Aug. 28, 1962 M. L. SUGARMAN, JR., ET AL 3,051,569

PHOTOCONDUCTIVE MATERIALS

Filed Oct. 26, 1959

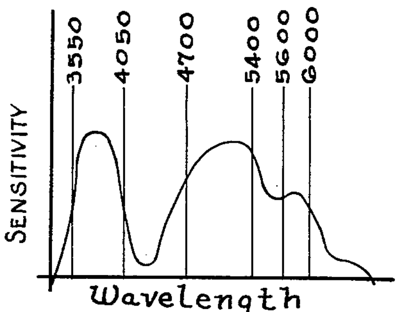

Fig. 1

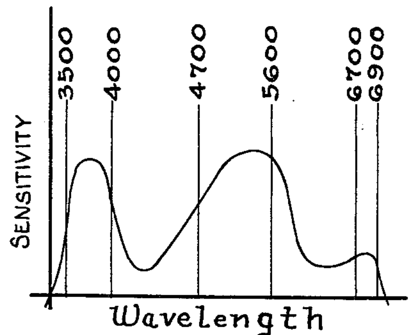

Fig. 2

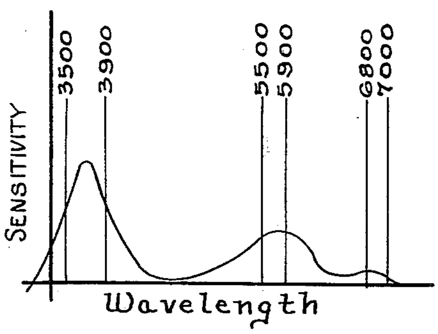

Fig. 3

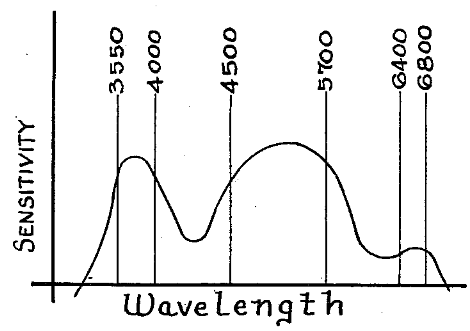

Fig. 4

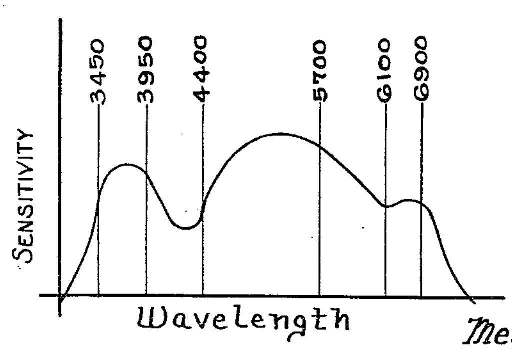

Fig. 5

INVENTORS
Meyer L. Sugarman Jr.
Nicholas P. Steiner
BY Wolfe, Hubbard, Voit + Osann
ATTORNEYS

United States Patent Office

3,051,569

Patented Aug. 28, 1962

3,051,569

PHOTOCONDUCTIVE MATERIALS

Meyer L. Sugarman, Jr., Glencoe, and Nicholas P. Steiner, Chicago, Ill., assignors to American Photocopy Equipment Company, Evanston, Ill., a corporation of Illinois

Filed Oct. 26, 1959, Ser. No. 848,600
13 Claims. (Cl. 96—1)

This invention relates to photoconductive materials and devices for use in electrostatic printing, and more particularly to improved photoconductive materials and compositions which are sensitive to visible light such as produced by an ordinary tungsten lamp and which are substantially white in appearance.

An electrostatic printing process is a process capable of producing a visible record or reproduction. Such a process is well known in the art and includes the steps of converting a light image or electrical signal into an electrostatic charge pattern on an electrically insulating layer. The pattern is developed into a visible image resulting in the reproduction of the original pattern.

A typical electrostatic process conventionally includes the preparation of an electrophotographic recording element, for example by coating the surface of a backing member such as paper with a photoconductive insulating material such as zinc oxide dispersed in an electrically insulating film forming vehicle such as a silicone resin. The recording element is subjected to a high voltage corona discharge which produces an electrostatic charge on the element surface. By focusing a light image on the charged surface, the portions irradiated by the light rays are discharged leaving the remainder of the surface in a charged condition or, in the terms of the art, leaving an electrostatic image on the element. This image is rendered visible in any suitable manner such as by applying a developer powder which adheres electrostatically to the charged areas of the sheet. The powder image thus formed may be fixed directly to the photoconductive coating, for example by heating to fuse a thermoplastic resin incorporated in the powder.

A detailed description of an electrostatic printing process may be found in U.S. Patent 2,874,063, issued February 17, 1959, to Harold G. Greig. In the process described in this patent, a sheet of paper having a coating containing relatively pure zinc oxide on its surface is charged by subjection to a corona discharge of approximately 600 to 800 volts. A latent image is formed on this paper by photographic exposure and the image is developed by contacting the paper with a developer mix. The mix described is essentially iron particles mixed with a carbon pigmented resin powder.

An electrophotographic recording element is conventionally prepared by first mixing a finely divided photoconductor and an electrically insulating film forming vehicle with a volatile organic solvent, for example by mixing zinc oxide and a silicone resin with toluene. This mixture is coated on a backing member, such as a sheet of sulfide paper, by any standard coating procedure. The coating is dried and the paper is punched or cut to the desired size.

A modified electrophotographic recording element has been produced by coating a backing member with a photoconductive insulating material and a film forming vehicle dispersed in an aqueous medium, and subsequently drying the coating so produced. One such vehicle which has been employed is an aqueous suspension of a polyvinyl acetate resin.

It will be appreciated that zinc oxide photoconductive material is white; however, a zinc oxide coated printing base while satisfactory for certain uses, also has certain limitations. Of these limitations, the most important is

the restricted spectral response of white zinc oxide, which is confined essentially to the far blue and the ultraviolet. Such a spectral response limits the process using white zinc oxide to applications where the required radiation wave length is available. The limited band of spectral response also restricts the speed of response throughout the spectrum except in the ultraviolet. Furthermore, white zinc oxide mixtures prefer negative blanket charges and have not been found to be as satisfactory for positive blanket charges.

One remedy for the limited spectral response of zinc oxide which has been suggested is to employ a photoconductive material having a spectral response in the visible spectrum. Photoconductive materials which have been suggested as being effective are the colored oxides, sulfides, selenides, tellurides and iodides of the metals cadmium, mercury, antimony, bismuth, thallium, indium, molybdenum, aluminum, lead and zinc. In addition, colored salts such as arsenic trisulfide, cadmium arsenide, and lead chromate have been employed, all of which are spectrally sensitive to light in the visible range of the spectrum.

Still another solution to the problem of spectral response has been the use of a photoconductive material, such as white zinc oxide dispersed in an electrically insulating film forming vehicle, having incorporated therein a dye which is capable of absorbing radiant energy and transferring the absorbed energy to the photoconductor. A recording element is produced from such a material by coating a backing member with the photoconductive material having the dye incorporated therein. Among the sensitizing dyes which have been used with zinc oxide are fluorescein, eosin, erythrosin, rose bengal, malachite green, crystal violet, basic fushsin, methyl green, brilliant green, kryptocyanine, methylene blue, acridine orange, methylene gray, alizarin reds and quinizarin.

With a selected dye incorporated into the white zinc oxide, the recording elements conventionally used exhibit a spectral peak at about 3750 angstroms, in the original range of the white zinc oxide, and a second peak, in the visible range of 4000 to 7000 angstroms, as a result of the dye sensitization. While the use of dyes has been somewhat successful in increasing the sensitivity of the recording element, the coatings are subject to the same disadvantage as are those coatings including the various colored compounds mentioned above, namely, that the coatings have a colored tint. Depending upon the dye used, the tints generally are blue, green, yellow, orange or red and various shades and hues thereof.

It is the primary object of the present invention to produce an improved white electrophotographic paper which is sensitive to visible light, or in terms of the art, has a spectral response to light wavelengths in the visible spectrum and has a substantially white to off-white spectral appearance.

Another object of the present invention is to provide a photosensitive composition for producing white photoconductive recording elements having a spectral sensitivity in the visible range of the spectrum without materially affecting the spectral reflecting characteristics or appearance of the base photoconductive material therein.

A further object of the present invention is to improve the aesthetic quality of photoconductive compositions and articles coated therewith and at the same time enhancing the spectral sensitivity thereof.

Still another object of the present invention is to provide an improved method for producing substantially white electrophotoconductive recording elements having a spectral sensitivity in the visible range of the spectrum. A further object of the present invention is to provide an improved method of producing a zinc oxide-containing photosensitive composition which is of increased sensitivity to visible light and yet which is white to off-white in spectral reflectivity.

Still a further detailed object of this invention is to produce a white zinc oxide-containing composition which, when coated on a suitable base material and charged with an electrostatic charge is highly sensitive to visible light of colors beyond the blue region of the spectrum so that the charge on the coating imparted by the corona discharge is rapidly and efficiently discharged when subjected to such visible light.

Other objects and advantages of the present invention will become apparent as the following description proceeds taken in connection with the accompanying drawings wherein:

FIGURES 1–5 are diagrams illustrating the spectral photographic sensitivity of a paper coating with a composition prepared in accordance with Examples I through V respectively.

The present invention contemplates a white photoconductive material comprising a finely divided white zinc oxide photoconductor dispersed in an electrically insulated film forming vehicle and having incorporated therein a plurality of spectral sensitizers principally organic dyes which broaden the basic spectral response of the photoconductor by absorbing radiant energy and transferring the absorbed energy to the zinc oxide photoconductor and at the same time produce an overall spectral reflection causing the finished composition to assume a spectral appearance which is white or at least slight off-white. A recording element for use in an electrostatic printing process may comprise a backing member such as paper having a surface coated with a layer of the white spectrally sensitive photoconductor composition embodying the present invention.

In accordance with the present invention one surface of a backing sheet, which may be a suitable copy paper which is to receive the desired copy image, is coated with a composition comprising a base photoconductor such as zinc oxide, for example, suspended in an electrically insulated film forming vehicle. The spectral response, the speed of response, and the contrast characteristics of the printing base are controlled by a choice of dye combinations which act together with the base photoconductor to produce a photoconductive composition having the desired sensitivity as well as the desired white to off-white spectral appearance. The photoconductor composition may have its peak spectral response in the visible region although it may be anywhere between the far infrared and the far ultraviolet.

It will be appreciated that the color of the individual dyes employed will indicate approximately the location of the absorption edge of the material and therefore indicate the spectral response of the photoconductor. It has been discovered that by mixing selected combinations of two or more dyes which are compatible, that is which do not interfere with the spectral photographic response which each imparts to the photoconductor, with the base photoconductor, it is possible to produce a white to off-white photoconductor composition, or a composition which when coated on the backing sheet appears to be white. Essentially, this is accomplished in the case of a white zinc oxide photoconductor composition by employing a combination of compatible dyes which, when mixed together, give a mixture which appears to be substantially dark gray to black. This mixture of dyes is then mixed with zinc oxide photoconductor powder. The small amount of the dye mixture employed in the photoconductor, so long as the dye mixture is gray to black, will be hidden by the predominately white characteristic of the zinc oxide. This is in contrast to the use of a single dye having a definite color tint which, by virtue of that color tint, imparts a light colored haze to the zinc oxide.

While dyes which are known to be gray or black in appearance are known, it has been found that these dyes generally do not posess the necessary spectral response characteristics required to impart the desired spectral photographic sensitivity to the zinc oxide, even though they do, when mixed with the zinc oxide, produce a white or near white coating. We have discovered that by mixing two or more compatible dyes, which are capable by themselves of imparting the desired spectral response to the zinc oxide or other white photoconductor, so as to produce a gray or black mixture, and incorporating this dye mixture into the zinc oxide, a white to off-white coating having the desired spectral response can be obtained. Alternately, dyes of properly selected complementary colors may be added to a coating containing a colored photoconductor, so as to furnish an overall surface reflectivity creating a white or near-white appearance. It will be appreciated from the foregoing that the appearance of the dye blend referred to above is its reflected light appearance.

One commercial zinc oxide product which we have used and found to be suitable is a white zinc oxide known as French process, Florence Green Seal, pigment grade, zinc oxide marketed by the New Jersey Zinc Sales Company Incorporated, of New York.

While any suitable resin may be employed so long as it does not interfere with the spectral response of the coating, we have found that a silicone resin solution containing 60% solids, such as Dow Corning Silicone 840 manufactured by the Dow Corning Company, or G.E. silicone resin SR–82 marketed by the General Electric Company can be employed to advantage. If the resin is colored, so as to give a normally tinted appearance to a non-dyed coating, this also may be compensated for in dye selection. For example, many resins are yellowish or brownish in appearance. A suitable blue or blue-green dye may be used to overcome the tint imparted to the coating by these resins.

The following examples will serve to illustrate compositions embodying the present invention. These examples are by way of illustration and not of limitation and it should be understood that there is no intention to so limit the present invention. On the contrary, the intention is to cover equivalents and modifications thereof falling within the spirit and scope of the invention as expressed in the appended claims.

Example I

An improved electrophotographic recording element embodying the present invention was prepared by coating a paper backing sheet with a basic coating mixture having added thereto a dye blend. The following basic ingredients were mixed together to form the coating mixture:

Zinc oxide (Florence Green Seal, French process, New Jersey Zinc Company)	grams	100
Silicone resin solution (containing 60% solids, such as Dow Corning Silicone 840, marketed by the Dow Corning Company)	cc	100
Toluene	cc	100

A dye blend is prepared as follows:

Rose Bengal (Eastman Organic Chemicals)	gram	0.003
Sodium fluorescein (Matheson Coleman Bell)	do	0.003
Methylene Blue (Merck)	do	0.003
Methanol	cc	2

The basic coating mixture was agitated for 10 minutes in a high speed blender. The dye blend was added slowly to the zinc oxide-resin-solvent mixture while the latter is being agitated.

The undyed coating mixture appeared substantially pure white, being the color of zinc oxide. The dye blend, on the other hand, had a dark gray to black spectral appearance. When added to the zinc oxide, the coating mixture and dye blend had a slightly offwhite or grayish tint, which looked essentially white to the normal observer.

The blended mixture was then coated on a sheet of paper in a layer about 0.1 mil to 1.5 mils thick, but preferably about 0.5 mil thick. The coated paper was dried to remove the solvent.

FIGURE 1 is a curve illustrating the spectral response of the coating produced in accordance with Example I as measured on a wedge spectrograph. Essentially, a wedge spectrograph includes a light source, such as a tungsten lamp. A beam of light from the lamp is projected through a prism or other suitable means for separating the light into respective wave length bands. The light beam is then passed through a wedge which uniformly decreases the light intensity in a direction perpendicular to that of the spectrum produced by the wave length separation. One illustrative wedge spectrograph is the Hilger wedge spectrograph which was used for producing the figures shown in the drawings.

The curves shown in the drawings were obtained in the following manner. A recording element was prepared according to Example I. The surface of the coating was then electrostatically charged for example with a corona discharge apparatus to a negative surface potential of about −600 volts. This surface was then exposed to the light from a Hilger wedge spectrograph. The result shown, after the paper was developed in a suitable manner such as described in the Greig Patent No. 2,874,063, is a light or white area under the curve, where the electrical charge was discharged by exposure to light and a dark area (the color of which depends upon the color of the developer powder) above the curve where the charge was not discharged by light. The peak of the curve is the point where a wave length of minimum intensity discharges the charge on the paper.

The intensity versus wave length curve shown as FIG. 1 was produced by exposing to light from a Hilger wedge spectrograph, a sheet of paper coated as described above. The curve produced illustrates the sensitivity of the paper to light of decreasing intensity and of given wave lengths. More specifically, the curve has a first peak in the ultraviolet wave length range, i.e. between 3550 and 4050 angstroms, and two additional peaks in the visible range of wave lengths beyond the blue range of the spectrum, i.e. between 4700 and 5400 angstroms, and between 5600 and 6000 angstroms. The first peak, in the ultraviolet, is the peak given by zinc oxide alone. The additional peaks in the visible light range are imparted by the combination of the sensitivity dyes and the zinc oxide.

Most important, in addition to the visible light sensitivity of the coating is the fact that the coating appears to be substantially white. This physical spectral appearance is important from an aesthetic point of view in that it enables the user to make a black-on-white or a color-on-white reproduction.

While a specific example of a recording element has been given, other materials and structures may be used. The backing element may be either a relatively insulating material, such as paper, or it may be a relatively conducting material such as metal foil or sheet or paper impregnated with carbon black.

The electrically-insulating film forming vehicle may be selected from a large group of substances. It is desirable for the film forming vehicle to have a relatively high dielectric strength. These materials may be natural or synthetic resins or waxes. Examples of suitable resins are the vinyl resins, silicone resins, phenol formaldehyde compounds, and cellulose ethers and esters. Shellac is an example of a suitable natural resin. Examples of suitable waxes are paraffin, carnauba wax and beeswax. Mixtures of two or more vehicles may be used and plasticizers or similar modifying agents may be incorporated with the film forming vehicle provided they do not adversely affect the electrical properties of the material.

It is generally preferable to mix the film forming vehicle with the zinc oxide prior to adding the dyes, although the dyes may be added, individually or in combination, at any stage of the mixing.

Example II

A coating composition was prepared and employed in accordance with the description in Example I except that the dye blend was prepared as follows:

Alphazurine 2G (National Aniline)	gram	0.012
Euchrysine GGA (General Dyestuff)	do	0.0084
Dibromofluorescein (Hilton Davis)	do	0.0072
Methylene Blue (Merck)	do	0.0018
Absolute Methanol	cc	5

A paper backing was coated with the composition as described in Example I. The coated paper was substantially white in appearance. FIG. 2 illustrates the spectral response of the composition prepared in accordance with Example II as measured on a wedge spectrograph. The curve represents a peak between 3500 and 4000 angstroms, one between 4700 and 5600 angstroms, and one between 6700 and 6900 angstroms, the latter two peaks being in the visible light spectrum beyond the blue range.

Example III

A coating composition was prepared and employed in accordance with the description in Example I except that the dye blend was prepared as follows:

Rhodamine B (National Aniline)	gram	0.003
Auramine O conc. (National Aniline)	do	0.003
Methylene Blue (Merck)	do	0.003
Absolute Methanol	cc	2

A paper backing was coated with the composition as described in Example I. FIG. 3 illustrates the spectral response of the composition prepared in accordance with Example III as measured on a wedge spectrograph. The curve represents a peak in the blue range, i.e. between 3500 and 3900 angstroms, a second peak between 5500 and 5900 angstroms, and a third peak between 6800 and 7000 angstroms. The paper was substantially white in appearance.

Example IV

A coating composition was prepared and employed in accordance with the description in Example I except that the dye blend was prepared as follows:

Dibromofluorescein (Hilton Davis)	gram	0.018
Euchrysine GGA (General Dyestuff)	do	0.018
Alphazurine 2G (National Aniline)	do	0.024
Blancophor HS 76 (General Dyestuff) (whitening agent)	do	0.030
Absolute Methanol	cc	15

A paper backing was coated with the composition as described in Example I to produce a substantially white paper. FIG. 4 illustrates the spectral response of the composition prepared in accordance with Example IV as measured on a wedge spectrograph. The curve represents peaks between 3500 and 4000 angstroms, between 4500 and 5700 angstroms, and between 6400 and 6800 angstroms.

Example V

A coating composition was prepared and employed in accordance with the description in Example I except that the dye blend was prepared as follows:

Dibromofluorescein (Hilton Davis)	gram	0.024
Auramine O conc. (National Aniline)	do	0.030
Alphazurine 2G (National Aniline)	do	0.030
Blancophor HS–76 (General Dyestuff)	do	0.030
Absolute Methanol	cc	18

A paper backing was coated with the composition as described in Example I to produce a substantially white paper. FIG. 5 illustrates the spectral response of the composition prepared in accordance with Example V as measured on a wedge spectrograph.

Example VI

A coating composition was prepared and employed in accordance with the description in Example I except that the dye blend was prepared as follows:

Alphazurine 2G (National Aniline)	gram	0.0132
Euchrysine GGA (General Dyestuff)	do	0.0048
Dibromofluorescein (Hilton Davis)	do	0.0072
Methylene Blue (Merck)	do	0.0030
Uramine SS	do	0.0045
Absolute Methanol	cc	6.5

A paper backing was coated with the composition as described in Example I. The coated paper appeared substantially white and had a spectral response quite similar to that produced by the blend of Example V and shown in FIG. 5.

The Blancophor HS–76 employed in Examples IV and V acts as an ultraviolet absorber which retards or eliminates bleaching of the dyes after prolonged exposure to strong light. In addition, this compound improves the apparent "whiteness" of the dried film.

In Example III, the Auramine, which in itself shows no sensitization other than its usual ultraviolet curve, does become effective in the dye blend. This indicates that supersensitization is taking place when the dye is blended with dibromofluorescein and alphazurine.

As stated above, the theoretical addition of three subtractive primaries in equal quantities should produce a true black which will appear a very light gray when added to the zinc oxide coating mixture. This is not always true in practice because theoretically perfect absorption does not take place in the zinc oxide particles. The final resulting color is a function of (*a*) the affinity of the dye to the resin vehicle in the coating mixture, (*b*) the competition between the resin and the dye for absorption to the zinc oxide particle, (*c*) the method of addition of the dye, that is whether it is separately added or premixed, (*d*) the method of dispersion of the dye whether by ball mill, high sheer mixture or stirring, and (*e*) the solubility of the dye and the solvent used in the coating mixture.

The proportion of powdered zinc oxide to film forming material in the final coating may vary over a wide range. The preferred ranges are 50–90% zinc oxide and 10–50% of film forming vehicle. The optimum proportions are dependent upon the nature of the photoconductor, the film forming vehicle, the dye, and the results desired.

The recording elements of the invention may be utilized to receive a visible image. One process for accomplishing this is described in U.S. Patent 2,874,063, to Greig and this description is incorporated herein by reference.

There has been described methods and compositions for extending the spectral response of zinc oxide photoconductive material and at the same time for producing attractive white coatings by incorporating into the photoconductive composition a dye blend which is capable of extending the spectral response and at the same time producing an overall spectral appearance which is white to off-white in appearance. The photoconductive elements produced are not only of improved photosensitivity but of enhanced attractiveness and aesthetic values.

It has not been possible to test all of the many possible dye blends in order to determine their utility as spectral sensitizers for the photoconductive material. It is not unlikely that certain other dye blends may be effective for this purpose. Obviously, if one skilled in the art after reading the specification were to test dye blends and find them suitable for the purpose of improving the spectral response as well as imparting white spectral reflectivity to the composition the use of such equivalent materials would be within the spirit and scope of the appended claims.

We claim as our invention:

1. An electrophotographic recording element comprising a backing member having a surface coated with finely divided photoconductive zinc oxide dispersed in an electrically insulating film forming vehicle and having incorporated therein an organic dye blend of a plurality of compatible colored spectrally sensitive organic dyes of such colors and in such amounts as to have when mixed a gray to black appearance, said gray to black blend being incorporated with said zinc oxide and vehicle in an amount sufficient to broaden the basic spectral response of the zinc oxide and at the same time produce in combination with said zinc oxide and vehicle an overall spectral reflection causing the finished dried coating to assume a white to off-white spectral appearance.

2. An electrophotographic composition comprising finely divided photoconductive zinc oxide suspended in an electrically insulating film forming vehicle and having incorporated therein at least one colored spectrally sensitive organic dye in an amount sufficient to broaden the basic spectral response of said zinc oxide, and at least one color component selected to produce a gray to black appearance when mixed with said spectrally sensitive colored organic dye and added in an amount sufficient to produce in combination with said zinc oxide and said spectrally sensitive colored organic dye an overall spectral reflection which is such as to impart to the composition a white to off-white spectral appearance.

3. A photoconductive composition comprising finely divided photoconductive zinc oxide having a spectral response of between 3500 A. to about 4000 A., suspended in an electrically insulating film forming vehicle and having incorporated therein an organic dye blend of a plurality of compatible colored spectrally sensitive organic dyes of such colors and in such amounts as to have when mixed a gray to black appearance, said gray to black blend being incorporated with said zinc oxide and vehicle in an amount sufficient, in cooperation with said zinc oxide, to broaden the basic spectral response thereof to include visible light between about 4300 A. and about 7000 A. and to produce in combination with said zinc oxide an overall spectral reflection imparting to the overall composition a white to off-white spectral appearance.

4. A photoconductive composition comprising finely divided photoconductive zinc oxide suspended in an electrically insulating film forming vehicle having incorporated therein an organic dye blend of a plurality of compatible colored spectrally sensitive organic dyes of such colors and in such amounts as to have when mixed a gray to black appearance, said gray to black blend being incorporated with said zinc oxide and vehicle in an amount sufficient, in cooperation with said zinc oxide, to broaden the basic spectral response thereof to include visible light between about 4300 A. and about 7000 A., and to produce, in combination with said zinc oxide, an overall spectral reflection imparting to the overall composition a white to off-white spectral appearance.

5. A white to off-white photoconductive composition consisting essentially of finely divided photoconductive zinc oxide suspended in an electrically insulating film forming vehicle and having incorporated therein a methanol solution of a substantially gray to black dye blend selected from the group consisting of a dye blend consisting of: Rose Bengal, Sodium fluorescein, and Methylene Blue; a dye blend consisting of Alphazurine 2G, Euchrysine GGA, Dibromofluorescein, and Methylene Blue; a dye blend consisting of Rhodamine B, Auramine O conc., and Methylene Blue; a dye blend consisting of Dibromofluorescein, Euchrysine GGA, Alphazurine 2G, and Blanchophor HS–76; a dye blend consisting of: Dibromofluorescein, Auramine O conc., Alphazurine 2G, and Blanchophor HS–76; and a dye blend consisting of Dibromofluorescein, Uramine SS, Euchrysine GGA, Alphazurine, and Methylene Blue; said dye blend being in an amount sufficient to broaden the basic spectral re-

sponse of said zinc oxide and to produce in combination with said zinc oxide and vehicle an overall spectral reflection imparting to the composition a white to off-white spectral appearance.

6. A white to off-white photoconductive composition consisting essentially of finely divided zinc oxide suspended in an electrically insulating film forming vehicle and having incorporated therein a substantially gray to black dye blend consisting of a methanol solution of Rose Bengal, Sodium fluorescein, and Methylene Blue, said dye blend being in an amount sufficient to broaden the basic spectral response of said zinc oxide and to produce in combination with said zinc oxide and vehicle an overall spectral reflection imparting to the composition a white to off-white spectral appearance.

7. A white to off-white photoconductive composition consisting essentially of finely divided zinc oxide suspended in an electrically insulating film forming vehicle and having incorporated therein a substantially gray to black dye blend consisting of a methanol solution of Alphazurine 2G, Euchrysine GGA, Dibromofluorescein, and Methylene Blue, said dye blend being in an amount sufficient to broaden the basic spectral response of said zinc oxide and to produce in combination with said zinc oxide and vehicle an overall spectral reflection imparting to the composition a white to off-white spectral appearance.

8. A white to off-white photoconductive composition consisting essentially of finely divided zinc oxide suspended in an electrically insulating film forming vehicle and having incorporated therein a substantially gray to black dye blend consisting of a methanol solution of Rhodamine B, Auramine O conc., and Methylene Blue, said dye blend being in an amount sufficient to broaden the basic spectral response of said zinc oxide and to produce in combination with said zinc oxide and vehicle an overall spectral reflection imparting to the composition a white to off-white spectral appearance.

9. A white to off-white photoconductive composition consisting essentially of finely divided zinc oxide suspended in an electrically insulating film forming vehicle and having incorporated therein a substantially gray to black dye blend consisting of a methanol solution of Dibromofluorescein, Euchrysine GGA, Alphazurine 2G, and Blancophor HS–76, said dye blend being in an amount sufficient to broaden the basic spectral response of said zinc oxide and to produce in combination with said zinc oxide and vehicle an overall spectral reflection imparting to the composition a white to off-white spectral appearance.

10. A white to off-white photoconductive composition consisting essentially of finely divided zinc oxide suspended in an electrically insulating film forming vehicle and having incorporated therein a substantially gray to black dye blend consisting of a methanol solution of Dibromofluorescein, Auramine O conc., Alphazurine 2G, and Blancophor HS–76, said dye blend being in an amount sufficient to broaden the basic spectral response being in an amount sufficient in combination with said zinc oxide and vehicle an overall spectral reflection imparting to the composition a white to off-white spectral appearance.

11. A white to off-white photoconductive composition consisting essentially of finely divided zinc oxide suspended in an electrically insulating film forming vehicle and having incorporated therein a substantially gray to black dye blend consisting of a methanol solution of Alphazurine 2G, Euchrysine GGA, Dibromofluoroescein, Methylene Blue, and Uramine SS, said dye blend being in an amount sufficient to broaden the basic spectral response in combination with said zinc oxide and vehicle an overall spectral reflection imparting to the composition a white to off-white spectral appearance.

12. In the production of an electrophotographic recording element comprising a backing member having on at least one surface a substantially white photoconductive composition, the steps including suspending finely divided photoconductive zinc oxide in an electrically insulating vehicle, intimately mixing into said suspension at least one colored spectrally sensitive organic dye in an amount sufficient to broaden the basic spectral response of said suspension and at least one color component selected to produce a gray to black appearance when mixed with said spectrally sensitive colored organic dye and added in an amount sufficient to produce in combination with said zinc oxide, vehicle, and spectral sensitizer an overall spectral reflection which is such as to impart to the composition a white to off-white spectral appearance, said spectral sensitizer and color component when mixed together as a blend being substantially gray to black in spectral appearance, and applying said composition as a coating on one surface of a backing member.

13. In the production of an electrophotographic recording element comprising a backing member having on at least one surface a substantially white photoconductive composition, the steps including suspending finely divided photoconductive zinc oxide in an electrically insulating vehicle, intimately mixing into said suspension an organic dye blend of a plurality of compatible colored spectrally sensitive organic dyes of such colors and in such amounts as to have when mixed a gray to black appearance, said gray to black blend being incorporated with said zinc oxide and vehicle, in an amount sufficient to broaden the basic spectral response of said suspension to impart to the suspension a white to off-white spectral appearance, and applying said composition as a coating on one surface of a backing member.

References Cited in the file of this patent

FOREIGN PATENTS

201,416	Australia	Apr. 13, 1956
576,729	Canada	May 26, 1959
576,733	Canada	May 26, 1959