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(54) **Method and apparatus for directly transferring developed images from a photoconductive drum to a print medium.**

(57) Method and apparatus for electrophotographically transferring a developed color image on the surface of a photoconductive drum (10) directly to an adjacent print media (30). The print media (30) is operative to pass between the one abutting surface location on the photoconductive drum (10) and an adjacent surface location on a transfer roller (28) which is connected to receive a DC bias voltage (42). Once a composite color image has been developed on the surface of the photoconductive drum (10), this surface is illuminated with light (76) within a chosen wavelength range and intensity to thereby cause hole-electron pairs (88) within a layer (90) of the photoconductive drum (10) to recombine and thereby reduce the net voltage across the photoconductive surface layer or layers (78, 86, 90) to a level on the order of about thirty (30) volts (Fig. 2C). In this manner, the DC bias voltage (42) applied to the direct transfer roller (28) can be made larger than otherwise possible, thereby increasing the maximum achievable electrostatic field strength between the surface of the transfer roller (28) and the photoconductive drum (10). This feature of increasing the electrostatic field strength across the print medium (30) improves image transfer fidelity and print quality during the electrophotographic printing process.

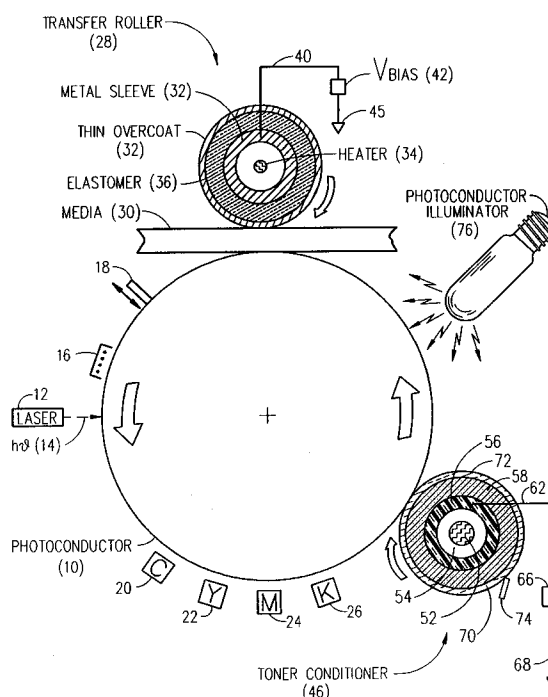


FIG. 1.

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Technical Field

This invention relates generally to electrophotographic color printing and more particularly to such printing using the direct transfer of liquid toners to a print medium.

Background Art and Related Applications

The use of liquid color toners in color image development processes is generally well known in the art of electrophotography and is described, for example, in U.S. Patent No. 4,286,039 issued to Landa et al, and in U.S. Patent No. 4,946,753 and U.S. Patent No. 4,925,766 both issued to Elmasry et al, all incorporated herein by reference.

In European Patent Application No. 92108239.2 filed 15 May 1992, and entitled "Electrostatically Assisted Transfer Roller And Method For directly Transferring Liquid Toner To A Print Medium", there are disclosed and claimed new and useful improvements in the art and technology of direct transfer electrophotographic color printing using liquid color toners. This co-pending application describes, among other things, the various advantages of using direct transfer techniques for transferring a composite color image directly from a photoconductive drum of an electrophotographic printer to an adjacent print medium. This approach is in contrast to the prior art which uses an intermediate transfer member (ITM) for first transferring a developed color image from the photoconductive drum to the surface of the intermediate transfer member and then subsequently transferring the developed color image from the surface of the intermediate transfer member to an adjacent print medium.

In the European patent application identified above, there is further described a method and apparatus for electrostatically assisting in the direct transfer of a developed color image directly from the surface of a photoconductive drum and to the surface of print media adjacent to which a direct transfer roller apparatus is positioned. This method and apparatus uses a combination of mechanical pressure, heat and electrostatic forces applied to the transfer roller during the direct image transfer process. This co-pending application discloses a preferred construction and embodiment of the direct transfer roller apparatus which is connected to receive a predetermined DC bias voltage for establishing an electrostatic transfer field between the surface of the transfer roller and an adjacent abutting surface of the photoconductive drum.

In European Patent Application No. 92108240.0 filed 15 May 1992, and entitled "Improved Conditioning Roller And Method Of Operation For Use With A Photoconductive Drum In An Electrophotog-

raphic Color Printer", there are disclosed and claimed new and useful improvements in conditioning the liquid toner on the photoconductive drum and reducing the isopar fluid therein to further enhance the performance of the direct color image transfer process and improve the print quality of the printed color image. Both of the above-identified European patent applications are incorporated herein by reference.

Whereas the inventions described in both of the above-identified applications represent a most significant advance in the art and technology of direct transfer electrophotographic color printing, there are nevertheless certain limitations which are imposed upon the level of the electrostatic field that can be applied between the transfer roller and the adjacent photoconductive drum surface without causing unacceptable electrostatic field breakdown conditions at the transfer roller/photoconductive drum interface through which the print medium passes. It is the solution to this latter problem to which the present invention is directed.

Disclosure of Invention

Accordingly, the general purpose and principal object of the present invention is to provide still further new and useful improvements in the art and technology of using color toners for directly transferring color images from the surface of a photoconductive drum onto an adjacent print medium.

Another object of this invention is to provide a new and improved method and apparatus of the type described which is useful in optimizing the conditions under which the direct transfer of a color image from the surface of a photoconductive drum to an adjacent print media takes place in the location where the print media passes between and in intimate contact with the drum and a transfer roller.

Another object of this invention is to provide a new and improved method and apparatus of the type described which is economical to manufacture, reliable in operation, and has a high price/performance figure of merit.

Another object of this invention is to provide a new and improved method and apparatus of the type described which is operable to eliminate air ionization problems previously encountered with earlier developed direct transfer electrophotographic color printers.

Another object of this invention is to provide a new and improved method and apparatus of the type described which serves to reduce electrical stresses on a photoconductive drum member of an electrophotographic printer, thereby in turn increasing the lifetime of the photoconductive drum.

A novel feature of this invention is the provision of a new and improved method and apparatus of

the type described wherein lower organic photoconductor (OPC) potentials are developed in the non-imaged OPC areas due to the overall illumination employed herein. This feature in turn helps prevent air ionization and other undesirable paper charging problems.

The various above objects of this invention, together with its attendant advantages and novel features, are accomplished herein by a method of electrophotographic color printing which includes the steps of:

- a. developing a composite color image on the surface of a photoconductive drum,
- b. illuminating the surface of the photoconductive drum with light within a chosen wavelength range corresponding to the wavelength characteristic of the photoconductive drum to thereby cause hole-electron pairs within a layer of the photoconductive drum to recombine and reduce the net voltage across the photoconductive drum layer to a level on the order of about +30 volts, and thereafter
- c. bringing a direct transfer roller into intimate contact with a print medium passing between the transfer roller and the surface of the photoconductive drum while simultaneously
- d. applying a predetermined DC bias voltage to the direct transfer member, whereby the reduction of voltage across the surface layer of the photoconductive drum permits a corresponding increase in DC bias voltage to be applied to the direct transfer roller. This feature, in turn, increases the strength of the electrostatic field which may now be established between the surface of the photoconductive drum and the surface of the transfer roller to thereby, in turn, increase the achievable electrostatic forces for pulling the charged toner and the develop color image from the surface of the photoconductive drum onto the print medium.

The above novel operation thus has the effect of improving the fidelity and print quality of the composite color image which is transferred from the surface of the photoconductive drum onto the adjacent surface of the print medium which passes between the photoconductive drum and the adjacent biased transfer roller.

The brief summary of the invention, together with its many attendant advantages, will become better understood with reference to the following description of the accompanying drawings.

Brief Descriptions of the Drawings

Figure 1 is an abbreviated schematic diagram illustrating the electrophotographic color printer and method of operation according to the present invention.

Figures 2A, 2B, and 2C illustrate the hole-electron pair charge neutralization process across the surface layer of the photoconductive drum member in Figure 1.

Figure 3 is a graph of absolute electrostatic pressure, $|P_e|$, developed across the print media versus nip dwell time. These two graphs plot a comparison of the prior art condition in the lower curve in Figure 3 where there is approximately +100 volts on the photoconductive drum and with approximately +30 volts on the photoconductive drum for the upper curve shown in Figure 3 using the process of the present invention.

Detailed Description of the Drawings

Referring now to Figure 1, there is shown an organic photoconductive drum 10 which is positioned adjacent to a source 12 of monochromatic (e.g. laser) light 14 used for developing color images on the surface of the drum 10. The apparatus in Figure 1 further includes a conventional corona charge mechanism 16 for the drum 10 and a conventional drum surface cleaning apparatus 18 mounted as shown adjacent to the surface of the photoconductive drum 10.

Cyan, yellow, magenta, and black color liquid toner sources 20, 22, 24, and 26 are located as shown adjacent to the lower surface of the photoconductive drum 10, and these color and black sources of transparent liquid toner are constructed and operated in a well known manner understood by those skilled in the electrophotographic color printing arts and are therefor not described in any significant detail herein. For a further discussion of the general construction and operation of these color and black sources 20, 22, 24, and 26 of liquid toner, reference may be made to the above identified Elmasry et al and Landa et al patents.

A heated and electrically biased transfer roller is designated generally as 28 and is rotatably mounted as shown above the upper surface of the photoconductive drum 10. The transfer roller 28 is operative to be driven against the upper surface of a print medium 30, such as paper, which passes between the outer surface of the transfer roller 28 and the outer surface of the organic photoconductive drum 10. Preferably, the transfer roller 28 is constructed and operated in accordance with the principles and teachings in the above identified co-pending application Serial No. 07/704,572, filed in May 17, 1991, and will include a conductive inner core member 32 within which a heater element 34 is located. The conductive inner core or metal sleeve member 32 is surrounded at its outer surface by a first cylindrically formed elastomer layer 36 which in turn is coated by a thin outer protective coating 38. The metal inner core member 32 is

connected by way of a conductor 40 to a source 42 of electrical bias, the other side of which is grounded at node 44.

A cylindrical air gap 45 separates the centrally located heater element 34 from the inner metal sleeve 38, and the heater element which is positioned at the axis of rotation of the transfer roller 28 will preferably be an elongated quartz heater tube. This heater tube will typically be heated during an image transfer operation to a controlled elevated temperature on the order of 80 - 90 °C or greater to provide the thermal energy in combination with electrical and mechanical forces in the nip zone of the transfer roller 28 which makes direct contact with the media 30. Typically, the inner metal sleeve 32 will be DC biased to a voltage in excess of minus 900 volts DC, and a mechanical pressure will also be applied to the nip zone at a level on the order of five (5) psi or greater.

Referring now to both Figures 1 and 2, a liquid toner conditioning and stabilizing apparatus is indicated generally as 46 and is located as shown on the right hand side of the photoconductive drum 10. This toner conditioning apparatus 46 is operatively driven by a drive motor 48 and drive belt 50 in intimate contact with the outer surface of the photoconductive drum 10. The toner conditioning and stabilizing apparatus 46 also includes a centrally disposed heating element 52 which is surrounded first by a cylindrical air gap 54 and then by an inner metal roller core 56 of a suitable metal such as aluminum. The heating element 52 may also be an elongated quartz tube positioned at the rotational axis of the conditioning roller 46. The roller core member 56 is surrounded by a metal slip ring 58 which is in turn connected through a bias electrode 60 and an interconnect pin 62 within the adjacent housing 64 to source 66 of DC bias, the other side of which is grounded at node 68. The outer surface of the metal slip ring 58 is surrounded by a soft core elastomer material 70 having a very smooth outer surface 72 which is required in the toner conditioning operation to be described below. The outer core member 70 may for example be a conductive silicone or a conductive polyurethane material. The reason that the soft core material 70 appears discontinuous in the figures is that the elements 60, 62, and 64 of the biasing arrangement for the slip ring 58 are located in front of the soft core roller 70.

In operation, the heated and biased transfer roller 28 and media 30 are initially moved away from the surface of the organic photoconductive drum 10 during the exposure and development process used for developing layers of cyan, yellow, magenta, and black transparent color toners, one on top of another, on the surface of the photoconductive drum 10. After each successive layer of

cyan, yellow, magenta, and black color toner is initially applied to the surface of the photoconductive drum 10, it is then treated with the toner conditioning apparatus 46 on the right hand side of the drum 10 and then subsequently exposed by light 14 from the monochromatic light source 12 on the left hand side of the photoconductive drum 10.

Then, after the cyan, yellow, magenta, and black color toners have all been exposed and developed to a desired composite image one on top of another and conditioned and stabilized in series by the toner conditioning apparatus 46, the heated and biased transfer roller 28 and print medium 30 are then brought into intimate contact in the position shown in Figure 1 with the surface of the photoconductive drum 10. Here the composite developed color image is transferred to the lower surface of the print medium 30 as a unitary and cohesive polymeric film which holds tightly together all of the developed color toners. As will be seen below, in the absence of using the toner conditioning and stabilizing apparatus 46 as shown in Figures 1 and 2, these color toners would be transferred in discrete particle form from the surface of the photoconductive drum 10 to the underside of the print medium 30. And, as previously indicated, prior art direct transfer electrophotographic color printers have been characterized by a somewhat inefficient and ineffective transfer of all of the developed color images and the discrete particle color toners onto a print medium. However, in accordance with the present invention, a high quality color image is now provided on the under surface of the print media 30.

Each of the sources of color liquid transparent toners 20, 22, 24, and 26 includes a combination of positively charged toner particles which are immersed in a charged isopar toner carrier liquid. When the positively charged surface of the photoconductive drum 10 rotates past these liquid toner sources 20, 22, 24, and 26, the positively charged toner particles are electrostatically pulled onto the surface of the photoconductive drum 10, while simultaneously the negatively charged counter ions are stripped away from their positively charged nuclei and onto an adjacent positively charged substrate (not shown). However, some of the carrier liquid is pulled onto the surface of the photoconductive drum 10 along with the positively charged toner particles which it surrounds and therefore needs to be conditioned and stabilized in order to develop the color-on-color layers of toner into a cohesive and unitary polymeric film. This is accomplished by operation of the toner conditioning and stabilizing apparatus 46 as shown on the right hand side of Figure 1 and in the enlarged cross section view in Figure 2.

From the above description of the toner conditioning apparatus 46, it is seen that this apparatus is operative to provide a combination of mechanical pressure, electrostatic forces, and a low level of thermal energy to the successive layers of liquid toner as they pass in succession counterclockwise against the smooth surface 72 of the outer conditioning soft core roller member 70. The outer roller member 70 is preferably a soft elastomeric material such as a polyurethane or conductive silicone material having a volume resistivity less than about 10^8 ohm • centimeters and a Shore A Hardness less than 30. The soft elastomeric roller 70 outer cover layer must be designed to have a smooth surface finish which is useful to preserve the fidelity of images and must also be blade cleaned to remove excess carrier fluid therefrom.

The inner core 56 of the toner conditioning apparatus 46 is a cylindrical metal sleeve such as aluminum and biased to a maximum allowable DC potential of the same polarity as that of the liquid toner particles. This feature is useful in order to provide a recharging of any electrically discharged toner particles which will naturally take place during the operation of the above color toner development process. Both DC and AC bias may be used on conductor 62 to provide the proper sign and level of toner charge for the efficient transfer of the developed polymeric film on the outer surface of the photoconductive drum 10 directly onto the undersurface of the print medium 30.

Thus, there has been described herein a novel electrophotographic color printing and toner conditioning apparatus 46 which is operative in an efficient manner to properly prepare developed transparent color liquid toners for direct transfer to a receiving sheet of paper. The electrically biased and heated conditioning roller 46 which is in intimate contact with the surface of the photoconductive drum 10 compresses the charged toner particles thereon which are received by the conditioning apparatus 46 in discrete particle form. This electrostatic and mechanical compression by the toner conditioning apparatus 46 of the multiple and serially deposited discrete particle films operates to preserve the fidelity of the images superimposed one upon another, and it also helps prevent degradation of these images. Such degradation may otherwise take the form of poor edge acuity around printed characters, streaks, and general toner scattering.

The electrostatic pressure, P_e , acting on the various toner layers can be shown from Maxwell's well known stress equation to be directly related to the net charge on the toner film times the average of the electrical field above and below the toner film. That is to say:

$$\text{Equation 1: } P_e = [(E_{AT} + E_{BT})/2] \cdot \sigma_{net}$$

where E_{AT} is the electrostatic field above the toner layer, E_{BT} is the electrostatic field below the toner layer and σ_{net} is equal to the net charge on the toner layer on the photoconductive drum 10. This relationship is applicable to the electrostatic pressure, P_e , at both the toner conditioning and stabilizing roller 46 and also to the electrostatically assisted transfer roller 28.

Thus, the biased and heated roller conditioning apparatus 46 will also serve to apply the proper toner charge level and polarity in the case where toners become charge deficient as indicated above. This toner conditioning apparatus 46 is also used to reduce and limit undesirable amounts of liquid carrier (e.g. isopar) that is normally carried out onto the print medium due to its presence on the photoconductor in both image and background regions. This isopar fluid is significantly removed by the conditioning apparatus 46 whose smooth outer surface 72 is continuously cleaned by the wiping action of the cleaning blade 74 as previously described to scrape away residual isopar from the surface 72 of the conditioning roller 46. Optimum cleaning is achieved by the use of a sharp cleaning blade 74 which brushes in intimate contact with the smooth surface 72 of the roller member 46 thereby enabling the isopar excess liquid to be collected in an adjacent container (not shown).

A photoconductor illuminator 76 such as a light emitting diode (LED) array is positioned approximately a distance of two (2) millimeters from the surface of the organic photoconductor 10 and is designed to give off a light wavelength in the vicinity of 840 nanometers. This wavelength is in the wavelength range corresponding to the wavelength range characteristic of the organic photoconductor substrate region, its charge generation layer which is disposed on the surface of the substrate region, and its charge transport layer which is disposed on the surface of the charged generation layer as indicated in more detail in Figures 2A through 2C below. The power level of the LED array should be about 3500 miliwatts per centimeter squared or greater.

Referring now to Figure 2A, the substrate region 78 of the organic photoconductor 10 will retain a negative charge 80 after the photoconductor 10 receives a latent image generated by a laser beam. This process attracts a positive toner charge 82 to the surface 84 of a charge transport layer 86 due to the electrostatic fields present, and also produces photogenerated charged hole-electron pairs 88 within a charge generation layer 90. In the charge generation stage of operation prior to any light exposure from the photoconductor illuminator 76, the photogenerated charge pairs 88 in the

intermediate charge generation layer 90 will remain in the position as indicated in Figure 2A and, in the absence of applying light from the photoconductor illuminator 76, would otherwise represent the charge condition at the surface of the organic photoconductor 10 during transfer of the developed image onto the print media 30.

However, in accordance with the present invention as indicated in Figures 2B and 2C, the application of light from the photoconductor illuminator 76 to the surface of the photoconductor 10 produces the charge transport stage condition in the various layers of the photoconductive drum 10 as shown in Figure 2B. Here the incident light received at the surface 84 of the charge transport layer 86 causes the negative charges 92 in the charge generation layer 90 to be accelerated toward the surface 84 of the charge transport layer 86 and thereby tends to neutralize and reduce the amount of total positive charge that now exists at the surface 84 of the charge transport layer 86. Simultaneously, the positive charge 96 in the charge generation layer 90 is accelerated toward the negative charge 80 in the substrate to thereby nearly neutralize any net charge in the region indicated at 98 in Figure 2C. Thus, Figure 2C represents the condition where the region 98 therein is almost completely neutralized, the charge generation layer 90 is substantially neutralized, and only a small amount of negative charge 100 is left beneath the surface 84 of the charge transport layer 86. This neutralization effect thus leaves a substantially reduced net positive charge density atop the surface 84 of the charge transport layer 86 as shown in Figure 2C. The net effect of this action will be a reduced positive photoconductor potential which will ultimately allow a higher transfer biased to be applied to the transfer roller, thus creating a higher electrostatic transfer pressure.

Thus, in Figure 2A the charge generation stage is represented where charged hole-electron pairs are generated due to light impinging on the surface of the photoconductive drum 10. In Figure 2B, the charged pairs split and migrate toward opposite-signed surface and substrate charge densities. In Figure 3C, there is represented the final stage of charge neutralization where the potential on the surface of the photoconductive drum is near zero. This process takes place in both imaged (toner bearing) regions as well as in the background or unexposed regions.

The organic photoconductor 10 is comprised of a substrate material upon which a thin barrier/sub-layer 78 is formed to a thickness of about 0.1 microns, and the charge generation layer 90 is formed on the surface of this barrier/sub-layer 78, also to a thickness of about 0.1 microns. The charge transport layer 86 is formed on the surface

of the charge generation layer 90 to a thickness on the order of about 10 microns, and the transmittance versus wavelength characteristic for this composite layered structure peaks in the vicinity of 840 nanometers.

Referring now to Figure 3, this figure presents a calculation of the electrostatic pressure pulling a typical liquid toner film from the photoconductor to the paper both with and without the overall illumination at 76 shown in Figure 1. The lower curve in Figure 3 shows the toner transfer pressure for a photoconductor that has not been overall exposed and illuminated and has an image potential which was measured at about +100 volts.

On the other hand, the upper curve in Figure 3 shows the same type of plot, but with the image potential measured at about +30 volts as a result of the overall illumination exposure made in accordance with the present invention. A comparison of the upper and lower plots in Figure 3 indicates about a 20% improvement in the electrostatic transfer pressures in the upper plot, since the lower photoconductor potentials provided by the present invention allow a higher bias to be used across the print media during image transfer without exceeding the critical levels which cause air ionization and disruptive toner affects. This higher bias, in turn, produces an improved transfer efficiency of the developed image from the surface of the photoconductive drum 10 to the print media 30, thereby resulting in an improved print quality of color images on the print media and a higher fidelity of the transferred color images.

Various modifications may be made in and to the above described preferred embodiment without departing from the spirit and scope of this invention. For example, the present invention is not limited to the use of an LED array for the illuminator 76 and other light sources such as quartz lamps, electroluminescent strips and the like which match to wavelength range of the photoconductive material layers of the photoconductor and have a sufficient power level to obtain adequate electron discharge at the surface of the photoconductor 10 may also be used herein. In addition, the present invention is not limited by the particular materials or geometric configuration of the conditioning roller described herein, and this toner stabilizing roller 46 may be used in combination with many different types of electrophotographic writing schemes, color toner transferring techniques for applying toner to the photoconductive drum and with various different additional schemes for aiding in the direct transfer of the developed color toners from the surface of the photoconductive drum to an adjacent print media. Also, it should be understood that the present invention is not limited to use with the particular transfer roller apparatus 28 described

herein. Accordingly, these and other design modifications are clearly within the scope of the following appended claims.

Claims

1. A method for electrophotographically color printing which includes the steps of:
 - a. developing a composite color image on the surface of a photoconductive drum (10),
 - b. illuminating the surface of the photoconductive drum (10) with light (76) within a chosen wavelength range corresponding to the wavelength characteristic of the photoconductive drum to thereby cause hole-electron pairs (88) within a layer (90) of the photoconductive drum (10) to recombine and reduce the net voltage (V) across the photoconductive drum layers, and thereafter
 - c. bringing a direct transfer roller (28) into intimate contact with a print medium (30) passing between the transfer roller (28) and the surface of the photoconductive drum (10) while simultaneously,
 - d. applying a predetermined DC bias voltage (42) to the direct transfer roller (28), whereby the reduction of voltage across the surface layer of the photoconductive drum (10) permits a corresponding increase in DC bias voltage (42) to be applied to the direct transfer roller (28) to thereby increase the strength of the electrostatic field established between the surface of the photoconductive drum (10) and the surface of the transfer roller (28) to thereby, in turn, increase the achievable electrostatic forces for pulling the charged toner and developed color image from the surface of the photoconductive drum (10) onto the print medium (30).
2. Apparatus for electrophotographic coloring printing including:
 - a. means (12) for developing a composite color image on the surface of a photoconductive drum (10),
 - b. means (76) for illuminating the surface of the photoconductive drum (10) with light within a chosen wavelength range corresponding to the wavelength characteristic of the photoconductive drum to thereby cause hole-electron pairs (88) within a layer (90) of the photoconductive drum (10) to recombine and reduce the net voltage (V) across the photoconductive drum layers (78, 86, 90),
 - c. means for bringing a direct transfer roller (28) into intimate contact with a print medium (30) passing between the transfer roller

er (28) and the surface of the photoconductive drum (10), and

d. means for applying a predetermined DC bias voltage (42) to the direct transfer member (28), whereby the reduction of voltage (V) across the surface layer of the photoconductive drum (10) permits a corresponding increase in DC bias voltage (42) to be applied to the direct transfer roller (28) to thereby increase the strength of the electrostatic field between the surface of the photoconductive drum (10) and the surface of the transfer roller (28) to thereby, in turn, increase the achievable electrostatic forces for pulling the charged toner and develop color image from the surface of the photoconductive drum (10) onto the print medium (30).

3. A method for increasing the electrostatic field strength that may be applied between the surface of a photoconductive drum (10) and an adjacent direct transfer member (28) between which print media (30) passes during the transfer of images from the drum (10) to the media (30) characterized by: illuminating the surface of a photoconductive drum (10) with light (76) within a chosen wavelength range corresponding to the wavelength versus-transmittance characteristic of the photoconductive drum (10) to thereby cause hole-electron pairs (88) within a layer (90) or layers of the photoconductive drum (10) to recombine and reduce the net voltage across the photoconductive drum layers (78, 86, 90).
4. The method defined in claim 3 which further includes applying a predetermined DC bias voltage (42) to said adjacent direct transfer member (28), whereby the reduction of net charge at the surface layer (90) of said photoconductive drum (10) permits a corresponding increase in DC bias voltage (42) to be applied to said direct transfer member (28) to thereby increase the strength of the electrostatic field between the surface of the photoconductive drum (10) and the surface of said transfer member (28) to thereby, in turn, increase the achievable electrostatic forces for pulling the charged toner and develop color image from the surface of the photoconductive drum (10) onto the print medium (30).
5. The method defined in claim 4 which further includes applying liquid color toners in series to said photoconductive drum (10).

6. The method defined in claim 5 which further includes contacting the surface of said photoconductive drum (10) with a deformable conditioning roller (46) for reducing isopar fluid in said liquid toners to thereby further improve the print quality of color images transferred to said print media (30). 5
7. The method defined in any one of claims 3 through 6 wherein organic photoconductor potentials are lowered in non-imaged areas due to the overall illumination (76) of said photoconductive drum (10), whereby air ionization is presented and undesirable paper (30) charging problems are minimized. 10 15
8. The method defined in claim 6 wherein organic photoconductor potentials are lowered in non-imaged areas due to the overall illumination (76) of said photoconductive drum (10), whereby air ionization is presented and undesirable paper charging problems are minimized. 20

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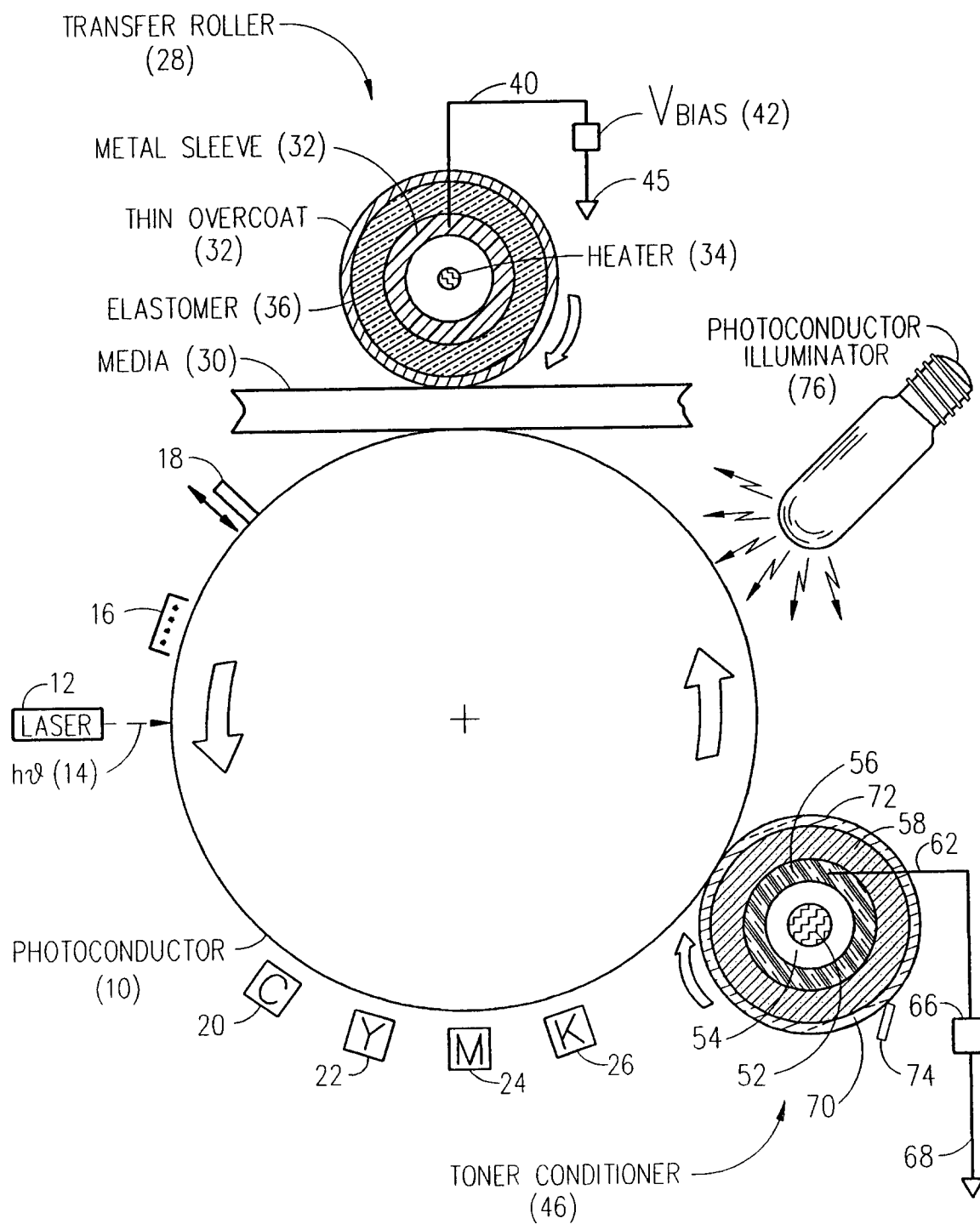


FIG. 1.

DISCHARGE AREA DEVELOPMENT / EXPOSED REGIONS ON ORGANIC PHOTOCONDUCTOR

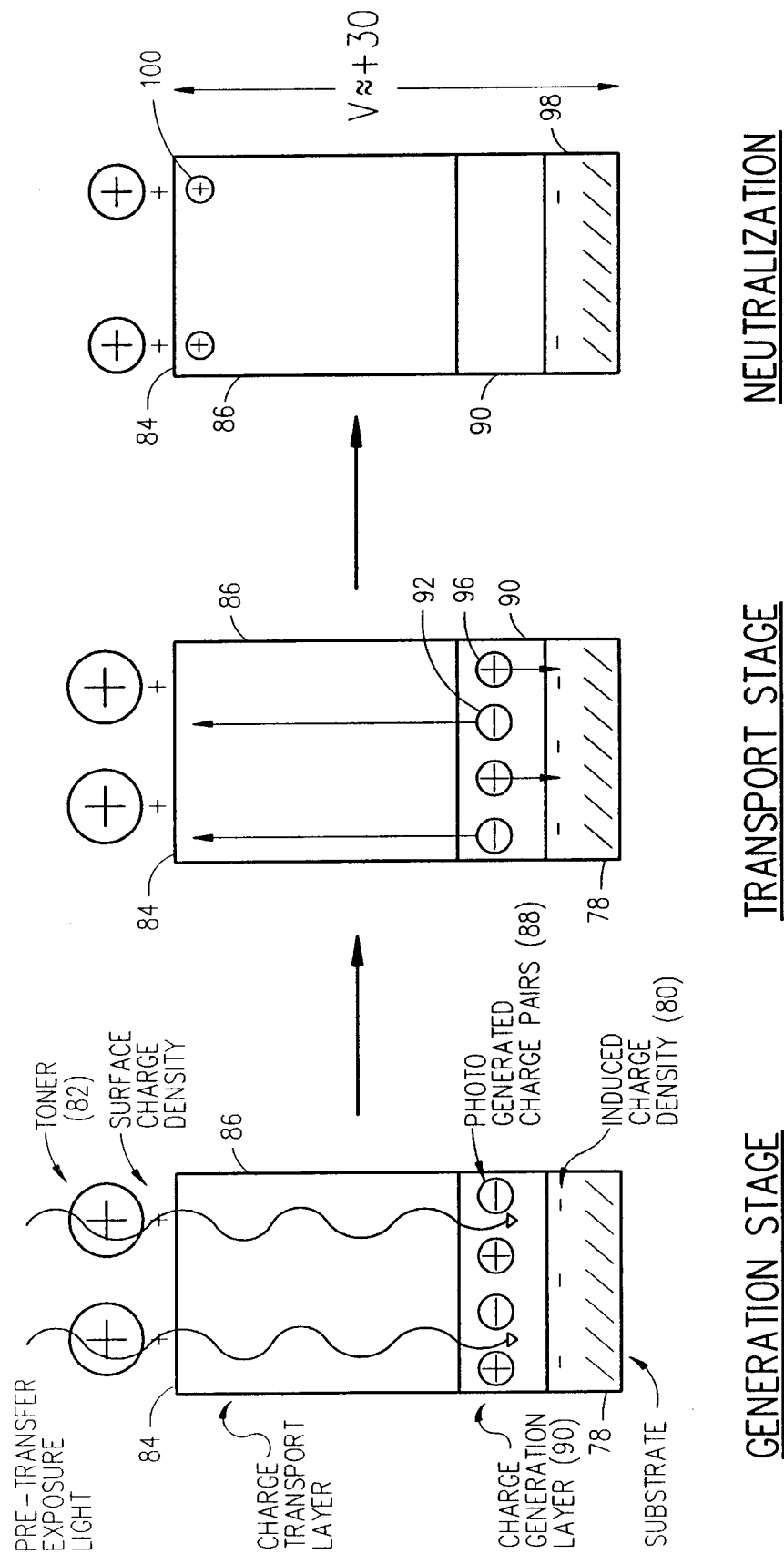


FIG. 2A.

FIG. 2B.

FIG. 2C.

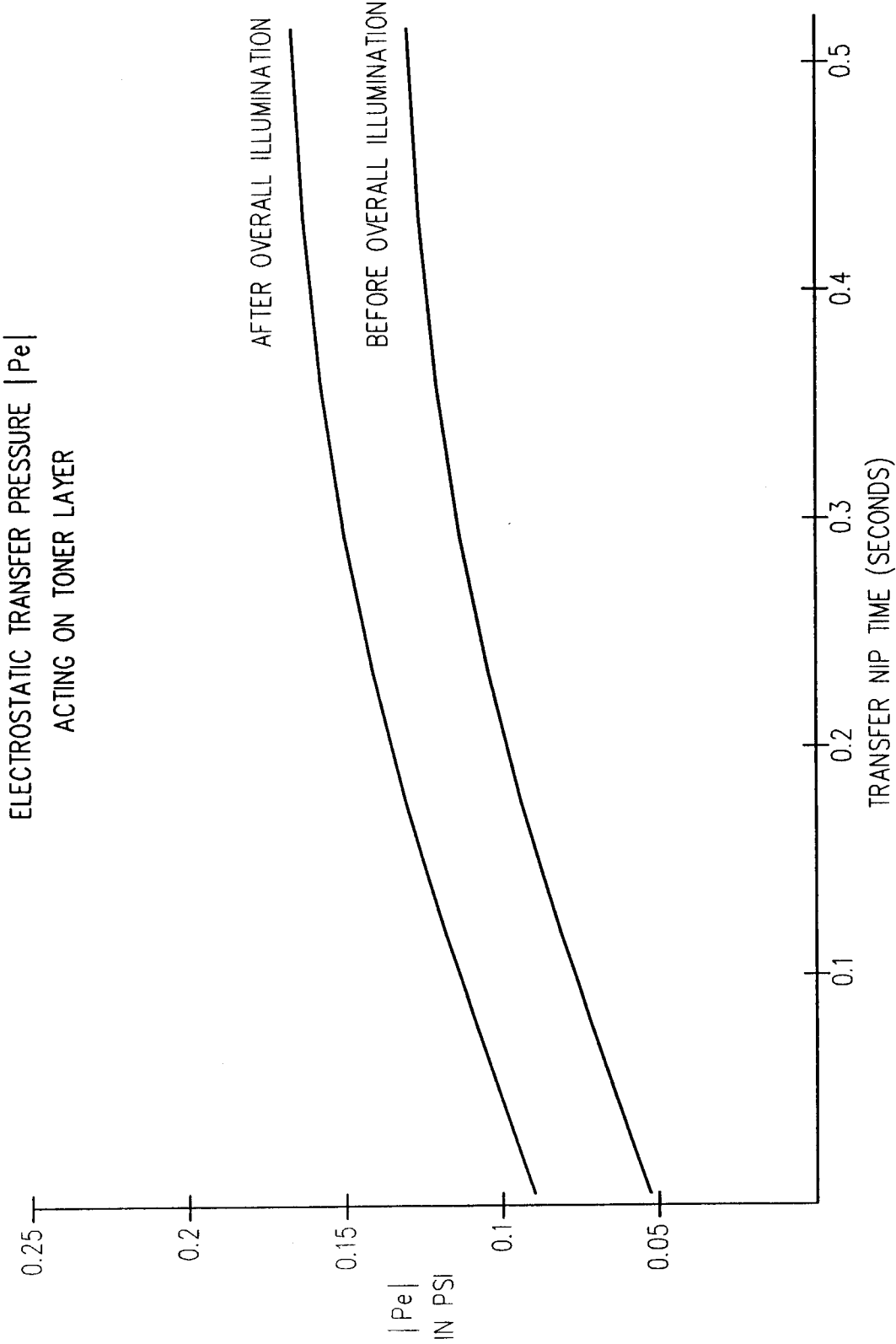


FIG. 3.