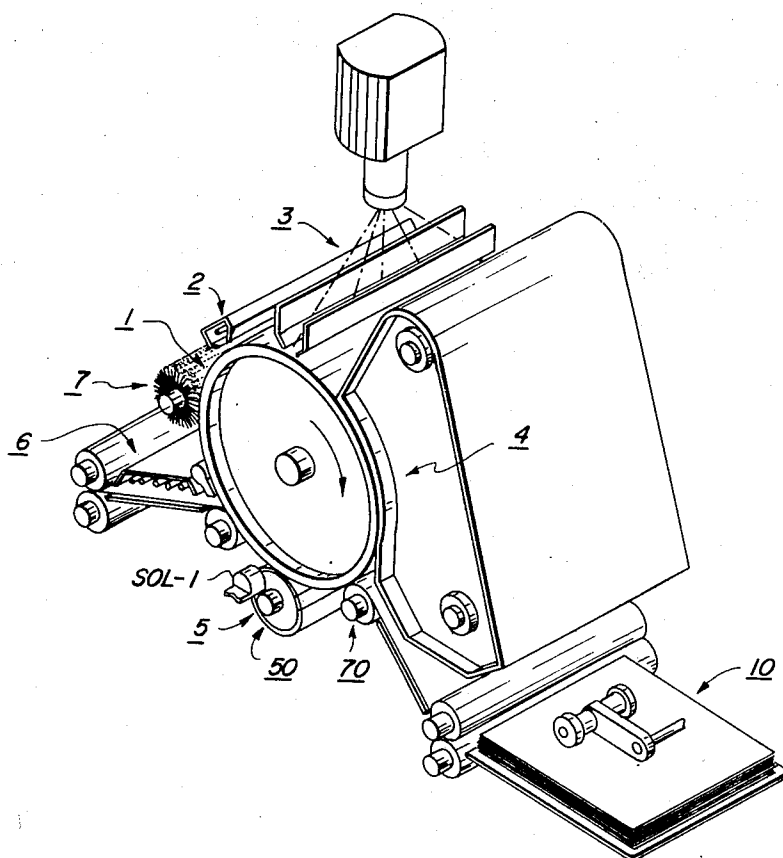
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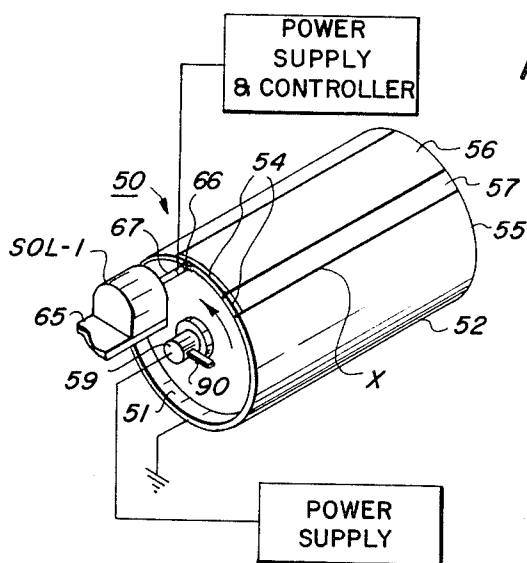
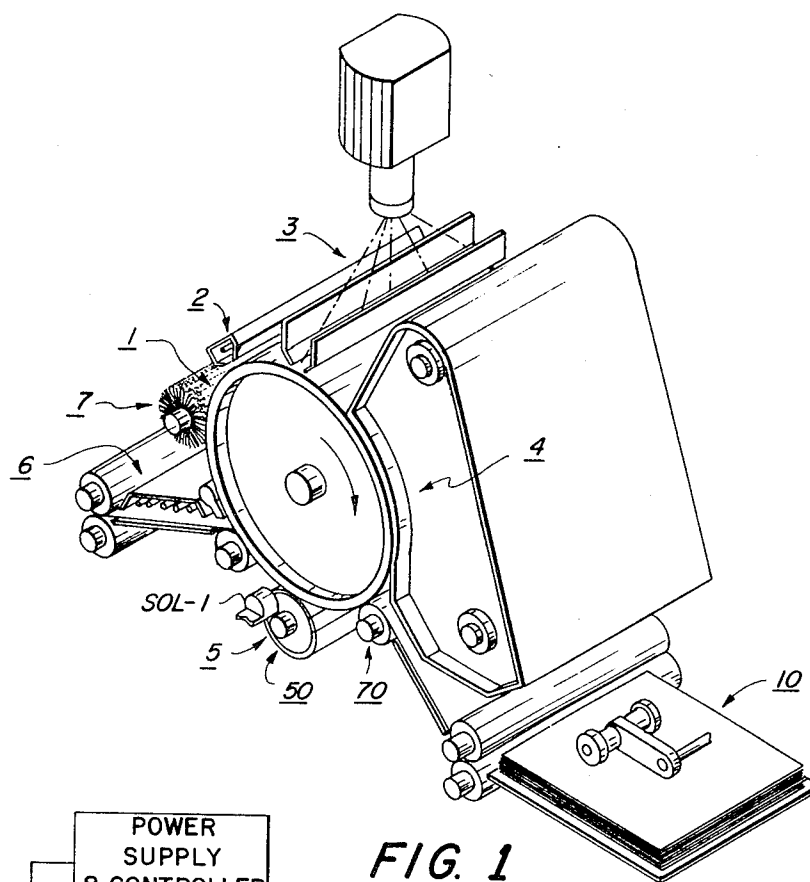
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ABSTRACT

Apparatus for effecting transfer of electroscopic toner particles from a surface carrying electrical charges in image configuration to a support medium. An electrically biased transfer roller having an outer peripheral surface of electrically isolated segments of a conductive resilient material is positioned adjacent the electrical charge carrying surface with the support medium passing therebetween. The electrically isolated conductive segments are selectively actuated in response to the length of the support medium to effect transfer of the electroscopic toner particles thereto to the exclusion of effecting transfer of the toner particles to the transfer roller surface.

7 Claims, 2 Drawing Figures





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TRANSFER APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to apparatus for transferring electroscopic toner particles to a support medium and, in particular, to an electrically biased transfer roller positioned adjacent an electroscopic toner particle bearing surface with a support medium passing therebetween to effect transfer of the particles to the support medium.

More specifically, this invention relates to an electrically biased transfer roller having an outer peripheral surface comprising electrically isolated conductive rubber segments selectively actuated to effect transfer of the toner particles to the support medium without transferring toner particles onto the transfer roller per se.

In a document reproducing system utilizing a reusable imaging member, such as xerography, it is important that the image reproduction be easily and efficiently transferred from the intermediate imaging member (i.e., photoreceptor) to a support medium upon which the image is permanently affixed. One such system for effecting the transfer of marking particles or toner to a support medium is disclosed in C. F. Carlson, U.S. Pat. No. 2,588,699 wherein a uniform electrostatic charge is applied to the side of the support medium opposite the electroscopic toner powder by an ion-producing source such as an array of ion emitting filaments suitably coupled to a high voltage source.

Another system for effecting the transfer of toner particles to a support medium is an electrically biased transfer roller utilized in place on the ion-producing filaments disclosed in the Carlson patent. Such a transfer apparatus is disclosed in C. J. Fitch, U.S. Pat. No. 2,807,233 and comprises a transfer roller including an inner metallic portion and an outer portion of a very resilient or yielding material with a high electrical resistance, as for example a layer of soft semiconducting rubber having an electrical resistivity of approximately 10^6 ohms. per cubic centimeter. An electrically biased transfer roller offers certain advantages over an ion-producing source, such as a corotron, in that the transfer efficiency of the electroscopic toner powder to the support medium is more efficient and less sensitive to relative humidity. In addition, more positive control is exercised over the support medium as it passes through the transfer station thereby eliminating the necessity to strip the support material from the photoreceptive surface. A further and very important advantage is that a reference point can be established to allow a sequential transfer of images to a single support medium in registration. Such a registered sequential transfer is useful in color-reproducing systems wherein an original document is imaged onto a photoreceptor through optical color separation filters to form a series of latent images which are developed by the application of electroscopic toner powder in accordance with the color separation to create a reproduction of the original document. The series of color separated electroscopic toner powder images are sequentially transferred to a support medium before becoming permanently affixed thereto. During the sequential transfer of these images, the registration of one color separated image relative to another is an extremely critical parameter.

However, it has been found that if the transfer roller contacts the photoreceptive surface without a support medium being present therebetween, toner powder is offset onto the transfer roller effecting the uniformity of subsequent transfers and causing toner powder to be offset onto the reverse side of the support medium. This problem is especially aggravated in a color-reproducing system. Therefore, it has not been possible to utilize an electrically biased transfer roller in reproducing systems wherein cut sheet support medium is of different lengths depending upon the length of the document being reproduced.

SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to improve apparatus for transferring electroscopic toner powder to a support medium.

Another object of this invention is to effect transfer of toner powder to a support medium without transferring the powder to portions of the electrode roller devoid of support material.

Still another object of this invention is to electrically isolate selective portions of the transfer roller to effect image transfer in response to the selectively actuated electrically isolated portions.

These and other objects are attained in accordance with the present invention wherein there is provided an electrically biased transfer roller for transferring electroscopic toner particles to a support medium and having an outer peripheral surface of electrically isolated conductive segments selectively actuable to effect transfer of the electroscopic toner particles in accordance with the electrical bias on the isolated segments.

DESCRIPTION OF THE DRAWINGS

Further objects of this invention, together with additional features contributing thereto and advantages accruing therefrom, will be apparent from the following description of one embodiment of the invention when read in conjunction with the accompanying drawings wherein:

FIG. 1 is a perspective mechanical schematic of an automatic xerographic reproducing machine utilizing the invention of this application; and

FIG. 2 is an enlarged portion of the apparatus shown in FIG. 1 to better illustrate the features of the electrically biased transfer roller.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to FIG. 1, there is shown a mechanical schematic of an automatic xerographic reproducing machine utilizing an electrically biased transfer roller 50 constructed in accordance with this invention. The photoreceptive surface 1, is uniformly charged by means of an ion emitting device 2 and exposed to a light image 3 of a document to be reproduced creating an electrostatic latent image on or in the photoreceptive surface. The electrostatic latent image is then developed 4 by applying electroscopic toner to the latent image, illustrated by a cascade development apparatus of a type well known in the art. The electroscopic toner powder image formed thereby is forwarded through a transfer station 5 whereat an electrically biased transfer roller 50 effects transfer of the electroscopic toner powder image from the photoreceptive surface onto a support medium 10 illustrated as a sheet of paper. The electroscopic toner powder image transferred to the support surface is forwarded beneath a fixing device 6 whereat the toner powder is permanently affixed to the paper, and the photoreceptor 1 is rotated through a cleaning station 7 hereat any residual toner powder remaining on the photoreceptive surface is removed and the surface reconditioned for another cycle as is well known in the xerographic art.

The electrically biased transfer roller 50 comprises an inner-metallic portion 51 and an outer portion 52 of very resilient or yielding material having a high electrical resistance, as for example, a layer of soft semiconducting rubber. The conductive rubber is preferably a very poor conductor of electricity and may have an electrical resistivity of approximately 10^6 ohms. per cubic centimeter. The transfer roller 50 is mechanically biased in the direction of the photoreceptor 1 with the support material 10 passing therebetween. To accommodate the transfer of electroscopic toner powder images from the photoreceptive surface to the support medium, without offsetting residual toner powder onto the transfer roller surface, the outer peripheral surface comprises electrically isolated portions 55, 56 and 57.

The portions 55, 56 and 57 of the roller surfaces are electrically isolated from one another by means of thin pieces of dielectric or insulating material such as mylar extending the length of the roller. A suitable electrical contact surface 54 is provided on the end of portions 56 and 57 for a purpose to be hereinafter described in detail.

In a preferred embodiment, the circumference of the arc of portion 55 is substantially 11 inches, the arc of the portion 56 is substantially 3 inches and the arc of portion 57 is substantially 1 inch with the entire circumference of the transfer roller being approximately 14 inches. In operation, the leading edge of a sheet of support material is fed into registration with the leading edge of the portion 55, indicated as point X, as this portion passes in contact with the photoreceptor 1. The electroscopic toner powder image is thereat transferred from the photoreceptor to the support medium in registration therewith by control of a registration gate 70 which functions to register and synchronize the position of support material 10, transfer roll 50 and the toner powder image to insure that the leading edge of the support material 10 arrives at point X at the time the leading edge of the toner powder image on the photoreceptor is at that position.

In the event that the support medium is, for example, a sheet of paper 11 inches in length, only electrically isolated portion 55 is electrically biased to attract the toner powder to the support medium. This portion is continuously electrically biased during machine operation through the transfer roller shaft. When the support medium does not extend about the entire peripheral surface of the transfer roller, electrically isolated portions 56 and 57 are not energized, or are energized with an electrical charge of a polarity the same as the electroscopic toner powder to prevent the toner powder from transferring to these surfaces. When it is desired to utilize sheet material of, for example, 13 inch length the portion 55 of the transfer roller which is continuously energized, and the electrically isolated portion 56 are energized to effect image transfer through 13 inches of the roller's circumference. In this example the electrically isolated portion 57 would not be energized or would be energized with an electrical bias of a polarity the same as the electroscopic toner powder to prevent offsetting of toner powder onto the roller surface.

To effect energization of the electrically isolated portion 56 (and/or 57 as required) a solenoid SOL-1 is carried by a support member 65 and positioned adjacent the transfer roller. The plunger of the solenoid is mechanically coupled to a suitable electrical contact 66 through an insulator 67 such that upon energization of the solenoid the plunger is extended to couple with the suitable contact surface 54 on the portion 56 at the transfer zone whereat portion 56 is most immediate the photoreceptor. A sensor 90 is positioned adjacent the drum shaft to send the rotational position of the transfer roller and to control the energization of the solenoid to extend the plunger energizing the electrically isolated portion 56 only when that portion is passing adjacent the photoreceptor. A sheet of support material is forwarded by a sheet feeding apparatus and registered against registration stops 70 to be forwarded into contact with point X in registration with an image formed on the photoreceptor. The rotational position of the transfer roller is determined by the sensor 90, in accordance with any conventional manner such as a limit switch—detent or photocell system, and functions to release the registration gate and energize the solenoid SOL-1 to apply the power supply to the portions 56 and/or 57 in accordance with the length of the support medium. This actuation of the solenoid may be preset by a controller such as a timer actuated in

response to the rotational position of the roller determined by sensor 90.

The transfer roller 50 and, therefore, the outer peripheral surface portion 55 is connected to a suitable power supply, for example 1,000 volts, of a polarity opposite that of the charge on the electroscopic toner powder through the roller shaft 59. The power supply creates an electric field between the transfer roller 50 and the conductive plate of the photoreceptor 1 to cause the electroscopic toner powder adhering to the photoreceptor to transfer onto the support medium. A second power supply of the same magnitude and polarity is coupled to contact 66 carried by the plunger of solenoid SOL-1 and is applied to the portions 56 and/or 57 in accordance with the length of the support medium being utilized in the reproducing machine.

While the invention has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the true spirit and scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teaching of the invention without departing from its essential teachings.

What is claimed is:

1. Apparatus for effecting the transfer of electroscopic toner powder to a support medium including
 - a rotatable member having an outer peripheral surface of a highly electrical resistive material adapted to retain an electrical charge,
 - said outer peripheral surface being divided into electrically isolated portions, and
 - mean to selectively electrically charge said isolated portions.
2. The apparatus of claim 1 wherein said means to selectively electrically charge said isolated portions is actuated in response to the length of a support medium.
3. The apparatus of claim 1 wherein said electrically isolated portions of said outer peripheral surface are electrically charged to opposite polarities.
4. Apparatus for effecting the transfer of electroscopic toner powder to a support medium including
 - a rotatable member having an outer peripheral surface of a material capable of carrying an electrical charge,
 - said outer peripheral surface being divided into electrically isolated portions, and
 - mean to selectively electrically charge said isolated portions.
5. The apparatus of claim 4 wherein one of said electrically isolated portions is charged to a polarity opposite to the electrical charge of electroscopic toner powder to be transferred to a support medium.
6. The apparatus of claim 4 wherein said rotatable member is positioned adjacent an electroscopic toner bearing surface with a support medium passing therebetween in contact with said member and said surface.
7. The apparatus of claim 4 wherein said means to selectively electrically charge said isolated portions is actuated in response to the length of a support medium adapted to be forwarded in operative contact therewith.

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