

[54] **ELECTROSTATICALLY DEFORMABLE
THERMOPLASTIC LAYER
CONTAINING A 1,4-DIALKYLAMINO-
9,10-ANTHRAQUINONE DYE**

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[22] Filed: **April 13, 1971**
[21] Appl. No.: **133,735**

[52] U.S. Cl. **96/1.5, 96/1 R, 96/1.1,
96/27 R, 96/84 R**
[51] Int. Cl. **G03g 5/02**
[58] Field of Search **96/1.1, 27 R, 84 R, 1.5**

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[57] **ABSTRACT**

A thermoplastic-deformable imaging system is pro-
vided which absorbs substantially all of the incident
radiation which is not reflected from the ther-
moplastic-air interface of a thermoplastic deformable
layer residing over an underlying photoconductive
layer so as to eliminate secondary reflection from the
thermoplastic-photoconductor interface. The ther-
moplastic deformable layer is provided with an ab-
sorbing pigment which substantially absorbs non-
reflected radiation so that this radiation is not sec-
ondarily reflected.

3 Claims, No Drawings

ELECTROSTATICALLY DEFORMABLE THERMOPLASTIC LAYER CONTAINING A 1,4-DIALKYLAMINO-9,10-ANTHRAQUINONE DYE

BACKGROUND OF THE INVENTION

This invention relates to xerography and more particularly to a novel electrostatic surface deformable imaging system.

In surface deformation imaging a plastic film superimposed on a conductive substrate has deposited on its surface a non-uniform charge pattern and is then usually softened causing either relief imaging or frost imaging. In the frost imaging process solid area coverage is obtained whereas in relief imaging only line copy image reproduction may be achieved. In relief imaging charges held on the surface of an insulating film layer supported by a conductive support substrate experience a force of attraction toward the charges of opposite polarity induced in the conductive substrate. When charge is dissipated or added or when a combination of both operations is performed on the insulating film in a non-uniform fashion employing a suitable method sharp charge differences will develop on the film surface. These differences result in an imbalance of force on the surface of the film causing it to deform if a cold flow material is used, or deformation may result in non-cold flow materials when heat or a suitable solvent is applied. A photoconductive film is employed to supply these charge differences in response to selective illumination.

In frost imaging a form of surface deformation distinctly different from relief can be induced by charging a thin insulating film resulting in a diffusely reflecting or light scattering surface, the charged surface taking on a frosted appearance. The frost process is discussed in detail in a publication entitled "A Cyclic Xerographic Method Based On Frost Deformation" by R. W. Gundlach and C. J. Claus, Journal of Photographic Science and Engineering, February edition, 1963. The relief imaging process has been described in U. S. Pat. Nos. 3,055,006, 3,063,872 and 3,113,179.

As above explained, the frost method may involve the electrophotographic process whereby a latent electrostatic image is produced on a thin dielectric thermoplastic film. This film is then deformed either concurrently with or subsequent to charging by heating or exposure to an atmosphere of solvent vapors which produce a solid area of visible image. By employing the proper sequence of charging and exposure on a plastic overcoated layer, a charge pattern can be created which controls selected wrinkling or frosting of the deformable layer to form solid area images. After the image is made visible by frosting, it may then be frozen by allowing the frosted film to harden by various methods such as, by removing the source of heat, solvent vapor or the like used to soften the deformable layer. If it is desired to reuse the same film, the image can be erased after use by simply restoring and maintaining a low viscosity for a sufficient period of time using the very same methods employed to initially soften the film.

After the frost image is formed it may be readout before permanently fixed by freezing as described above or before erasure to be used again. Readout may be accomplished by employing an incident light having any suitable wavelength, for example, light having a

wavelength of 6,328A may be directed at the frost image surface with the surface reflection being monitored. The reflection from the thermoplastic or image bearing surface is that which provides the readout, however, it is found that secondary reflection from the underlying photoconductive layer is also read out which interferes with the desired readout. It has been found that when employing a conventional thermoplastic over an arsenic doped selenium photoconductive layer, for example, the first surface or thermoplastic surface reflection is approximately 4.5 percent and the resultant second surface reflection from the underlying photoconductor is approximately 11 percent for normal incident light, the resultant second surface reflection referring to the percentage of incident light that passes out of the plastic after being reflected at the plastic photoconductor interface. It is, therefore, seen that an unfavorable ratio of first to resultant second surface reflection does exist which substantially interferes with proper readout.

SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to provide a surface deformation imaging system devoid of the above noted deficiencies.

It is another object of this invention to provide a novel surface deformable imaging system.

Still another object of this invention is to provide a frost imaging member which substantially reduces secondary readout.

Again, another object of this invention is to provide a two layer frost imaging member from which substantially all readout is from the imaging layer.

These and other objects are accomplished in accordance with the system of the present invention, generally speaking, by providing a thermoplastic deformable imaging layer which absorbs substantially all of the incident radiation employed for readout thereby eliminating secondary reflection from the thermoplastic-photoconductor interface. The absorbing thermoplastic chosen must absorb substantially all of the incident radiation which is not reflected although it has been found that approximately 80 percent absorption is satisfactory. Employing radiation of 6,328A directed at a 1.5 micron thermoplastic layer with 80 percent absorption it is found that favorable ratio of reflection from the thermoplastic surface to reflection from the thermoplastic-photoconductive surface is about 10:1. The absorbing thermoplastic layer comprises conventionally available frostable materials in combination with a class of dyes which provide an absorbing and deformable thermoplastic.

A suitable absorbing dye, e.g., 1,4-diisopropyl 9,10-anthraquinone is blended at about 20 percent by wt. with a thermoplastic resin, e.g., Piccopale H-2, an aliphatic amorphous hydrocarbon and coated about 1.5 micron thick on a photoconductive substrate. The coating is corona charged and heated until a prominent frost is obtained. When incident light of 6,328A is employed for readout substantially all of the readout is found to originate from the thermoplastic-air interface.

Although incident radiation of 6,328A has been discussed in connection with readout, any suitable wavelength of radiation may be employed. So it is that the absorbing dyes which are incorporated into the

thermoplastic material must be selected so that they absorb the incident radiation particularly well and do not in any way curtail the deformable properties of the imaging layer. When, for example, the incident radiation is as specified about 6,328A, it is found that the compound 1,4-dialkylamino 9,10-anthraquinone when incorporated into the deformable imaging layer performs very satisfactorily. Preferred such compounds have alkyl groups selected from the group consisting of methyl, ethyl, propyl, isopropyl, butyl, pentyl, hexyl, anyl, dodecyl, and stearyl among others.

In illustrating the process of the present invention a thermoplastic layer of 1.5 μ has been employed by way of example, however, any suitable thickness may be employed which meets the requirements of the present process. Thicknesses of 1 to 4 microns have been found to function satisfactorily while thickness of 1 to 2 microns are preferred. The deformable imaging layer may comprise any suitable thermoplastic. Typical thermoplastic materials include polymers of vinyltoluene and styrene, copolymers of vinyltoluene and styrene, and polymers and copolymers of substituted vinyltoluene and substituted styrene and other like compounds.

The underlying photoconductive layer may comprise any suitable photoconductive material. Typical inorganic photoconductor materials include: sulfur, selenium, zinc sulfide, zinc oxide, zinc cadmium sulfide, zinc magnesium oxide, cadmium selenide, zinc silicate, calcium strontium sulfide, cadmium sulfide, mercuric iodide, mercuric oxide, mercuric sulfide, indium trisulfide, gallium selenide, arsenic disulfide, arsenic trisulfide, arsenic triselenide, antimony trisulfide, cadmium sulfo-selenide, and mixtures thereof. Typical organic photoconductors include: triphenylamine; 2,4-bis(4,4'-diethyl-aminophenyl)-1,3,4-oxadiazole; N-isopropyl-carbazole; triphenylpyrrol; 4,5-diphenylimidazolidinone; 4,5-diphenylimidazolidinethione; 4,5-bis-(4'-amino-phenyl)-imidazolidinone; 1,5-dicyanonaphthalene; 1,4-dicyanonaphthalene; aminophthalodinitrile; nitrophthalodinitrile; 1,2,5,6-tetraazacyclooctatetraene-(2,4,6,8); 2-mercaptobenzothiazole-2-phenyl-4-diphenylidene-oxazolone; 6-hydroxy-2,3-di (p-methoxy-phenyl)-benzofurane; 4-dimethylamino-benzylidenbenzhydrazide; 3-benzylidene-amino-carbazole; polyvinyl carbazole; (2-nitro-benzylidene)-p-bromo-aniline; 2,4-diphenyl-quinazoline; 1,2,4-triazine; 1,5-diphenyl-3-mentyl-pyrazoline; 2-(4'-dimethylamino phenyl)-benzoxazole; 3-amino-carbazole; phthalocyanines and mixtures thereof.

Any suitable method of charging may be employed in the process of the present invention. Typical methods of charging include: contact charging, corona charging and electron gun charging.

Any suitable method of exposing may be used in accordance with the process of the present invention. Typical methods of exposure include: holographic techniques, non-lens slit scanning systems, reflux contact, optical projection systems involving lens imaging of opaque-reflection subjects as well as transparent film originals.

Any suitable method of fixing may be employed in the process of the present invention. Typical methods include freezing or removal of solvent vapor or heat.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

To further define the specifics of the present invention the following examples are intended to illustrate and not limit the particulars of the present system. Parts and percentages are by weight unless otherwise indicated.

EXAMPLE I

A 1.5 micron coating of 20 wt. percent, Calco Oil Blue V (American Cyanamid, 1,4-dialkylamino 9,10-anthraquinone) in Piccopale H-2 resin is prepared on a selenium photoconductive layer. The coating is corona charged to 100 volts across the coating, selectively exposed, recharged and heated to about 60°C until an excellent frost image develops and then cooled to room temperature. Another sample is prepared without the anthraquinone and the optical properties are measured. The dyed plastic layer is found to absorb 70 percent of the 6,328A radiation through 1.5 microns of thickness while the undyed is found to have negligible absorption.

EXAMPLE II

A 17 wt. percent, 1,4-diisopropylamino 9,10-anthraquinone dyed Piccopale H-2 coating was prepared and evaluated as in Example I. The dyed plastic develops an excellent frost and is found to absorb 75 percent of the 6,328A radiation through 1.5 microns of thickness while the undyed again exhibits negligible absorption.

EXAMPLE III

A 50-50 mixture of Piccopale H-2, and Dow 276-V2 (a mixture of cyclic oligomers of alpha-methylstyrene) is added to 20 wt. percent Calco Oil Blue V coated on a photoconductive layer and imaged as in Example I. The layer develops an excellent frost at 25°C and is found to absorb 70 percent of 6,328A radiation through about 1.5 microns of thickness.

Although the present examples were specific in terms of conditions and materials used, any of the above listed typical materials may be substituted when suitable in the above examples with similar results. In addition to the steps used to carry out the process of the present invention, other steps or modifications may be used if desirable. In addition, other materials may be incorporated in the system of the present invention which will enhance, synergize or otherwise desirably affect the properties of the systems for their present use.

Anyone skilled in the art will have other modifications occur to him based on the teachings of the present invention. These modifications are intended to be encompassed within the scope of this invention.

What is claimed is:

1. A deformable imaging member capable of absorbing light at a wavelength of 6,328A, comprising a photoconductive substrate provided with an overlying deformable layer of about 1 to 2 microns in thickness, said deformable layer comprising a thermoplastic material containing 1,4-dialkylamino-9,10-anthraquinone.

2. In a method for readout of an image from a deformable imaging member by monitoring the reflectance of incident light having a wavelength of 6,328A from said member:

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the improvement comprising, providing a deformable imaging member capable of absorbing light at a wavelength of 6,328Å, said member comprising a photoconductive substrate provided with an overlying deformable layer of about 1 to 2 microns in thickness and, said deformable layer comprising a

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thermoplastic material containing 1,4-dialkylamine-9,10-anthraquinone.

3. The deformable imaging member as defined in claim 1, wherein said photoconductive substrate is an arsenic doped selenium photoconductor.

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