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3,639,640

ELECTROSTATOGRAPHIC RECORDING ELEMENT
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No Drawing. Filed Feb. 27, 1969, Ser. No. 803,103
Int. Cl. G03g 5/00

U.S. Cl. 117—224

10 Claims

ABSTRACT OF THE DISCLOSURE

An electrostatographic recording element containing a lithopone pigment in the dielectric, insulating layer of said element. The electrostatographic recording elements of this invention are useful in both direct and transfer electrostatic recording processes.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to an electrostatographic recording element which can be employed in electrostatic printing processes to provide a permanent record of the information generated by such processes. In the case of a direct electrostatic recording process, the information to be recorded is usually generated by way of an electrically energized stylus or an electrostatic writing tube (commonly referred to as a CRT pin-tube) which is in close proximity to the electrostatographic recording element. Energization of the stylus or the electrostatic writing tube results in the deposition of a charge pattern on the surface of the electrostatographic recording element which is commonly referred to as a "latent image," and this charge pattern can be developed by any of the well-known electrostatic developing techniques to form a permanent visible image or print. In the case of a transfer electrostatic recording process, the charge pattern or "latent image" is originally formed on a surface other than the surface of the electrostatographic recording element, e.g., on the surface of a photoconductive element; and this charge pattern is then transferred to the electrostatographic recording element in order to enable a permanent visible record to be made of the thus-formed latent image. After transfer of the latent image to the electrostatographic recording element, development of this image is achieved in a manner similar to that employed in a direct electrostatographic process.

Description of the prior art

Although a number of electrostatographic recording elements have been described in the prior art, the dielectric coatings employed in most of these prior art materials resulted in electrostatographic recording elements having a relatively high-gloss finish and appearance (cf., for example, U.S. Patents 3,075,859 and 3,110,621). In addition to the fact that such elements have a feel and appearance which is dissimilar to the feel and appearance of ordinary paper, in a number of instances the high-gloss surface of such elements is unreceptive to the marking of such elements with conventional marking means. Although attempts have been made to improve the receptivity of the dielectric coating of the prior art electrostatographic recording elements to marking with conventional marking means (e.g. pencil, pen and ink, etc.), the receptivity to marking of the resulting electrostatographic recording element usually depends on the resins which are employed to form the dielectric layer of said element, and, more particularly, on the interrelationship of the various resins which are employed. For example, U.S. Patent 3,097,964 discloses an electrostatographic recording element wherein the dielectric coating is derived from a liquid colloidal

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dispersion of a film-forming, lyophilic dielectric resin in which there are suspended small solid particles of a different lyophobic dielectric resin. If the proper balance of the lyophilic-lyophobic properties of the resins is achieved, the embedded particles of the lyophobic resin provide "tooth" on the surface of the resulting dielectric coating, thereby enabling the electrostatographic element to be written on or marked with conventional marking means.

SUMMARY OF THE INVENTION

The present invention relates to an electrostatographic recording element which comprises a conductive base material having a continuous dielectric, insulating coating thereon, said coating comprising lithopone dispersed in a dielectric resin binder. The recording elements of this invention are capable of being marked with conventional marking implements, and those wherein a paper base material has been employed have a finish and appearance which closely resembles the finish and appearance of a coated bond. The recording elements of this invention can be employed in both direct and transfer electrostatic recording processes to provide permanent copies of the information recorded by way of such processes which are capable of being easily marked with conventional marking means.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As hereinbefore indicated, the electrostatographic recording elements of the present invention comprises a conductive base material having a continuous dielectric, insulating coating thereon of lithopone in a dielectric resin binder. The conductive base material can be any one of a number of base materials employed in electrostatographic recording elements, such as a metal foil, an electrically conductive paper, an electrically conductive film, an electrically conductive cloth, and the like; with an electrically conductive paper being the preferred support.

When a base material other than a metal foil is employed, electrical conductivity can be imparted to the base by impregnating or coating the base with any of the compositions or materials which have previously been employed to impart electrical conductivity to such bases. Illustrative of such materials are materials such as carbon black, inorganic electrolytes (e.g. sodium chloride, calcium chloride, lithium chloride, and the like), electrically conductive resinous polymers (e.g. resinous polymers of quaternary ammonium salts), and the like. Since materials such as carbon black impart a color to the base which might be considered to be objectionable and materials such as inorganic electrolytes are somewhat dependent on the ambient relative humidity for their effectiveness as conductive agents, the use of electrically conductive resinous polymers to impart electrical conductivity to the base materials is preferred. Examples of such polymers can be found, for example, in U.S. Pat. 3,011,918, which relates to homopolymers and copolymers of vinylbenzyl quaternary ammonium compounds and papers coated with such compounds. Other compounds which are useful for this purpose are, for example, polymers of vinyl pyridine quaternized with aliphatic esters, e.g. a polymer of vinyl pyridine which has been quaternized with diethyl sulfate.

As indicated above, the dielectric layer of the electrostatographic elements of this invention is comprised of lithopone pigment dispersed in a dielectric resin binder. Lithopone, which is essentially a stoichiometric mixture of zinc sulfide and barium sulfate, imparts a surface finish and appearance to the dielectric layer or coating which is more attractive and more receptive to marking with conventional marking means than the finishes ob-

tained through the use of a dielectric binder resin alone; and unlike a conductive or a semi-conductive pigment which might be employed to achieve a similar finish and appearance, lithopone pigment has been found to exhibit little or no deleterious effects with regard to the dielectric properties of various dielectric binder resins. Although lithopone can be employed with other relatively non-conductive pigments such as alkali metal or alkaline earth metal stearates (e.g. calcium stearate, lithium stearate, barium stearate, and the like), the use of lithopone alone or as the major pigment component of the dielectric layer is preferred.

The resin binder which is employed in the dielectric insulating coating of the electrostatographic elements of this invention has not been found to be narrowly critical, and any of the dielectric resins disclosed in the prior art can be used to form the dielectric, insulating coating. Illustrative of such binder materials are resins such as polyolefins (e.g. polyethylene, polypropylene and the like) unmodified or oil-modified alkyd resins, styrenated alkyd resins, oil modified styrenated alkyds, saturated polyester resins, polyvinyl acetates, polyvinyl chlorides propylene modified polyvinyl chlorides, polyvinyl butyral, vinyl chloride-vinyl acetate copolymers, vinyl acetate-crotonic acid copolymers, vinyl chloride-vinyl acetate-maleic acid terpolymers, copolymers of ethylene and vinyl acetate, acrylic acid ester polymers, methacrylic acid ester polymers, polystyrene, butadiene-styrene copolymers, styrene-ethylene copolymers-ethyl cellulose, cellulose acetate, cellulose acetate butyrate, cellulose acetate propionate, cellulose nitrate, sucrose esters (e.g. sucrose benzoate and the like), polysulfones, epoxide resins organo-silicone polymers, waxes, petroleum resins, coal tar resins, shellacs, and the like.

Although the essential components of an electrostatographic recording element of this invention are the same, regardless of whether the element is employed in a direct or a transfer electrostatographic recording process, it has been found that electrical conductivity requirements of the base material employed in an electrostatographic element designed for use in a transfer process are somewhat less than those for the base material of an element designed for use in a direct process. Thus, if the element comprises a non-metallic base material and is designed for use in a transfer process, a coating of an electrically conductive resin polymer on the side of the base material opposite the side carrying the dielectric, insulating coating has been found to be sufficient to provide an electrostatographic element which performs satisfactorily in a charge transfer process, and in such instances the surface resistivity of the side of the base material opposite the side carrying the electrically conductive resin coating can have a surface resistivity prior to the application of the dielectric insulating coating of as high as 1×10^9 ohms/sq. at a 50% relative humidity. In the case of an electrostatographic element comprising a non-metallic base material which is designed for use in a direct charge process, the surface resistivity of the side on which the dielectric, insulating coating is to be placed should be lower than 1.25×10^8 ohms/sq. prior to the application of said insulating coating. In those instances wherein the electrical conductivity of the base material is imparted by way of a coating of an electrically conductive resin, the desired surface resistivity can be obtained by using the side of the base material carrying the coating of the electrically conductive resin to also carry the dielectric insulating coating. To further improve the performance characteristics of an electrostatographic element of this invention designed for use in a direct electrostatographic process, both sides of a non-metallic base material can be coated with an electrically conductive resin prior to the application to one of the sides of dielectric insulating coating containing lithopone. In electrostatographic elements designed for use in a transfer electrostatographic process, a dielectric coating of from

about 0.3 to about 0.5 mil is preferred, and in electrostatographic elements designed for use in a direct electrostatographic process a dielectric coating of from about 0.05 to about 0.25 mil is preferred.

When a non-metallic base material is employed in preparing an electrostatographic element of the present invention, a preferred method of preparing such elements involves the use of dissimilar solvents in the application of the electrically conductive material and the dielectric coating to the base material. The use of dissimilar solvent systems for the electrically conductive material and the dielectric coating minimizes or eliminates any intermixing of the electrically conductive material and the dielectric coating at the interface of said coating and the base support. When the non-metallic base material is paper, it is also preferable, whenever possible, to apply the electrically conductive material to the paper from a non-aqueous solvent system, to minimize cockling, and curl in the resulting base support.

The following specific examples serve to further illustrate the present invention, but are not intended to limit the scope thereof in any way. All parts or percentages set forth in these examples represent parts or percentages by weight, and not by volume, unless the contrary is clearly expressed therein.

Example 1.—A paper having a basis weight of 50 pounds (25" x 38"—500) was coated and impregnated on both sides with a solution of 12 parts of a vinylbenzyl trimethylammonium chloride polymer (a conductive resin polymer containing 32% solids and sold by the Dow Chemical Company, a company of Midland, Michigan under the designation "Dow QX 2611.7"), 30 parts of methanol and 67.5 parts of ethanol to provide, after drying, an electrically conductive coating on one side thereof of 0.32 lb./1000 sq. ft. (4%) and 0.08 lb./1000 sq. ft. (1%) on the other side thereof. The side having the 4% coating of conductive resin was subsequently coated with a dispersion of 10 parts of a polyvinyl butyral resin (sold by Union Carbide Corporation under the designation "Bakelite XYHL"), 11.6 parts of lithopone, 29.6 parts of ethanol and 48.8 parts of toluene to provide, after drying, a continuous dielectric insulating coating thereon having a thickness of from about 0.05 to about 0.25 mil. When a charge pattern is deposited on the resulting electrostatographic element by way of an energized CRT pin tube or an electrical stylus in close proximity to said element to form a latent image thereon, this image is retained on the surface of the element until it is developed by passing the element through developing section wherein the surface is treated with either a liquid or a powdered toner containing a colored, resinous substance in particulate form having an electrostatic charge opposite that of the latent image. The developed image is then capable of being permanently set onto the surface of the electrostatographic element by passing the developed element through a fixing section wherein the image is exposed to heat, pressure, vapor, or combinations thereof to provide a permanent visible image on said element. The dielectric surface of the element has a feel and appearance resembling a coated bond paper, and is receptive to marking with conventional marking means, such as pencil, pen and ink, ball-point pen, and the like.

Example 2.—A paper having a basis weight of 50 pounds (25" x 38"—500) was coated and impregnated on one side thereof with a solution of 10 parts of an electrically conductive resin polymer containing 40% solids and sold by Calgon Inc. under the designation "Calgon 261," 30 parts of methanol, and 60 parts ethanol, to provide, after drying, an electrically conductive coating of 0.22 lb./1000 sq. ft. (4%). The side opposite the side carrying the conductive coating was subsequently coated with a dispersion of 5 parts of a polyvinyl butyral resin "Bakelite XYHL") 5 parts of sucrose benzoate, 11.6 parts of lithopone, 3.3 parts of barium stearate, 28.7 parts of ethanol, and 46.4 parts of toluene to provide, after drying, a con-

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tinuous, dielectric insulating coating thereon having a thickness of from about 0.3 to about 0.5 mil. When a charge pattern is transferred to the dielectric coating from a photoconductive element having a latent image thereon to form a latent image on the electrostatographic element, this image is retained on the surface of the element until it is developed by passing the element through a developing section wherein the surface is treated with either a liquid or a powdered toner containing a colored, resinous substance in particulate form having an electrostatic charge opposite that of the latent image. The developed image is then capable of being permanently set onto the surface of the electrostatographic element by passing the developed element through a fixing section wherein the image is exposed to heat, pressure, vapor, or combinations thereof to provide a permanent visible image on said element. The dielectric surface of the element has a feel and appearance resembling a coated bond paper, and is receptive to marking with conventional marking means, such as pencil, pen and ink, ball-point pen, and the like.

What is claimed is:

1. An electrostatographic recording element which comprises a conductive base material having a continuous dielectric, insulating coating thereon, said coating comprising lithopone dispersed in a dielectric resin binder.

2. An electrostatographic recording element as claimed in claim 1 wherein the conductive base material is selected from the class consisting of a metal foil, an electrically conductive paper, an electrically conductive film, and an electrically conductive cloth.

3. An electrostatographic recording element as claimed in claim 2 wherein the conductive base material is an electrically conductive paper base.

4. An electrostatographic recording element as claimed in claim 3, wherein the electrically conductive paper base comprises a paper sheet having conductive resin coating on at least one side thereof.

5. An electrostatographic recording element as claimed in claim 4 which comprises a paper sheet having a conductive resin coating on one side thereof and the con-

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tinuous dielectric insulating coating on the opposite side thereof.

6. An electrostatographic recording element as claimed in claim 4, wherein the paper base comprises a paper sheet having a conductive resin coating on both sides thereof.

7. An electrostatographic recording element as claimed in claim 5 or 6 wherein the conductive resin coating is derived from a resinous polymer of a quaternary ammonium salt.

8. An electrostatographic recording element as claimed in claim 7 wherein the continuous, dielectric insulating layer is derived from a dispersion of lithopone and a polyvinyl butyral resin.

9. An electrostatographic recording element as claimed in claim 7 wherein the continuous dielectric insulating layer is derived from a dispersion of lithopone and barium stearate in a mixture of polyvinyl butyral and sucrose benzoate.

10. A method of producing an electrostatographic recording paper which comprises treating at least one side of a paper base sheet with a solution of an electrically conductive material in a non-aqueous solvent, evaporating the non-aqueous solvent, applying a dispersion comprising lithopone and a dielectric resin in a solvent which is dissimilar from that employed with the electrically conductive material, and evaporating said dissimilar solvent to form a continuous dielectric insulating coating on said base which is in positive contact with said base through an interface which substantially completely segregates said insulating coating from said base.

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U.S. Cl. X.R.

117—201