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Reinis et al.

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[54] METHOD OF COLOR IMAGING A LAYER OF ELECTRICALLY PHOTOSENSITIVE AGGLOMERATES

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[21] Appl. No.: 310,040

[52] U.S. Cl. .... 96/1.2, 96/1 M, 96/1 PE, 96/1.5

[51] Int. Cl. ... G03g 5/00, G03g 13/00, G03g 17/00

[58] Field of Search .... 96/1.2, 1.3, 1 PE, 1 M, 96/1.5

[56] References Cited

UNITED STATES PATENTS

2,940,847	6/1960	Kaprelian	96/1.2
3,346,475	10/1967	Matkan et al.	96/1.3 X
3,384,566	5/1968	Clark	96/1 R
3,510,419	5/1970	Carriera et al.	96/1.3 X
3,556,783	1/1971	Kyriakakis	96/1.2
3,595,772	7/1971	Zucker	96/1.3
3,607,256	9/1971	Silverberg	96/1.3
3,645,874	2/1972	Wells	96/1.3 X
3,647,659	3/1972	Keller et al.	96/1.3 X
3,655,372	4/1972	Krohn et al.	96/1.3
3,657,091	4/1972	Forest	96/1.3
3,674,475	7/1972	Silverberg	96/1.3
3,676,116	7/1972	Krohn et al.	96/1.3
3,689,399	9/1972	Ota	96/1 PE
3,718,462	2/1973	Krohn et al.	96/1.3
3,737,310	6/1973	Snelling et al.	96/1.3 X

FOREIGN PATENTS OR APPLICATIONS

7,005,615	10/1970	Netherlands	96/1.3
7,005,938	10/1970	Netherlands	96/1.3

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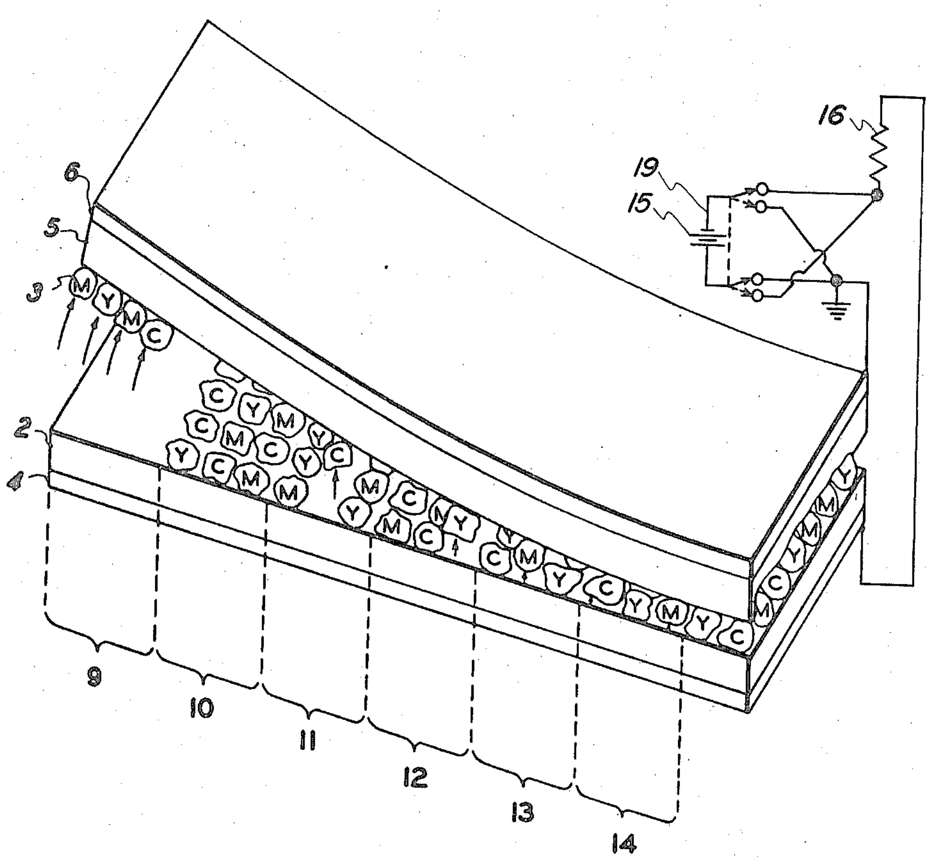
[57] ABSTRACT

A method for obtaining color separation wherein an electrically photosensitive imaging layer comprises a randomly mixed mono-layer of a plurality of at least two different electrically photosensitive agglomerates. The imaging layer is placed between two members and subjected to a first electric field. Such field is then modified as by reducing, grounding or reversing the field. After such modification, the first field is substantially restored across the imaging layer prior to imagewise exposure of the imaging layer to electromagnetic radiation to which it is sensitive. The imaging layer is then exposed to appropriate electromagnetic radiation and the members separated. Upon separation of the members exposed, agglomerates of the mono-layer of plurality of agglomerates are independently removed from the mono-layer in imagewise configuration thereby forming a multi-color copy of the original image on one of the sheets.

15 Claims, 5 Drawing Figures



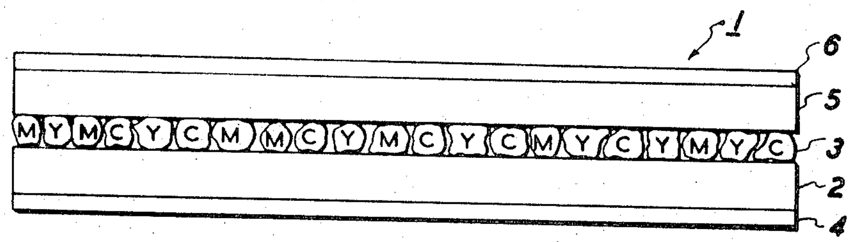


FIG. 1

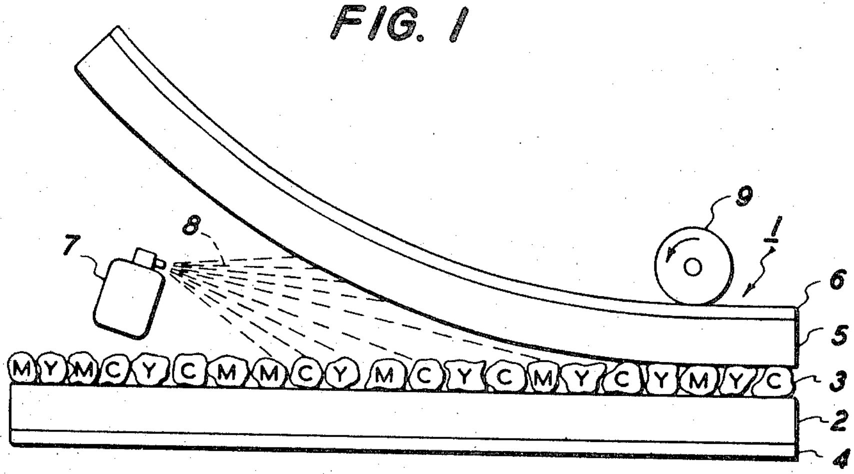


FIG. 2

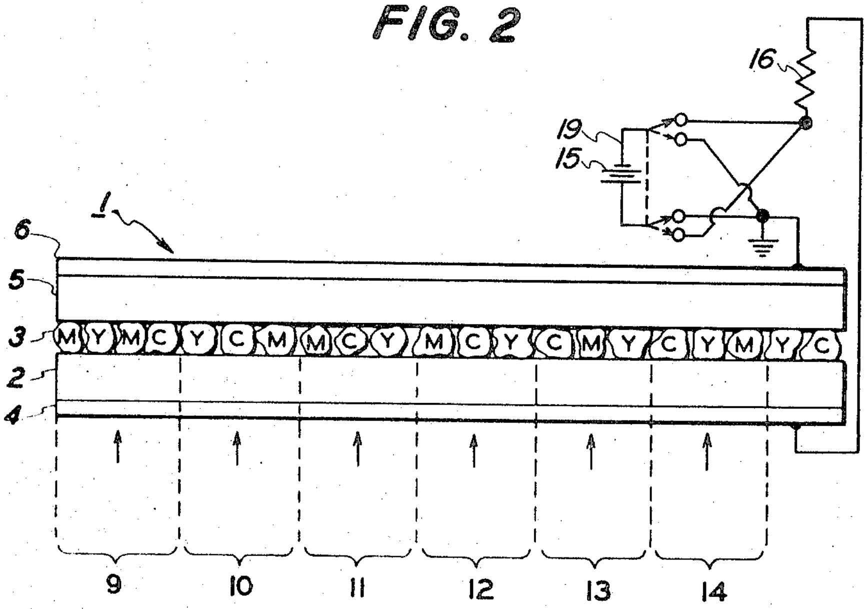


FIG. 3

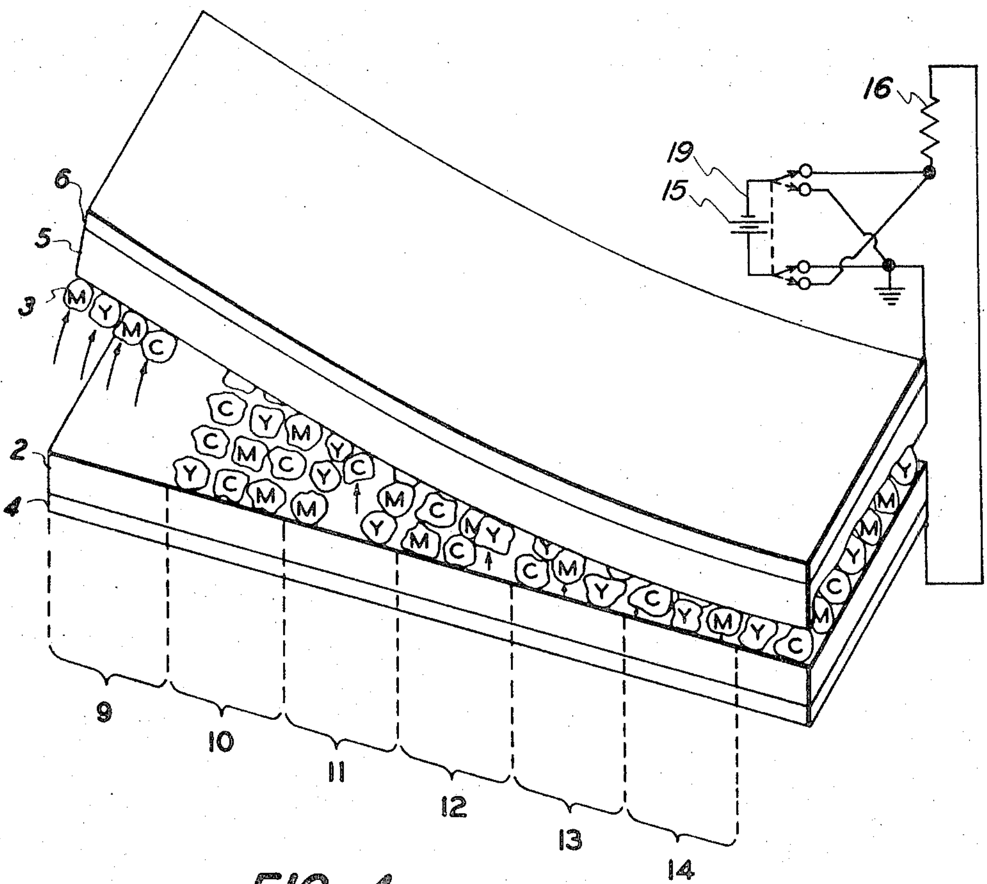


FIG. 4

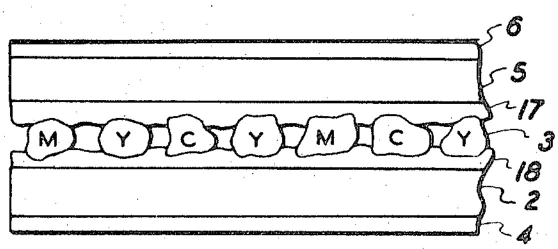


FIG. 5

METHOD OF COLOR IMAGING A LAYER OF ELECTRICALLY PHOTOSENSITIVE AGGLOMERATES

BACKGROUND OF THE INVENTION

This invention relates in general to imaging and, more specifically, to processes — an improved method — of producing multi-color images.

There has recently been discovered a color imaging method wherein there is employed an imaging member having an imaging layer comprising a randomly mixed mono-layer of a plurality of at least two different electrically photosensitive agglomerates sandwiched between two members. An image is produced by subjecting the imaging layer to an electric field and exposing the imaging layer to electromagnetic radiation to which at least one of the agglomerates is sensitive. Upon separation of the member while under the electric field, the exposed agglomerates of the model layer are independently removed from the mono-layer in imagewise configuration thereby forming a multi-color copy of the original image on one of the sheets. A more detailed explanation and description of such a process is described in copending application Ser. No. 222,619, filed Feb. 1, 1972 now abandoned, which application is incorporated herein by reference.

In such a color process, independent movement of the differently colored agglomerates is essential for proper color separation. Further, the more freely removable these agglomerates become, the chances for greater resolution in broader density scales are made possible as well as improved color images. While acceptable images are produced by the newly discovered process referred to above, there is desired more control over the density and resolution of the images provided as well as the number of intermediate density steps obtainable. Also, desirably, a means should be provided whereby the operator of the process can control the amount of density variation the process will produce.

SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to provide an improved multi-color imaging system overcoming the above noted deficiencies.

It is another object of this invention to provide a multi-color imaging system capable of producing images of higher resolution and density.

It is yet another object of this invention to provide a photographic imaging system utilizing an imaging layer comprising a mono-layer of a random mixture of individual electrically photosensitive agglomerates wherein each individual agglomerate is even more readily, freely and independently removable from the imaging layer than previously obtained.

Another object of this invention is to provide a multicolor imaging method which allows the operator to determine the image contrast.

Another object of this invention is to provide a multicolor imaging method providing images of improved resolution.

In accordance with this invention, images can be produced by the above described color imaging process having lower contrast, improved resolution and more density variation by means of oscillating the electric field across the imaging layer prior to exposing the imaging layer to actinic electromagnetic radiation. More particularly, the imaging layer of the process is subjected to a first electric field as in the usual case for exposure purposes and then modified as by reversing, grounding or reducing the field to an extent further defined below. Subsequent to such alteration, the field is then substantially restored and is maintained at a value considered suitable for exposure purposes as previously known in the art for such imaging layer. That is, while the restored field need not be of the same magnitude as the first field, it is one which provides imaging conditions and preferably is slightly higher in potential than the first field. The restored field is sufficient to provide selective adhesion of the agglomerates in the imaging layer to the members between which they are sandwiched in accordance with the pattern of light and shadow to which they are exposed under said field.

DETAILED DESCRIPTION OF THE INVENTION

The color imaging process is practiced in accordance with this invention by inserting field oscillation into the process at any point prior to exposure of the imaging layer to suitable electromagnetic radiation. Basically, the field manipulation involves first raising the potential across the imaging layer to provide a first electrical field. The field is then modified by reversing, grounding or reducing it. Finally, the field is again altered or modified by raising the potential across the imaging layer typically to the extent of substantially restoring the original or first electric field across the imaging layer. Of course, the actual values of field strength are dependent upon the nature of the imaging layer and the donor and receiver layers residing in the electrical field.

The strength of the electrical potential applied initially in the first electrical field across the imaging layer depends, as stated, on the structure of the sandwich or set and the materials employed therein. The potential strength required may, however, be easily determined. If too large a potential is applied, electrical breakdown of the sandwich will occur allowing arcing between the electrodes. If too little potential is applied, the imaging layer will not selectively adhere to the surface of the members in imagewise configuration should the imaging layer be exposed to suitable electromagnetic radiation at that time and the sandwich opened. The preferred potential across the imaging layer is, however, in the range of from about 2,000 volts per mil. to about 7,000 volts per mil. of insulating material in the field. Since relatively high potentials are utilized, it is desirable to insert a resistor in the circuit to limit the flow of current. Resistors on the order of from about 1 megohm to about 20,000 megohms are conveniently employed. While the potential across the imaging layer is not varied during the exposure step of the imaging process, alternating current can be employed prior to such exposure step. Thus, direct current or alternating current can be employed prior to the imagewise exposure step of the process. Direct current is preferred due to the relatively high potential employed and appropriate circuitry for alternating current would be necessary if the operator of the process desired to employ this type of electrical power source.

Another embodiment of this invention includes both types of electrical fields. That is, one may oscillate the field across the imaging layer by subjecting the layer to a field of alternating current. After such treatment, the imaging layer is then subjected to direct current of imaging intensity and the process completed as described below. For example, high voltage 60 cycle AC current of about 3,000 volts, per mil. of insulating material in the field is applied across the imaging layer for about one second. The field is discontinued and a DC field of about the same strength is applied while the imaging layer is exposed to actinic radiation and the sandwich subsequently separated. In this embodiment, a transformer is preferably employed with the AC field to provide an output to the electrodes of high voltage and low current.

The extent to which the potential must be reduced to achieve effective field modification across the imaging layer varies greatly and is dependent upon the original potential across the set (V_o), the original potential across the imaging layer (V_L), the dielectric constant of the receiving member (K_R), that of the donor member (K_D), that of the imaging layer (K_L), and the thickness of the donor member (d_D), the receiver member (d_R), and the imaging layer (d_L). The maximum reduced potential (V_R) can be calculated for any particular manifold set by the formula:

$$V_R = V_0 - V_L \left[1 + K_L/d_L(d_D / K_D + d_R/K_R) \right]$$

In most instances, reduction of the potential to a value below about one-half to about one-third of the original potential is sufficient to achieve the desired results in the process of this invention. Of course, the manipulations required for reversing or grounding the first electrical field are well-known to those skilled in the art.

Subsequent to the alteration of the first electrical field across the imaging layer as described above, the altered or modified field is then again modified so as to restore the electrostatic charges initially induced into the imaging layer by the first electrical field. This easliy accomplished by subjecting the imaging layer to a second electric field of the same polarity and typically of substantially the same potential as first employed. As mentioned above, potentials slightly higher than that first employed are preferred in most instances.

Subsequent to the field alteration step, the imaging layer is exposed to electromagnetic radiation to which it is sensitive. The usual procedures and materials employed in the color imaging process described in copending application Ser. No. 222,619 are practiced in concert with the field alteration step employed in accordance with this invention.

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows schematically a side view of a first embodiment photosensitive imaging member for use in the invention;

FIG. 2 shows one method of releasing the agglomerates in another embodiment of the invention;

FIG. 3 shows exposure of the imaging member to light of different colors;

FIG. 4 shows separation of the imaging member to produce the final full-color image; and

FIG. 5 shows schematically a side sectional view of an alternative embodiment photosensitive imaging member for use in the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a color imaging member generally designated 1 which is made up of several components. Donor member 2 has coated on one surface thereof a layer of imaging material comprising a randomly mixed mono-layer of a plurality of at least two different electrically photosensitive agglomerates. Utilizing subtractive polychromatic image formation, these agglomerates are colored Magenta, Yellow and Cyan. The different colors for the particle agglomerates in FIG. 1 are indicated by "M" for "Magenta," "Y" for "Yellow" and "C" for "Cyan."

Each agglomerate with layer 3 of FIG. 1 contains a single color, for example, an agglomeration of many pigment particles of a single color, or a combination of pigment or dye with encapsulating binder. Also, the photosensitive particles may be transparent and provided with color suitable for use in the subtractive color system.

Color separation in the imaging member 1 of FIG. 1 is obtained by the stabilization of the differently colored electrically photosensitive particles in the imaging layer and the configuration of the layer such that the stabilized particles may freely respond to the combined effect of electromagnetic radiation and an applied potential by selectively adhering to either of the donor or receiver members, 2 and 5, respectively, of FIG. 1, depending upon the polarity of the applied potential. Such stabilization is achieved by either impaction whereby the individual electrically photosensitive particles are impactly agglomerated into agglomerates of the desired size, or by encapsulating the individual electrically photosensitive particles in a binder. The impaction technique is satisfactorily carried out in a Svedgari Attritor Impactor, manufactured by the Union Process, Incoporated of Akron, Ohio; and the encapsulation technique is achieved through a novel agglomeration process disclosed herein. Such layer configuration is a random mixture of the differently colored electrically photosensitive particle agglomerates so that good color balance is achieved; and more importantly, the thickness of the imaging layer is about that of the diameter of the agglomerates but no greater than twice the diameters. As can be seen from the drawings, the tops and bottoms of the agglomerates are not necessarily co-planar, one with the other, nor are the agglomerates necessarily touching or spaced a preselected distance apart. The imaging layer is, therefore, a mono-layer of agglomerates and will be referred to throughout as such; but it is understood, of course, that such terminology means any configuration of agglomerates less than two complete and superimposed layers of agglomerates and one which will allow color separation of the agglomerates in the imaging method employed.

Returning now to FIG. 1, mono-layer 3, as mentioned above, comprises differently colored particles: for example, a Magenta pigment, a Yellow pigment, and a Cyan pigment are agglomerated in separate batches (uni-mixes), by either impaction or the novel process disclosed below, and then all three uni-mixes are mixed and uniformly dispersed by sonification. Satisfactory dispersing by sonification is provided by any of the standard dispersion equipment models available from the Branson Sonic Power Company of Danbury, Conn. The uniformly dispersed agglomerates are then coated onto the donor member 2 at a thickness equal to about the diameter of the agglomerates by any suitable coating method well-known to those skilled in the art. Typical coating methods include extrusion, air-knife, reverse rod and draw-down. As coated, the imaging layer comprises a randomly mixed mono-layer of a plurality of different electrically photosensitive agglomerates. Unless otherwise clearly intended, as used throughout, the terms "electrically photosensitive agglomerates" or "agglomerates" shall include both "electrically photosensitive particle agglomerates" or "particles agglomerates" and "electrically photosensitive particle-binder agglomerates" or "particle-binder agglomerates"; the former terms referring to agglomerates containing only electrically photosensitive particles, and the latter terms referring to the combination of such particles and binder.

As shown in FIG. 1, donor member 2 has a conductive backing 4 which is optional where donor member 2 is insulating and which may be eliminated. Receiver member 5 is in contact with the upper surface of the imaging mono-layer 3 and when receiver member 5 is insulating, you can optionally have, as shown in FIG. 1, a conductive backing layer 6.

To produce a color image with an imaging member of FIG. 1, a preferred method is to provide an imaging member of FIG. 1 wherein a suitable binder or cement for the agglomerates is included in the imaging layer. In accordance with this invention, the cement is dissolved as, for example, by means illustrated in FIG. 2 wherein a suitable solvent 8 is applied to the imaging layer from container 7. Any suitable means of application, such as a brush or roll coating, can be employed and FIG. 2 illustrates the spraying of the imaging layer with the solvent.

The imaging set is then placed in an electric field as is shown in FIG. 3 using the conductive coating 4 and 6 as the electrodes which are connected to power supply 16 through resistor 16 and double through switch 19. A first electrical field is applied to the electrodes and prior to exposure of the imaging layer to actinic electromagnetic radiation, the field is modified by changing switch 19 from position A to position B. Modifications may also be achieved by lowering the voltage or grounding the circuit as described above. subsequent to such modification, the first or original electric field is restored by changing switch 19 from position B back to position A. Of course, the final applied field need not be exactly the same potential as the first field as preferably slightly greater. After switch 19 is moved from position B back to position A, the imaging layer is exposed to an imagewise pattern of electromagnetic radiation to which it is sensitive as indicated by the light rays in the various aportioned areas as shown in FIG. 3. FIG. 3 schematically shows this exposure of the set to different areas of light being projected through donor substrate 2. Area 9 represents that projection of white light, area 10, the projection of no light; area 11, the projection or red light, area 12, the projection of blue light; area 13, the projection of green light; and area 14, the projection of yellow light. After exposure, the imaging member 1 is separated as shown in FIG. 4, producing a visible multi-colored image. With subtractive color formation, as shown in FIG. 4, the positive image conforming to the orginal is ordinarily formed on the donor member 2. The applied potential of the restored or third field condition is maintained across the imaging material during the separating step.

As shown in FIG. 4, white light projection in area 9 results in the transfer of the Magenta, Yellow and Cyan colored individual agglomerates exposed to such projection to the receiver member 5, leaving a white or transparent area on donor member 2. Where no light strikes the imaging mono-layer, as in area 10, all of the individual agglomerates remain on the donor substrate, combining to form a black-appearing area on donor substrate 2 via light scattering. Where red light is projected, as in area 11, any Cyan material exposed will transfer to receiving sheet 5 upon stripout, leaving behind the Magenta and Yellow areas which by light scattering effect combine to appear red to the eye. Where blue light strikes the imaging material, as in area 12, the Yellow material transfers, leaving behind Magenta and Cyan which combine by light scattering effect to appear blue to the eye. Where green light strikes the imaging material, as in area 13, the Magenta material transfers, leaving behind Yellow and Cyan which combine to appear green to the eye. Where yellow light strikes the imaging material, as in area 14, the Magenta and Cyan materials transfer leaving behind only Yellow. Integrating this phenomena over the entire surface of the donor member 2 results in a faithful full-color reproduction of the color orginal. Improved images are obtained due to the field oscillation imposed on the imaging layer. The agglomerates separate to a higher degree of color accuracy than previously obtained.

The embodiment of the invention depicted in FIGS. 1, 3 and 4 may have incoporated many various materials for each of the components to the imaging set.

At least one of donor member 2 or receiver member 5 should be at least partially transparent so that an image may be projected onto the imaging layer therethrough. Preferably, complete transparency is had as, for example, by use of Mylar polyester film manufactured by the Dupont Co. of Wilmington, Del. Insulating materials suitable for use in members 2 and 5 are polyethylene, polyethylene terephthalate (Mylar polyester film), cellulose acetate, and the like, optionally backed by conductive electrode material, such as evaporated tin oxide. Opaque material, such as paper, may also be used for one of these members. Either of members 2 and 5 may also singularly provide the dual characteristics of transparency and conductivity. Typical conductive transparent materials include cellophane, conductively coated glass, such as tin or indium oxide coated glass, aluminum coated glass or similar coatings on plastic substrates. NESA, a tin oxide coated glass available from Pittsburgh Plate Glass Co., is often used because it is a good conductor and is highly transparent and is readily available.

The imaging mono-layer 3 of individual agglomerates may comprise any suitable electrically photosensitive material within or on the surface of the particle agglomerates which has suitable color and spectral response. The agglomerates may be either particle agglomerates or particle-binder agglomerates; that is, they may consist entirely of the electrically photosensitive material or may comprise a photosensitive material dispered in a binder. In most instances, the size of the agglomerates ranges from about 0.1 to 25 microns in diameter; optimum, from about 3 to 15; and preferred, from about 5 to 10. Typical highly colored photosensitive materials include: Algol Yellow GC, 1, 2, 5, 6-di(C.C'-diphenyl) thiazole-anthraquinone, C. I. No. 67300, available from General Dye Stuffs: Calcium Litho Red the calcium lake of 1-(2-azonaphthalene-1'sulfonic acid)-2-naphthol, C. I. No. 15630 available from Collway Colors; Cyan Blue GTNF, the beta form or copper phthalocyanine, C. I. No. 74160, available from Collway Colors and many others as listed in the above mentioned incorporated copending application.

A suitable binder for the particle-binder agglomerates will preferably comprise insulating waxes or polymers as formerly employed. Typical waxes and polymers include low melt waxes, such as octadencane, nonadecane, eicosane and mixtures thereof; microcrystalline waxes; paraffin waxes; waxes made from hydrogenated oils; polyethylenes; modified styrenes; vinylacetate-ethylene copolymers; vinyl chloride-vinyl acetate copolymers; styrene-vinyl toluene copolymers; polypropylenes; and mixtures thereof.

The electrical potential is shown in FIGS. 3 and 4 as being applied from a potential source 15 having a conductive pathway between conductive backing 6 and conductive backing 4; that is, imaging member 1 is placed between electrodes (conductive backings 4 and 6) having different electrical potential. Alternatively, an electrical charge can be imposed upon one or both of the donor-member and receiving member before or after forming the sandwich by any one of the several known methods for inducing a static electrical charge into a material. Static charges can be imposed by contacting the sheet or substrate with an electrically charged electrode. Additionally, one or both sheets may be charged using corona discharge devices, such as those described in U.S. Pat. No. 2,588,699 to Carlson, U.S. Pat. No. 2,777,957 to Walkup, U.S. Pat. No. 2,885,556 to Gundlach or by using conductive rollers as described in U.S. Pat. No. 2,980,830 to Tregay et al., or by frictional means as described in U.S. Pat. No. 2,297,691 to Carlson or other suitable apparatus. Imaging occurs when charges are imposed. The maximum limit of applied potential is the breakdown of imaging member 1, such that conductivity of the member 1 is sufficient to prevent imaging. This will vary depending upon the materials utilized. Whether potential is applied or charges imposed, the requirement is to create an electric field across imaging mon-layer 3; for it is the combined effect of an electric field and electromagnetic radiation upon the electrically photosensitive particles within the agglomerates which causes the agglomerates to selectively adhere to either of members 2 and 5 upon separation of imaging member 1.

Additionally, under certain conditions, it is preferable to prefabricate imaging member 1 of FIGS. 1, 3 and 4. This is especially true from the viewpoint of a mere user of imaging member 1. Thus, the manufacturer may wish not only to stabilize the photosensitive particles for imaging but to further stabilize imaging mono-layer 3 and to render the entire imaging member 1 sufficiently rigid to withstand handling, transportation and storage operations. This can be accomplished by "cementing" the agglomerates within imaging layer 3 together with a soluble interagglomerate cement. The cement is preferably insulating.

Preferably, the agglomerates withstand the cementing and solvent addition without losing their identity as agglomerates. Although some particle disassociation is tolerable, cleaner background is produced when the agglomerates are preferably particle-binder agglomerates which are insoluble in the solvent used to dissolve, the cement.

Suitable cements include Piccotex 75, Piccotex 100 and Piccotex 120 available from the Pennsylvania Industrial Chemical Co. the AROCLOR series of polychlorinated polyphenyls available from Monsanto and other solid or semi-solid resins and polymers soluble in hydrocarbon solvents. Typical materials which are solvents, include kerosene, carbon tetrachloride, petroleum ether, silicone oils, such as dimethylpolysiloxanes, long chain aliphatic hydrocarbon oils, such as those ordinarily used as transformer oils, trichloroethylene, chlorobenzene, benzene, toluene, xylene, hexane, acetone, vegetable oils and mixtures thereof; member of the FREON series of chlorinated, fluorinated hydrocarbons available from E. I. du Pont de Nemours; and, of preference, is Sohio Odorless Solvent 3440, a kerosene fraction available from Standard Oil of Ohio.

Referring now to FIG. 5, there is shown therein an alternative embodiment of my invention. This alternate embodiment is in all other respects identical to that in FIGS. 1, 3 and 4 and like-numbered components in FIG. 5 are identical to like-numbered components in those figures. The one aspect in which these embodiments of the invention differ is the use of two adhesive layers, 17 and 18, in FIG. 5, to balance the adhesion between the mono-layer 3 and receiver member 5 with the adhesion between mono-layer 3 and donor-substrate 2. This embodiment of the invention dampens out any natural tendencies that the various suitable electrically photosensitive materials (incorporated within the individual particle agglomerates of mono-layer 3) may have to possess greater adhesion for donor member 2 over receiver member 6. Adhesive layers 17 and 18 preferably comprise the same material so as to insure adhesive balance. However, layers 17 and 18 may each comprise a different material provided the adhesion is substantially balanced. For a detailed list of typical materials suitable for use in layers 17 and 18, reference is made to copending U.S. application Ser. No. 105,387, filed on Jan. 11, 1971, now U.S. Pat. No. 3,741,762 which is hereby incorporated by referency and to U.S. Pat. No. 3,598,581, which is hereby incorporated by reference.

The materials that may be suitably incorporated within the layers 17 and 18 comprise solids and semi-solids and thereby facilitate commercial manufacture, assembly, storage, maintenance and handling of the fabricated imaging member and provide a neater imaging member with which the consumer may work. The user of the imaging member fabricated in accordance with the second embodiment of the invention need not remove receiver sheet 5 prior to image production.

In operation, the FIG. 5 embodiment of the invention is practiced in all other respects in a manner identical to the practice to the first embodiment of the invention with the added requirement that the layers 17 and 18 must be in a liquid state at the time of stripout. That is to say, at some point of the practice of the FIG. 5 embodiment of the invention, the imaging member is subjected to a temperature which will liquify the thermally liquifiable layers 17 and 18. Such liquefaction can occur either before, during or after the exposure step. For some materials, normal ambient temperatures will be adequate, however, when higher melting point layers are employed, heat is applied to the manifold set.

EXAMPLE I

A yellow colored dispersion of 5 micron agglomerates is made by ball milling for two hours 3 gm. of yellow pigment described in U.S. Pat. No. 3,447,922 (N-2''-pyridyl-8, 13-dioxodinaphtho (2,1-b,2'3'-d)-d-furan-6-carboxamide) in 60 ml. of DC naptha which has been purified through a clay column. After milling, 5 gm. of a modified polystyrene, available from the Pennsylvania Industrial Chemical Company under the tradename Piccotex 75, and 20 ml. of Sohio Odorless Solvent 3440 are added thereto and the solids dissolved by heating the dispersion to 65°C under moderate stirring. The dispersion is ball milled for an additional 2 hours. Then 60 ml. of isopropyl alcohol is added under rapid stirring thereby precipitating the solids about the yellow pigment particles. The dispersion and precipitate are vacuum filtered and flushed with 200 ml. of isopropyl alcohol. The resulting moist filter cake is dispersed in 80 ml. of isopropyl alcohol by sonification. A cyan colored dispersion of 5 micron agglomerates is prepared by ball milling 3 gm. of purified metalfree alpha phthalocyanine pigment with 0.2 gm. of Indanthrone Blue (C. I. Vat Blue 6) available from Du Pont de Nemours in 80 cc of petroleum ether (90–120°C) for 2 hours, 3 gm. of Allied Chemical AC–612 polyethylene is added thereto and dissolved by heating the dispersion to 100°C under moderate stirring, 600 cc of n-butanol is added to the dispersion under moderate stirring while the dispersion is maintained at boiling and then the dispersion is cooled slowly thereby precipitating the polyethylene about the Cyan pigments, the dispersion with precipitate is then vacuum filtered and flushed with 500 cc of isopropyl alcohol, the resulting moist filter cake is dispersed in 90 cc of isopropyl alcohol by sonification; the yellow dispersion and the cyan dispersion are combined in a 1:1 ratio and coated onto a 4 × 6 inch rectangle donor member of standard Baker aluminum foil with a No. 6 Meyer wire-sound draw-down rod; the coating is air-dried for 5 minutes; a receiver member of 2-mil. Mylar is placed on the tin oxide surface of a NESA glass plate and its free surface is moistened with one quick brush stroke of a camel hair brush saturated with Sohio Odorless Solvent 3440; the moistened Mylar surface is contacted to the dried coating thereby forming a color imaging member and an electric potential of 8 KV is applied between the tin oxide NESA surface and the aluminum. The leads to the power supply are reversed for 5 seconds and then replaced in their original positions. The imaging member is then exposed through the receiver member to 100 ft.-candles of light for 1 second through a standard photographic color test target comprising a neutral step density wedge and cyan and yellow filters; the receiver and donor members are separated thereby yielding a positive cyan and yellow image on the Mylar receiver member in areas corresponding to the filters in the test target. The images exhibit two intermediate 0.3 density steps.

EXAMPLE II — PRIOR ART

The procedure of Example I is repeated with the exception that the field oscillation step is omitted. Upon separating the members, there is provided an image having 0 intermediate 0.3 density steps.

Although specific componets and proportions have been stated in the above description of preferred embodiments of the invention, other typical materials as listed above as suitable may be added to the mixture to synergize, enhance, or otherwise modify the properties of the imaging layer. For example, various dyes, spectral sensitizers or electrical sensitizers, such as Lewis acids may be added to the several layers.

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 the invention.

What is claimed is:

1. A method of imaging comprising:

a. providing an imaging mono-layer sandwiched between a donor and a receiver member, at least one of said donor and receiver members being at least partially transparent to electromagnetic radiation to which said imaging layer is sensitive, said mono-layer comprising a plurality of randomly mixed electrically photosensitive agglomerates of at least two different colors with correspondingly different spectral sensitivities to electromagnetic radiation, each individual agglomerate of said plurality being removable from said mono-layer independently of the other monolayer agglomerates;

b. maintaining first electrical field across said imaging layer;

c. modifying said first electrical field wherein said modification involves reducing, grounding or reversing the potential across said imaging layer;

d. substantially restoring said first electrical field to a constant potential;

e. exposing said mono-layer to a pattern of electromagnetic radiation to which at least one of said agglomerates are sensitive while applying said restored electric field across said imaging mono-layer, said electric field being held at a substantially constant potential during said exposure; and

f. during the application of said restores field, separating said receiver member from said donor member whereby exposed individual agglomerates are removed from said mono-layer in imagewise configuration by selective adhesion to at least one of said donor and receiver members while the non-exposed individual agglomerates adhere to the other forming a colored image.

2. The method of claim 1 wherein said agglomerates are particle agglomerates.

3. The method of claim 1 wherein said agglomerates are particle-binder agglomerates.

4. The method of claim 1 wherein said agglomerates have diameters ranging from about 0.1 micron to about 25 microns.

5. The method of claim 4 wherein said diameters are from about 3 to about 15 microns.

6. The method of claim 5 wherein said diameters are from about 5 to 10 microns.

7. The method of claim 1 wherein at least one of said members is electrically insulating.

8. The method of claim 7 wherein said electric field is caused by the induction of a static electrical charge into at least one of said members.

9. The method of claim 1 wherein said first electrical field is in the range of from about 2,000 volts per mil to about 7,000 volts per mil.

10. The method of claim 1 wherein said electric field is modified by reversing the potential across said imaging layer.

11. The method of claim 1 wherein the electrical field is modified by grounding said first electrical field.

12. The method of claim 1 wherein said field is modified by reducing said first electrical field.

13. The method of claim 1 wherein said electrically photosensitive material is an organic material.

14. The method of claim 13 wherein said organic material comprises metal-free phthalocyanine.

15. The method of claim 13 wherein said organic electrically photosensitive material is dispersed in an insulating binder.

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