

[54] **TRANSFER SYSTEM**

3,781,105 12/1973 Meagher 117/17.5 X

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[51] Int. Cl. **G03g 15/16**

[58] Field of Search 355/3 R, 3 DD, 17, 3;
96/1.4, 1 R; 117/17.5; 317/262 A

[56] **References Cited**

UNITED STATES PATENTS

3,626,260 12/1971 Kimura et al. 317/262 R
3,697,171 10/1972 Sullivan 355/17
3,702,482 11/1972 Dolcimascolo et al. 355/3 X

[57] **ABSTRACT**

A xerographic image is transferred to a support sheet by a field created by an electrode that presses the support sheet against the image it is to receive. An insulating layer on the electrode prevents the transfer of charge from the field source to the support sheet. Discharge means is provided to remove charge collected on the contacting side of the electrode to maintain full field strength and further prevent delivery of charge to the support sheet. With this transfer system, several good quality copies can be produced by a single electrostatic latent image that is redeveloped following each transfer operation.

3 Claims, 3 Drawing Figures

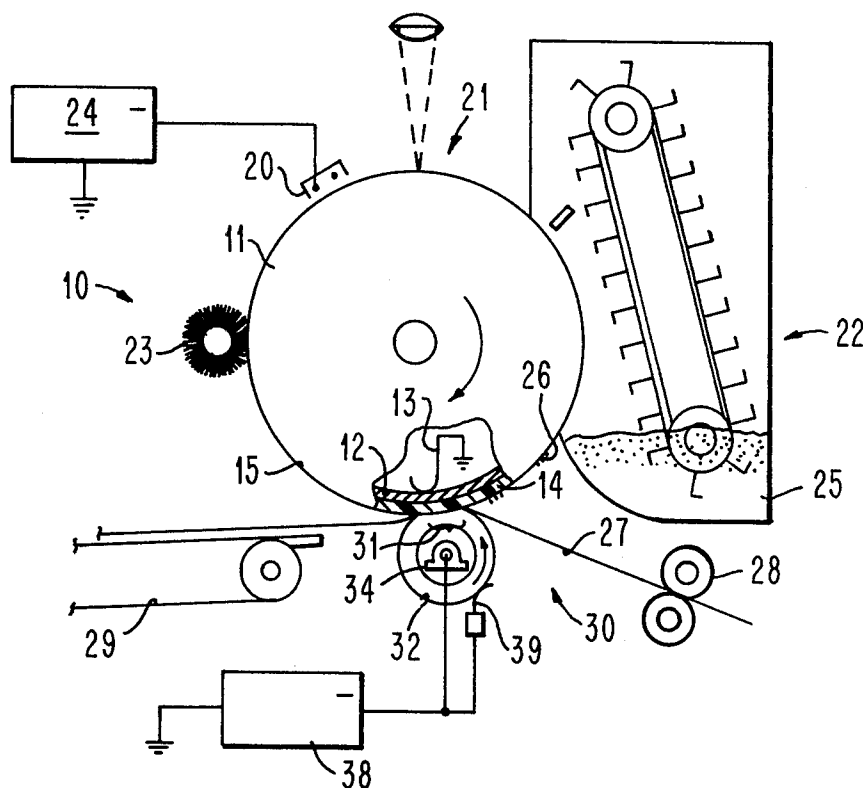


FIG. 1

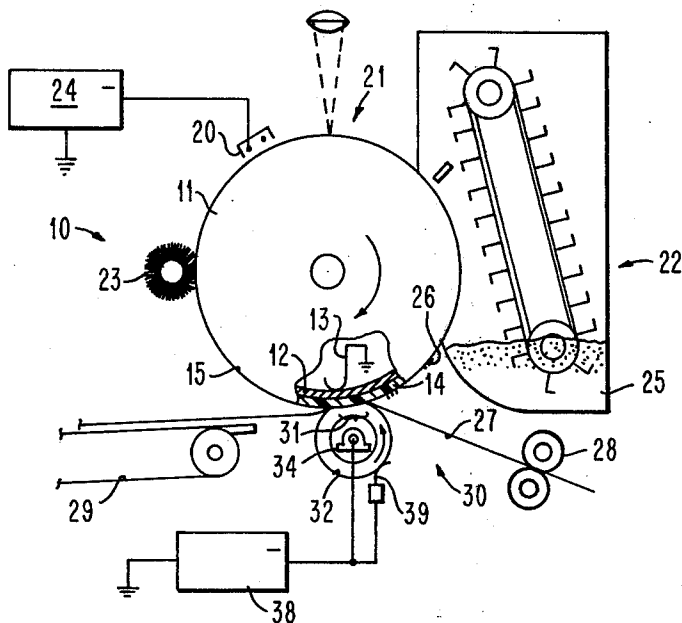


FIG. 2

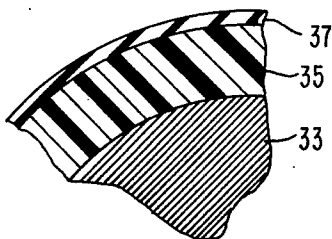
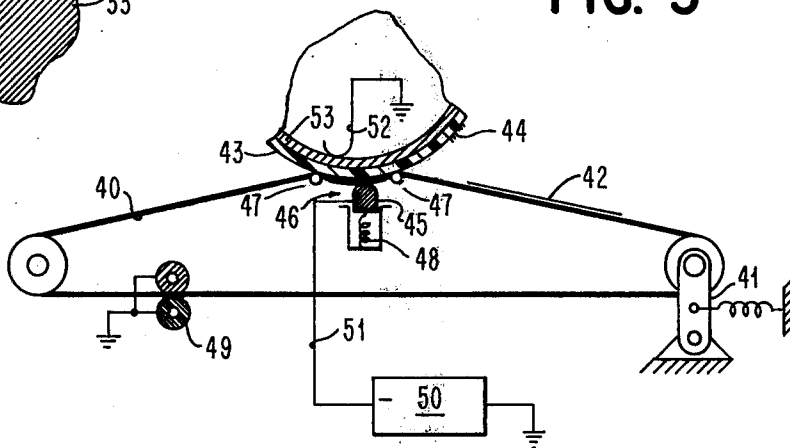


FIG. 3



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TRANSFER SYSTEM

BACKGROUND OF THE INVENTION

While conventional xerography employs a transfer corona that charges the back side of a transfer sheet to develop a field that attracts a toner image from a xerographic drum surface, the art has had many proposals for other techniques to create the required transfer field. U.S. Pat. No. 2,588,900 discloses the use of a field creating electrode for the transfer of an ink image. One form of transfer field creating electrode known is a roll that presses the image receiving sheet against an ink bearing surface while creating a field by a bias electrode internal of the pressing roll. The electrode employs conductive resilient material which contacts the back of the image receiving sheet.

Other alternatives known to the art include the use of a transfer field generating electrode having a dielectric external surface onto which is impressed a charge and wherein the thus charged surface contacts the back of the image receiving sheet.

In recent times it has been proposed to employ a dielectric outer surface on a conductive rubber roll to provide a transfer electrode where no direct current flow is permitted from the bias creating current source to the image receiving sheet. While this technique overcomes some difficulties inherent in systems wherein the image receiving paper directly receives charge during the transfer process, I have found that the quality of transfer deteriorates due to the accumulation of charge on the dielectric outer surface of the electrode and the presence of attractable ions in the vicinity of the transfer electrode.

DISCLOSURE OF THE INVENTION

My invention provides an improved transfer station by employing a transfer field creating electrode having a dielectric outer surface that prevents current flow from the biased field creating source to the image receiving sheet and includes means for removing charge that tends to accumulate on the dielectric outer surface. The preferred embodiment of my invention employs as the transfer electrode, a roll of deformable conductive rubber that surrounds a metal central shaft through which bias potential is introduced and which has a thin dielectric outer layer for contacting the backside of the image receiving sheet. A brush or similar electrically conductive contact means rubs the surface of the dielectric layer and is connected to the same potential as the roll shaft to provide a conductive path with no external field applied thereby enabling discharge of any charge accumulating on the outer surface of the transfer roll. The removal of charge from the transfer electrode assures that the full applied electrostatic field will be available to the transfer process. I have also found that by eliminating the transfer of charge to the image receiving material the transfer process and separation of the transfer receiving material from the xerographic drum does not disturb the latent electrostatic image. The image is thus available for repeated redevelopment as described in U.S. Pat. No. 3,736,055 for example.

These and other objects, features and advantages of my invention will be more fully understood by those skilled in the art from the following description of a specific illustrative preferred embodiment thereof,

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wherein reference is made to the accompanying drawings of which:

FIG. 1 shows a xerographic printing machine including a transfer roll constructed in accordance with a preferred embodiment of my invention.

FIG. 2 shows an enlarged fragmentary cross-sectional view of the transfer roll shown in FIG. 1.

FIG. 3 shows a partial cross-sectional view of a xerographic printer employing a modified transfer system constructed in accordance with my invention.

Referring now more specifically to the drawings, in FIG. 1 there is shown a typical xerographic printer or copy machine 10 including a drum 11 having an electrically grounded conductive backing plate 12 that is grounded through lead 13. A photoconductive layer 14 is carried by the drum 11 to provide an imaging surface 15. The imaging surface 15 rotates with the drum 11 to successively pass a charge corona unit 20, an image discharge station 21, a development station 22 and transfer station 30 and cleaning station 23. A uniform negative charge supplied by power supply 24 through corona unit 20 to the surface 15 is image-wise discharged at image station 21 to provide a differential electrostatic charge latent image that is presented to the development station 22. Positively charged toner marking particles in a developer mix 25 are applied by development station 22 to the electrostatic latent image where they are selectively attracted to the surface 15 to provide a physical image 26. Image support materials such as paper sheets 27 are supplied by feed rolls 28 to the transfer station 30 in timed synchronism with the arrival of the physical image 26.

At the transfer station 30 the sheet material 27 is lightly pressed into contiguous relative with the imaging surface 15 and the physical image 26 thereon over a region 31 by a yieldable cylindrical transfer roll 32. An electrostatic field created by negative bias supplied to the transfer roll 32 opposite region 31 and the grounded backing plate 12, moves the positive toner particles of the physical image 26 toward the sheet material 27 and into intimate contact therewith. When the sheet material 27 is separated from the image surface 15 and the transfer roll 32, it carries with it a substantial proportion of the physical image 26. The imaged sheet is transported by conveyor 29 to a fixing station (not shown) in accordance with techniques well known to those skilled in the art.

The structure of transfer roll 32 is best seen with reference to FIG. 2. Roll 32 comprises a central metal electrode shaft 33 carried by rotational support bearings 34, FIG. 1. A relatively thick deformable layer or body 35 of a conductive rubber material is formed about the shaft 33 to form the roll-like shape. The outer surface of the roll 32 is provided by a thin dielectric current flow barrier layer 37 that is flexible so as to allow its deformation along with the layer 35. A transfer bias potential power source 38, FIG. 1, is electrically connected through the shaft 33 and conductive rubber layer 35 to apply the transfer field across the region 31. The transfer field thus created is defined by the potential difference between the grounded backing plate 12 of the xerographic drum 11 and the potential of bias power source 38 separated by the thickness of dielectric layer 37, the thickness of image support sheet 27, the thickness of photoconductive layer 14 and any space therebetween. The presence of dielectric layer

37, however, prevents transfer of charge from bias power source 38 to the image support sheet 27.

A conductive wiper 39 extending the entire width of the transfer roll 32 is electrically connected to bias potential source 38 and is located on the backside of the transfer roll 32 to remove charge from the outer surface of layer 37 during each rotation of the transfer roll 32. The charge to be removed results from the accumulation of ions from the sheet material 27 and from the surrounding atmosphere onto the surface of layer 37 due to the fields created by the potential internal of the roll 32. If this charge is not periodically removed, it would eventually build up to the potential of bias power supply 38 and thereby negate the transfer field. Accumulation of lesser amounts of charge reduce the efficiency of the transfer operation and cause it to be variable depending upon the particular state of the accumulation of such ions during any particular operation. By periodically removing this charge, the transfer roll 32 is maintained at peak efficiency and the effective field is made more constant and predictable.

My invention can be implemented in forms other than the preferred transfer roll embodiment shown. For example, FIG. 3 shows a dielectric belt 40 that is tensioned by spring biased link 41 for resiliently urging a copy sheet 42 into contact with a photoconductive imaging surface 43 and physical image 44 thereon. A transfer electrode 45 is positioned opposite the region 46 where a pair of idlers 47 urge the belt 40 toward surface 43. A spring 48 lightly biases electrode 45 against the inner surface of belt 40. With this arrangement, it is possible for charge to accumulate on both the inner and outer surfaces of the belt 40. A pair of conductive grounding rolls 49 are thus provided to contact opposite surfaces of the belt 40 simultaneously thereby enabling discharge of any charge that may tend to accumulate on either surface. The transfer field is created across contact region 46 by bias power supply 50 connected by wire 51 to electrode and grounded wiper 52 which engages the photoconductor backing plate 53.

Those skilled in the art will recognize that various changes, additions and substitutions can be made to the embodiments shown without departing from the scope and spirit of my invention. Thus my invention is to be measured solely by the appended claims.

I claim:

1. An electrostatic printer of the type having an imaging surface on which an electrostatic image can be im-

pressed and a physical image developed thereon with marking material bearing an electrostatic charge of a first polarity, transfer means cooperable with said imaging surface and with image support material for transferring at least a portion of said physical image from said imaging surface to said image support material, said transfer means including movable and yieldable cylindrical means having an outer surface for pressing said image support material into contiguous relation with said imaging surface and the physical image thereon, said outer surface being formed of a thin dielectric material to provide a current flow barrier layer, and transfer electrostatic field applying means positioned opposite the region of said contiguous relation, wherein the improvement comprises:

electrical conductor means contacting said dielectric material at a location displaced from said region of contiguous relation and providing a conductive path for periodically removing charge from said outer surface of said yieldable cylindrical means.

2. An electrostatic printer as defined in claim 1 wherein said transfer field applying means comprises means defining a ground plate behind said imaging surface, and a body of conductive material positioned opposite said region of contiguous relation and a source of electrical potential operatively connected to said body of conductive material and said means defining a ground plate, wherein the improvement further comprises:

means connecting said source of electrical potential to said electrical conductor means.

3. An electrostatic printer as defined in claim 1 wherein said yieldable cylindrical means comprises a transfer roll including rotational support means, internal electrode means, a deformable body of conductive material defining a roll-like shape surrounding said internal electrode means and in current flow communication therewith, and a thin dielectric layer surrounding said deformable body and providing said outer surface of said transfer roll, wherein said transfer field applying means comprise a source of bias potential of a polarity opposite to said first polarity connected to said internal electrode means, and wherein:

said electrical conductor means engages said outer surface of said dielectric layer and is electrically connected to said source of bias potential.

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