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TRANSFER OF IMAGES TO A NON-CONDUCTIVE SUBSTRATE

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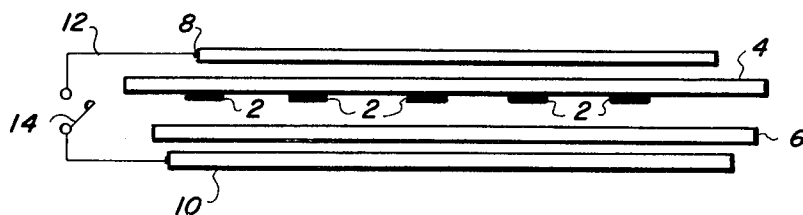


FIG. 1a

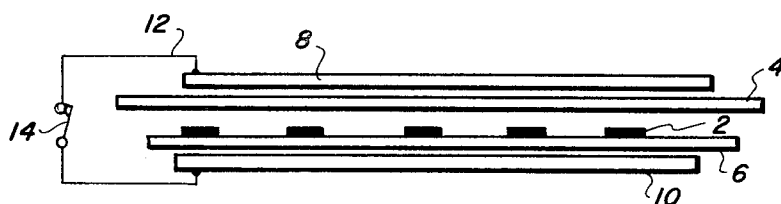


FIG. 1b

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3,706,553

TRANSFER OF IMAGES TO A NONCONDUCTIVE SUBSTRATE

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9 Claims

ABSTRACT OF THE DISCLOSURE

A method of transferring insulating image material containing a static charge from an image bearing surface to an electrically non-conductive image receiving surface by means of coulombic attraction and the rearrangement of electrical charges.

BACKGROUND OF THE INVENTION

The present invention relates in general to the transfer of images from an image bearing surface to an image receiving surface and more particularly to a method for accomplishing such transfer by means of a rearrangement of static electric charges and coulombic attraction.

Various imaging processes are known wherein a thin film of material is deposited on a substrate or image bearing surface to provide a contract to said surface in image configuration. Due to the process steps employed in producing such images, the substrate on which the image is first formed is, in some cases, not the substrate which is most durable, useful or desirable.

One such imaging process which provides images comprising a thin film or layer of an insulating or semiconductive material on a substrate is the manifold imaging process as described in copending application Ser. No. 708,380, filed Feb. 26, 1968. In this imaging system, an imaging layer is prepared by a coating of a layer of electrically photosensitive imaging material onto a substrate. In one form the imaging layer comprises a photosensitive material such as metal-free phthalocyanine dispersed in a cohesively weak insulating or dielectric binder. This coated substrate is called the donor. When needed, the imaging layer is rendered cohesively weak. The process step of weakening the imaging layer is termed activation and in most cases the imaging layer is activated by contacting it with a swelling agent, solvent, or partial solvent for the imaging layer or by heating the layer. A receiver sheet is laid over the surface of the imaging layer and an electric field is applied across the imaging layer while it is exposed to a pattern of light and shadow representative of the image to be reproduced. Upon separation of the donor substrate or sheet and receiving sheet the imaging layer fractures along the lines defined by the pattern of light and shadow to which the imaging layer has been exposed. Part of the imaging layer is transferred to one of the sheets while the remainder is retained on the other sheet so that a positive image, that is, a duplicate of the original is produced on one sheet while a negative image is produced on the other.

In many instances, the apparatus employed to produce images by means of the manifold imaging process more conveniently uses donor and receiver sheets which are not well suited for the end use of the image. However, transferring images from one substrate to another without loss of image quality as, in the past, been difficult and required expensive and complicated machinery.

Another example of prior art imaging processes wherein the transfer of imaging material from one surface to another is employed is xerography. In most xerographic processes, an image formed by a toner on a carrier is transferred from a dielectric surface containing an electrostatic

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image to an image receiving substrate or medium in order to provide a usable copy. The machinery or apparatus commonly employed to perform this function is now common and notably complex.

SUMMARY OF THE INVENTION

It is, accordingly, an object of this invention to provide a method for transferring an image from one substrate to another which overcomes the above noted disadvantages.

Another object of this invention is to provide a method of transferring dielectric imaging material from an image bearing surface to an image receiving surface without complex equipment.

Another object of this invention is to provide images of improved quality which have been transferred from an image bearing substrate to an image receiving medium.

These and other objects of this invention are apparent from the following description of the invention.

In accordance with this invention there is provided a process whereby a releasable image residing on an electrically insulating medium is transferred to an electrically non-conductive image receiving medium. Such transfer is accomplished by charging the surface of the image and the medium upon which the image resides. The thus charged image is then contacted with the non-conductive receiving medium thus forming an image transfer set. A conductive path is then provided between the outer or exposed surfaces of the image bearing medium and the image receiving medium. This is normally accomplished by contacting the exposed surfaces with conductive plates which are interconnected by a conductive wire. By means of the conductive path, both surfaces are brought to the same potential and the releasable image transfers to the image receiving medium. Upon separation of the set, there is provided a high quality image on the receiving substrate or medium. Included in the term "image" are portions of images and defined or artistic patterns of dielectric material on a substrate.

According to this invention, the image is electrically charged and such charge is held by the imaging material until after the transfer is accomplished. Thus, the process of this invention is particularly adapted for use in transferring images wherein the imaging material is electrically insulating so as to maintain an electric charge for at least a brief period of time. A wide variety of insulating materials can thus be employed in the process of this invention. Insulating materials such as polyethylene, polypropylene, polyamides, polymethacrylates, polyacrylates, polyvinylchlorides, polyvinylacetates, polystyrene, polythioloxanes, chlorinated rubber, polyacrylonitrile, epoxies, phenolics, hydrocarbon resins and other natural resins such as rosin derivatives as well as mixtures and copolymers of the above materials can be employed. Particularly preferred images to be transferred according to the process of this invention are those comprising insulating materials which retain a charge and which are or can be rendered releasable. Such materials include microcrystalline waxes such as: Sunoco 1290, Sunoco 5825, Sunoco 985, all available from Sun Oil Co.; Paraffint RG, available from the Moore and Munger Company; paraffin waxes such as: Sunoco 5512, Sunoco 3425, available from Sun Oil Co.; Sohio Parowax, available from Standard Oil of Ohio; waxes made from hydrogenated oils such as: Capitol City 1380 wax, available from Capitol City Products, Co., Columbus, Ohio; Caster Wax L-2790, available from Baker Caster Oil Co.; Vitikote L-340, available from Duro Commodities; polyethylenes such as: Polyethylene DYJT, Polyethylene DYLT, polyethylene DYT, all available from Union Carbide Corp.; Marlex TR 822, Marlex 1478, available from Phillips Petroleum Co.; Epolene C-

13, Epolene C-10, available from Eastman Chemical Products, Co.; Polyethylene AC8, Polyethylene AC612, Polyethylene AC324, available from Allied Chemicals; modified styrenes such as: Piccotex 75, Piccotex 100, Piccotex 120, available from Pennsylvania Industrial Chemical; vinylacetateethylene copolymers such as: Elvax Resin 210, Elvax Resin 420, available from E. I. du Pont de Nemours & Co., Inc., Vistanex NH, Vistanex L-80, available from Enjay Chemical Co.; vinyl chloridevinyl acetate copolymers such as: Vinylite VYLF, available from Union Carbide Corp.; styrene-vinyl toluene copolymers; polypropylenes; and mixtures thereof.

There has recently been discovered a photoelectrophoretic imaging method wherein electrically photosensitive pigments are employed to produce images under the influence of light and an electrical field. Images made by this process comprise individual particles of electrically photosensitive materials which are capable of retaining an electric charge. Such a process is more fully described in U.S. Pat. 3,384,565 which is incorporated herein by reference. Images produced in accordance with the process described in the patent can be transferred by the method of this invention.

The materials employed to produce images by means of the manifold imaging process are more fully described in copending application Ser. No. 708,380, filed Feb. 8, 1968, which description is incorporated herein by reference. Both of the above mentioned imaging processes employ electrically photosensitive materials which are also an insulating material capable of retaining a charge and thus images produced by such processes may be transferred from an image bearing medium to an image receiving medium in accordance with the process of this invention. On the other hand, insulating imaging materials which do not contain electrically photosensitive materials may also be transferred in accordance with this invention.

The surface of the insulating image materials and the supporting surface of the image bearing medium are electrically charged to the extent required to transfer the image. The amount of charge will vary depending in part upon the dielectric constant, polarity, of the charge and thickness of the image material. It will also vary depending upon the dielectric constant and thickness of the image bearing and image receiving media. When employing a material exhibiting an extremely high dielectric constant, lower voltages can be employed such as from about 200 to about 400 volts. Alternatively, if materials exhibiting very low dielectric constant are employed, higher voltages are employed ranging up to an amount less than the electrical breakdown strength of the image bearing medium.

In general a transfer voltage is applied across the image material and the image receiving medium. Such voltage has a minimum value which varies with different materials and must exist in order to effect transfer.

In general, the transfer voltage is calculated according to the following formula:

$$V = V_L \left[1 + \frac{K_L}{D_L} \left(\frac{D_d}{K_d} + \frac{D_r}{K_r} \right) \right]$$

where

V_L = a voltage constant for the image material
 K_L = dielectric constant of the image material
 K_d = dielectric constant of the image bearing substrate
 K_r = dielectric constant of the image receiving medium
 D_d = thickness of image bearing medium
 D_r = thickness of image receiving medium
 D_L = thickness of image material

In a case wherein the image bearing medium and the image receiving medium each are 1 mil in thickness and have equal dielectric constants of 3.25, the dielectric constant of the image material is 5 and is .2 mil thick, the calculated transfer voltage is 4,000 volts where the image material voltage constant is 240 volts.

Where the image is not releasable from the image bearing medium, it is desirable to include an activation step in the process of this invention. The activation step may take many forms such as heating the imaging layer thus reducing the adhesion or applying a substance to the surface of the imaging material or including a substance in the imaging material which substance lowers the adhesive strength of the imaging material with respect to the image bearing medium. The substance so employed is termed an "activator." Preferably, the activator should have a high resistivity so as to prevent electrical breakdown of the transfer set. Accordingly, it will generally be found to be desirable to purify commercial grades of activators so as to remove impurities which might impart a higher level of conductivity. This may be accomplished by running the fluids through a clay column or by employing any other suitable purification technique. Generally speaking, the activator may consist of any suitable material having the aforementioned properties. For purposes of this specification and the appended claims, the term activator shall be understood to include not only materials which are conventionally termed solvents but also those which are partial solvents, swelling agents or softening agents for the imaging material. The activator can be applied at any convenient point in the process prior to separation of the sandwich.

It is generally preferable that the activator have a relatively low boiling point so that fixing of the image on the image receiving medium can be accomplished upon evaporation of the activator. It is desirable that fixing of the image be accomplished quickly with mild heating at most. It is to be understood, however, that the invention is not limited to the use of these relatively volatile activators. In fact, very high boiling point non-volatile activators including silicone oils such as dimethyl-polysiloxanes and very high boiling point long chain aliphatic hydrocarbon oils ordinarily used as transformer oils such as Wemco-C transformer oil, available from Westinghouse Electric Co., have also been successfully utilized in the imaging process. Although these less volatile activators do not dry off by evaporation, image fixing can be accomplished by contacting the image with an absorbent sheet such as paper which absorbs the activator fluid. In short, any suitable volatile or nonvolatile activator may be employed. Typical activators include Sohio Odorless Solvent 3440, an aliphatic (kerosene) hydrocarbon fraction, available from Standard Oil Co. of Ohio, carbon tetrachloride, petroleum ether, Freon 214 (tetrafluorotetrachloropropane), other halogenated perchloroethylene, trichloromonofluoromethane, trichlorotrifluoroethane, trichlorotrifluoroethane, ethers such as diethyl ether, diisopropyl ether, dioxane, tetrahydrofuran, ethyleneglycol monoethyl ether, aromatic and aliphatic hydrocarbons such as benzene, toluene, xylene, hexane, cyclohexane, gasoline, mineral spirits and white mineral oil, vegetable oils such as coconut oil, babussu oil, palm oil, olive oil, castor oil, peanut oil and neatsfoot oil, decane, dodecane and mixtures thereof. Sohio Odorless Solvent 3440 is preferred because it is odorless, nontoxic and has a relatively high flash point.

The image bearing medium useful in the process of this invention is one which retains an electric charge for at least a short period of time and are described herein as electrically insulating. While many non-conductive materials usable as image receiving media can be classified as insulating, materials useful as image bearing media have greater electrical resistance and are thus termed electrically insulating. Typically insulating materials have a resistivity above about 10^{14} ohm-cms. at normal temperatures. Typical examples of such materials include polyethylene, polypropylene, polyethylene terephthalate, cellulose acetate, paper, plastic coated paper such as polyethylene coated paper, vinyl chloride-vinylidene chloride copolymers and mixtures thereof. Mylar (a polyester formed by the condensation reaction between ethylene

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glycol and terephthalic acid available from E. I. du Pont de Nemours & Co., Inc.) is preferred because of its durability and excellent insulative properties.

The image receiving medium useful in the process of this invention may comprise any suitable electrically non-conductive material. In the specification and claims "non-conductive" is intended to mean those materials having a resistivity greater than about 10^{-2} ohm-cms. at normal temperatures. Typical non-conductive materials include those listed above as image bearing media and, in addition, include metal impregnated plastics such as Stabilene film, available from Keuffel and Esser Co. As stated above, according to the process of this invention, the exterior surfaces of the transfer set made up of an image bearing medium, the imaging material and an image receiving medium are brought to the same potential. The most common means of achieving such balance is by backing the image bearing medium with an electrically conductive layer and connecting the conductive layer to a similarly conductive layer which is backing the image receiving medium. The transfer set is then separated while the two conductive layers are electrically interconnected or the set can be separated after removing the conductive layers.

Static charges can be imposed upon dielectric layers by means known to the art as by contacting the image and image bearing medium with an electrically charged electrode. Alternatively, the layer may be charged using corona discharge devices such as those described in U.S. Pat. No. 2,588,699 to Carlson, U.S. Pat. 2,777,957 to Walkup, U.S. Pat. 2,885,556 to Gundlach or by using conductive rollers as described in U.S. Pat. 2,980,834 to Tregay et al. or by frictional means as described in U.S. Pat. 2,297,691 to Carlson or other suitable apparatus.

The conductive layers employed may comprise any suitable conductive material and may be flexible or rigid. Typical conductive materials include metals such as aluminum, brass, steel, copper, nickel, zinc etc. Also, metallic coatings on plastic substrates, rubber rendered conductive by the inclusion of a suitable material therein and the like can be employed. Conductive rubber is preferred because of its flexibility. Transparent conductive electrodes such as tin oxide coated glass may be employed but are not required as the transfer of the image does not require light. Obviously, if photoconductive material is employed in the process the electrical charge may be lost if operated in the presence of light.

BRIEF DESCRIPTION OF THE DRAWINGS

The advantages of this improved method of transferring images will become apparent upon consideration of the detailed disclosure of the invention especially when taken in conjunction with the accompanying drawings wherein:

FIG. 1a is an expanded side sectional view of an image transfer set prior to balancing the potential of the exposed surfaces of the set.

FIG. 1b is an expanded side sectional view of an image transfer set after the potential of the exposed surfaces of the set has been balanced resulting in the transfer of the image.

DETAILED DESCRIPTION OF THE DRAWINGS

While FIGS. 1a and 1b are expanded in order to facilitate the explanation of the process of this invention, it is to be understood that in actual operation the elements of the image transfer sandwich are in contact with each other in the order shown in FIGS. 1a and 1b.

In FIG. 1a there is provided releasable imaging material 2 sandwiched between electrically insulating image bearing medium 4 and electrically non-conductive image receiving medium 6. The sandwich resides between conductive layers 8 and 10. Prior to being incorporated into the set, imaging material 2 and medium 4 have been electrically charged positive with respect to the upper

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surface of image bearing medium 4 which has been charged negative. Referring now to FIG. 1b, when image transfer is desired, an electrical connection is made between conductive layer 8 and conductive layers 10 by means of wire 12 through switch 14. FIG. 1b illustrates the imaging material 2 adhering to the image receiving medium 6 leaving image bearing medium 4 free of imaging material.

DESCRIPTION OF PREFERRED EMBODIMENTS

The following examples further specifically illustrate the present invention. The examples below are intended to illustrate various preferred embodiments of the image transfer process of this invention. The parts and percentages are by weight unless otherwise indicated.

Examples I-IV

There is first prepared images comprising a dielectric material which retains an electric charge by means of the manifold imaging process as follows:

A commercial, metal-free phthalocyanine is first purified by acetone extraction to remove organic impurities. Since this extraction step yields the less sensitive beta crystalline form, the x-form is obtained by the procedure described in Example I of U.S. Pat. 3,357,989. The x-form phthalocyanine thus produced is used to prepare the imaging layer according to the following procedure: 5 grams of Sunoco 1290, a microcrystalline wax with a melting point of 178° F. is dissolved in 100 cc. of reagent grade petroleum ether heated to 50° C. and quenched by immersing the container in cold water to form small wax crystals. Five grams of the purified and milled phthalocyanine produced according to the above procedure are then added to the wax paste along with ½ pint of clean porcelain balls in a 1 pint mill jar. This formulation is then ball milled in darkness for 3½ hours at 70 r.p.m. and after milling 20 cc. of Sohio Solvent 3440 is added to the paste. This paste is then coated in subdued green light on a 1 mil Mylar sheet with a No. 12 wire-wound drawdown rod which produces a 2.5 micron thick coating (Example I) after drying. The same paste is also applied on three other Mylar sheets with a No. 8 drawdown rod to produce a coating thickness of 1½ microns (Example II), with a No. 24 rod to produce a coating thickness of 5 microns (Example III) and a No. 36 rod to produce a coating thickness of 7½ microns (Example IV). Each of these coatings is then heated to about 140° F. in darkness in order to dry it. Then the coated donors are placed on the tin oxide surface of NESA glass plates with their coatings facing away from the tin oxide. A receiver sheet also of 1 mil thick Mylar is then placed on the coated surface of each donor. Then a sheet of black, electrically conductive paper is placed over the receiver sheet to form the complete manifold set. The receiver sheet is then lifted up and the phthalocyanine wax layer is activated with one quick brush stroke of a wide camel's hair brush saturated with Sohio Odorless Solvent. The receiver sheet is then lowered back down and a roller is rolled slowly once over the closed manifold set with light pressure to remove excess activator. The positive terminal of an 8,000 volt D.C. power supply is then connected to the NESA coating in series with a 5,500 megohm resistor and the negative terminal is connected to the black opaque electrode and grounded. With the voltage applied, a white incandescent light image is projected upward through the NESA glass using a Wollensak 90 mm., f 4.5 enlarger lens with illumination of approximately 2.5 foot-candle applied for .1 second for a total incident energy of .25 foot-candle second. After exposure, the receiver sheet is peeled from the set with the potential source still connected. The small amount of activator present evaporates within a second or so after separation of the sheets yielding a pair of excellent quality images with a duplicate of the original on the donor sheet and a reversal of the original on the receiver sheet in each case.

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Each of the positive images produced as described above residing on the two mil Mylar image-bearing medium are placed on 1 mil thick Mylar immediately after being produced. The 1 mil thick Mylar is resting upon a sheet of aluminum and a second sheet of aluminum is laid upon the Mylar image-bearing medium. A short length of 14 gauge copper wire equipped with spring clamps on each end is then attached one end to each aluminum sheet. Immediately after attaching the clips, the Mylar image bearing medium and the Mylar image receiving medium are separated by hand. Each of the four images produced as described above are transferred totally to the Mylar receiver leaving the original image bearing Mylar sheet substantially free of image material. The images on the Mylar receiver are fixed by heating the imaging material slightly to remove excess activator which was originally applied to the imaging material during their production by means of a manifold imaging process. All of the images thus transferred retain the density and resolution of the image originally produced on the Mylar image bearing medium.

Example V

An image is first prepared by means of the photoelectrophoretic color imaging process as described in U.S. Pat. 3,384,565 by preparing an 8% by weight suspension including equal amounts of the following pigments: Watchung Red B, a barium salt of 1-(4'-methyl-5'-chloroazobenzene-2'-sulphonic acid)-2-hydroxy-3-naphthoic acid C.I. No. 15865; Monolite Fast Blue GS, the alpha form of metal-free phthalocyanine, C.I. No. 74100; and, 1-cyano-2,3-phthaloyl-7,8 benzopyrrocoline as synthesized according to the first technique given for its synthesis on page 1215 of the Mar. 5, 1957, Journal of the American Chemical Society in an article entitled "Reactions of Naphthoquinones with Malonic Ester and its Analogs III 1-Substituted Phthaloyl and Phthaloyl Benzopyrrocolines" by Pratt et al. These pigments are magenta, cyan and yellow respectively. This mixture, which shall be referred to as a trimix hereinafter, is coated onto a 1 mil thick Mylar sheet and prepared for imaging in accordance with the procedure described in copending application Ser. No. 829,698, filed June 2, 1969, which is incorporated herein by reference. The trimix is subjected to an electric field by placing the sheet pigment side up on the conductive surface of a glass plate and connecting the conductive surface of the glass plate in series with a switch, a potential source and a conductive center of a roller having a coating of baryta paper on its surface. The roller is approximately 2½ inches in diameter. A full color positive photographic transparency is projected through the glass plate onto the trimix by placing the transparency between the suspension and a white light source as the roller is moved across the surface of the coated glass plate. The roller is held at a negative potential of (4,000) volts with respect to the conductive glass plate. The roller is passed over the Mylar 3 times and cleaned after each pass. After completion of 3 passes, it was found that an excellent quality full-color image with all colors well separated was left behind on the Mylar. The electric field and exposure were both continued during the entire period of the three passes by the roller. After discontinuing the voltage on the NES, a sheet of electrically insulating bond paper is laid over the image which is residing on the surface of the Mylar. A black rubber electrode is placed over the paper and is connected to the conductive surface of the glass plate and immediately after making the connection the paper and black rubber electrode are removed from the Mylar. The image which was formerly residing upon the Mylar adheres to the bond paper and is fixed by application of a transparent polymer coating.

Example VI

A black imaging layer useful in the manifold imaging process is prepared by combining about 5 grams of

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x-form phthalocyanine with about 5 grams Alcol Yellow GC, 1,2,5,6-di-(C)C'-diphenyl (thiazole-anthraquinone, C.I. No. 67300, available from General Dyestuffs Corporation), and about 2.8 grams of purified Watchung Red B, 1-(4'-methyl-5-chloro-2'-sulfonic acid) azobenzene-2-hydroxy-3-naphthoic acid, C.I. No. 15865, available from E. I. du Pont de Nemours & Co., about 8 grams of Sunoco Microcrystalline Grade 5825 having an ASTM melting point of 151° F., available from Sun Oil Company and about 2 grams Paraffint RG, a low molecular weight paraffinic material available from the Moore & Munger Company, New York, N.Y., and about 320 ml. of petroleum ether (90-120° C.) and about 14 ml. of Sohio Odorless Solvent 3440 are placed with the mixed pigments in a glass jar containing ½ inch flint pebbles. The mixture is then milled by revolving the glass jar at about 70 r.p.m. for about 16 hours. The mixture is then heated for approximately 2 hours at about 45° C. and allowed to cool to room temperature. The paste-like mixture is then coated in subdued green light on 1 mil thick Mylar by means of a #22 wire wound drawdown rod to produce a coating weight of about .27 gram per square foot. The thus formed imaging layer on the Mylar is employed in the manifold imaging process with a conductive aluminum sheet as a receiver. The voltage applied during imaging and subsequent separation of the donor and receiver sheets is 3.5 kv./mil. A positive image is thus produced on the Mylar and with the residual voltage on the image material and the Mylar sheet the image is contacted with a sheet of 2 mil Tedlar having a dielectric constant of 9, and backed with a conductive metal layer. The Mylar image bearing medium has a dielectric constant of 3.25. A conductive rubber sheet is laid over the Mylar and electrical contact is made with the conductive sheet backing the Tedlar. The Mylar together with the conductive rubber sheet is pulled from the Tedlar leaving the image formerly residing on the Mylar now residing on the Tedlar sheet.

Example VII

Another image is made by means of the manifold imaging process employing an imaging layer prepared as described in Example VI. A manifold set comprising a 1 mil Mylar donor sheet, the black imaging material and a 1 mil Mylar receiver is employed. The voltage employed during imaging and subsequent separation of the donor and receiver sheet is 4 kv./mil. After the production of the image, the 1 mil Mylar receiver is laid on another sheet of 1 mil Mylar which has been wetted with Sohio Odorless Solvent 3440. A conductive rubber sheet is placed on top of the Mylar bearing the image and connected to a conductive plate backing the wetted Mylar sheet. After assuring firm contact of the image with the wetted Mylar sheet, the rubber electrode and the Mylar receiver is removed leaving the image on the wetted Mylar sheet.

In all of the above examples, a right-reading copy can be obtained by the process of this invention by employing an appropriate number of mirrors in the optical system employed to produce the image. The use of mirrors in producing the image will provide a compensating factor which produces a right-reading positive image when transferred in accordance with the process of this invention.

Although specific components and proportions have been stated in the above description of the preferred embodiments of the invention, other typical materials as listed above if suitable may be used with similar results. In addition, other materials may be used to synergize, enhance or otherwise modify the properties of the imaging material. For example, various dyes, spectral sensitizers, particles made up of two or more layers, blends of materials, complexes and electrical sensitizers such as Lewis acid may be added to the imaging material.

Other modifications and ramifications of the present invention will occur to those skilled in the art upon a

reading of the present disclosure. These are intended to be included within the scope of this invention.

What is claimed is:

1. A method of making and transferring a dielectric image from an electrically insulating-image bearing medium to an electrically non-conductive image receiving medium, said receiving medium having a resistivity of at least 10^{-2} ohms-centimeters, which comprises the steps of:

(A) forming an image by a method comprising steps of:

- (1) providing an electrically photosensitive imaging layer sandwiched between a donor layer being electrically insulating, said imaging layer and a receiver layer, at least of one said layers being structurally fracturable in response to the combined effects of an applied electrical field and exposure to an electromagnetic radiation to which said layer is sensitive;
- (2) applying an electrical field across said imaging layer and exposing said imaging layer to a pattern of actinic electromagnetic radiation;
- (3) separating said receiver layer from said donor layer while under said field whereby said imaging layer fractures in imagewise configuration with a positive image adhering to one of said donor and receiver layers and a negative image adhering to the other of said donor and receiver layers, each of said images retaining an electrostatic charge; and,

(B) transferring the image on said insulating layer by the process comprising:

- (1) contacting said image with an image receiving medium while said image and said insulating layer are under an image transfer voltage;
- (2) providing an electrically conductive path between the exposed surfaces of said insulating layer and said image receiving medium by contacting each said surface with electrically conductive plates, said plates being electrically interconnected whereby said exposed surfaces are brought to the same potential;
- (3) separating said image receiving medium from said insulating layer whereby said image transfers to said image receiving medium.

2. A method of claim 1 further including step of rendering said imaging layer structurally fracturable in response to the combined effects of an applied electric field and exposure to an electromagnetic radiation to which said layer is sensitive by applying to said layer an activator.

3. The method of claim 1 further including the steps of rendering said image releasable from said insulating layer by applying thereto an activator.

4. The method of claim 9 further including the step of rendering said image releasable by applying thereto an activator selected from the group consisting of solvents, partial solvents, swelling and softening agents for said image material.

5. The method of claim 1 wherein the transfer voltage is in the range of from about 1,000 volts per mil to less than the electrical breakdown potential of said image bearing medium.

6. The method of claim 1 wherein the image bearing medium is a thermoplastic material.

7. The method of claim 4 wherein the activator is at least a partial solvent for said image.

8. The method of claim 1 wherein the transfer voltage is residual voltage retained from the process of producing the image.

9. The method of claim 1 wherein the image receiving medium is a thermoplastic.

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