United States Patent [19]

Rule et al.

[11] **3,820,989**

[45] **June 28, 1974**

[54] **TRI-SUBSTITUTED METHANES AS ORGANIC PHOTOCONDUCTORS**

[75] Inventors: **Norman Geoffrey Rule; Richard C. Riordan,** both of Rochester, N.Y.

[73] Assignee: **Eastman Kodak Company,** Rochester, N.Y.

[22] Filed: **Sept. 30, 1969**

[21] Appl. No.: **862,466**

[52] **U.S. Cl.** **96/1.5,** 96/1.6

[51] **Int. Cl.** **G03g 5/06**

[58] **Field of Search** .... 96/1.5, 1 SC

[56] **References Cited**

UNITED STATES PATENTS

3,140,948	7/1964	Stewart et al.	96/1.5
3,155,503	11/1964	Cassiers et al.	96/1.5
3,274,900	9/1966	Mae et al.	96/1.5
3,291,600	12/1966	Nicoll	96/1
3,310,401	3/1967	Greig	96/1 PC
3,317,315	5/1967	Nicoll et al.	96/1.5
3,542,544	11/1970	Seus et al.	96/1.5

Primary Examiner—Ronald H. Smith
Assistant Examiner—J. P. Brammer
Attorney, Agent, or Firm—Dennis M. DeLeo

[57] **ABSTRACT**

Alkylbis(N,N-dialkylaminoaryl)methane, cycloalkylbis(N,N-dialkylaminoaryl)methane and cycloalkenylbis(N,N-dialkyl-aminoaryl)methane are useful as photoconductors in electrophotographic elements.

16 Claims, No Drawings

TRI-SUBSTITUTED METHANES AS ORGANIC PHOTOCONDUCTORS

This invention relates to electrophotography, and in particular to photoconductive compositions and elements.

The process of xerography, as disclosed by Carlson in U.S. Pat. No. 2,297,691, employs an electrophotographic element comprising a support material bearing a coating of a normally insulating material whose electrical resistance varies with the amount of incident electromagnetic radiation it receives during an imagewise exposure. The element, commonly termed a photoconductive element, is first given a uniform surface charge, generally in the dark after a suitable period of dark adaptation. It is then exposed to a pattern of actinic radiation which has the effect of differentially reducing the potential of this surface charge in accordance with the relative energy contained in various parts of the radiation pattern. The differential surface charge or electrostatic latent image remaining on the electrophotographic element is then made visible by contacting the surface with a suitable electroscopic marking material. Such marking material or toner, whether contained in an insulating liquid or on a dry carrier, can be deposited on the exposed surface in accordance with either the charge pattern or discharge pattern as desired. Deposited marking material can then be either permanently fixed to the surface of the sensitive element by known means such as heat, pressure, solvent vapor, or the like, or transferred to a second element to which it can similarly be fixed. Likewise, the electrostatic charge pattern can be transferred to a second element and developed there.

Various photoconductive insulating materials have been employed in the manufacture of electrophotographic elements. For example, vapors of selenium and vapors of selenium alloys deposited on a suitable support and particles of photoconductive zinc oxide held in a resinous, film-forming binder have found wide application in the present-day document copying applications.

Since the introduction of electrophotography, a great many organic compounds have also been screened for their photoconductive properties. As a result, a very large number of organic compounds have been known to possess some degree of photoconductivity. Many organic compounds have revealed a useful level of photoconduction and have been incorporated into photoconductive compositions.

Typical of these organic photoconductors are the triphenylamines and the triarylmethane leuco bases. Optically clear photoconductor-containing elements having desirable electrophotographic properties can be especially useful in electrophotography. Such electrophotographic elements can be exposed through a transparent base if desired, thereby providing unusual flexibility in equipment design. Such compositions, when coated as a film or layer on a suitable support, also yield an element which is reusable; that is, it can be used to form subsequent images after residual toner from prior images has been removed by transfer and/or cleaning. Thus far, the selection of various compounds for incorporation into photoconductive compositions to form electrophotographic layers has proceeded on a compound-by-compound basis. Nothing as yet has been discovered from the large number of different photoconductive substances tested which permits effective prediction, and therefore selection of the particular compounds exhibiting the desired electrophotographic properties.

It is, therefore, an object of this invention to provide a novel class of photoconductors having high photosensitivity when electrically charged.

It is another object to provide novel photoconductor-containing compositions which exhibit high electrical speeds.

It is a further object of the invention to provide an improved process utilizing the novel photoconductors described herein.

Also, it is yet another object of this invention to provide electrophotographic elements containing the novel photoconductors described herein.

An additional object is to provide a novel class of chemical compounds.

These and other objects of the invention are accomplished by employing certain tri-substituted methane derivatives as photoconductors. Useful methane derivatives include

a. alkylbis(N,N-dialkylaminoaryl)methane

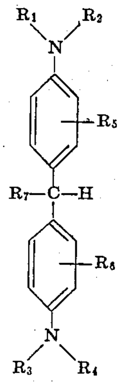
b. cycloalkylbis(N,N-dialkylaminoaryl)methane and

c. cycloalkenylbis(N,N-dialkylaminoaryl)methane.

The aryl moiety in the above described compounds can be further substituted by various groups including alkoxy having one to eight carbon atoms such as methoxy, ethoxy, propoxy, butoxy, etc., hydroxy, halogen such as chlorine, bromine, etc. The alkyl groups of these compounds generally contain one to eighteen carbon atoms and include substituted alkyl groups. Also, the cycloalkyl groups and the cycloalkenyl groups contain generally four to eight carbon atoms in the cyclic nucleus and may be further substituted by other substituents such as those described in the following paragraphs.

A large number of substituted diarylmethanes and triarylmethanes have exhibited photoconductive properties when used as photoconductors in electrophotographic elements. Typical of these are the leuco base of malachite green, bis(4-dimethylaminophenyl)-phenylmethane and bis(4-dimethylaminophenyl)methane as described in British Pat. Nos. 984,965 and 980,879. Also, diarylmethane compounds have been used as activators for zinc oxide photoconductors. Such uses are described in British Pat. No. 1,141,666. According to this invention, it has been found that the photoconductors described herein have enhanced speed and/or stability over those photoconductors described in the prior art. In particular, substantial increases in speed are obtained compared to speeds attainable with many other closely related compounds which do not have the central methyl carbon atom substituted by the groups set forth above. These increases in speed are observed when the photoconductor is incorporated into a coating composition, coated onto a support and the coating accepts a suitable potential (e.g., 500–600 volts). The relative speed of the coating is determined on the basis of the reciprocal of the exposure required to reduce the potential of the surface charge to 100 volts (toe speed). The term "toe speed" is known in the photographic art with reference to "H and D" curves. As used herein, the term refers to corresponding curves resulting from exposure plotted against voltage. The reduction of the surface potential to 100 volts or below is significant in that it represents a requirement for suitable broad area development of an electrostatic image. The relative speed at 100 volts is a measure of the ability to produce and hence to develop or otherwise utilize the electrostatic latent image. When many conventional photoconductors are used, the surface potential frequently does not drop to or below 100 volts and therefore no speed can be assigned to such a composition. When most photoconductors are used in photoconductive compositions, the surface potentials of such resultant compositions usually drop below 100 volts, and thus, a definite speed can be ascertained. However, these speeds are improved when the photoconductors of this invention are employed.

The preferred substituted methane derivatives useful as photoconductors in the present invention are characterized by the following formula:



wherein:

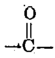
R_1, R_2, R_3 and R_4 are each lower aliphatic alkyl groups having one to 18 carbon atoms such as a methyl group, a propyl group, an ethyl group, a pentyl group, a hexyl group, an isobutyl group, a 3-methylpentyl group, an octyl group, etc.;

R_5 and R_6 each represent any of the following groups

1. a lower aliphatic alkyl having one to 18 carbon atoms typically including those set forth above for R_1, R_2, R_3 and R_4;
2. a lower alkoxy having one to 18 carbon atoms, e.g., methoxy, ethoxy, propoxy, butoxy, etc.;
3. hydrogen; or
4. halogen such as chlorine, bromine, fluorine or iodine;

R_7 represents any of the following groups

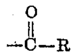
1. an aliphatic alkyl group having one to 18 carbon atoms, e.g., methyl, ethyl, propyl, butyl, isobutyl, octyl, dodecyl, etc., including a substituted alkyl group having one to 18 carbon atoms such as
   - a. alkoxyalkyl, e.g., ethoxypropyl, methoxybutyl, propoxymethyl, etc.,
   - b. aryloxyalkyl, e.g., phenoxyethyl, naphthoxymethyl, phenoxypentyl, etc.,
   - c. aminoalkyl, e.g., aminobutyl, aminoethyl, aminopropyl, etc.,
   - d. hydroxyalkyl, e.g., hydroxypropyl, hydroxyoctyl, hydroxymethyl, etc.,
   - e. aralkyl e.g., benzyl, phenethyl, ω, ω-diphenylalkyl, etc.,
   - f. alkylaminoalkyl e.g., methylaminopropyl, methylaminoethyl, etc., and also including dialkylaminoalkyl, e.g., diethylaminoethyl, dimethylaminopropyl, propylaminooctyl, etc.,
   - g. arylaminoalkyl, e.g., phenylaminoalkyl, diphenylaminoalkyl, N-phenyl-N-ethylaminopentyl, N-phenyl-N-ethylaminohexyl, naphthylaminomethyl, etc.,
   - h. nitroalkyl, e.g., nitrobutyl, nitroethyl, nitropentyl, etc.,
   - i. cyanoalkyl, e.g., cyanopropyl, cyanobutyl, cyanoethyl, etc.,
   - j. haloalkyl, e.g., chloromethyl, bromopentyl, chlorooctyl, etc.,
   - k. alkyl substituted with an acyl group having the formula



$$-\overset{\overset{\large O}{\|}}{C}-R$$

wherein R is hydroxy, hydrogen, aryl, e.g., phenyl, naphthyl, etc., lower alkyl having one to eight carbon atoms, e.g., methyl, ethyl, propyl, etc., amino including substituted amino, e.g., diloweralkylamino, lower alkoxy having one to eight carbon atoms, e.g., butoxy, methoxy, etc., aryloxy, e.g., phenoxy, naphthoxy, etc.;

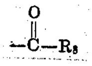
2. a cycloalkyl group having four to eight carbon atoms in the cyclic nucleus, e.g., cyclobutyl, cyclohexyl, cyclopentyl, etc., including a substituted cycloalkyl group such as
   - a. alkoxycycloalkyl, e.g., ethoxycyclohexyl, methoxycyclobutyl, propoxycyclohexyl, etc.,
   - b. aryloxycycloalkyl, e.g., phenoxycyclohexyl, naphthoxycyclohexyl, phenoxycyclopentyl, etc.,
   - c. aminocycloalkyl, e.g., aminocyclobutyl, aminocyclohexyl, aminocyclopentyl, etc.,
   - d. hydroxycycloalkyl e.g., hydroxycyclohexyl, hydroxycyclopentyl, hydroxycyclobutyl, etc.,
   - e. arylcycloalkyl e.g., phenylcyclohexyl, phenylcyclobutyl, etc.,
   - f. alkylaminocycloalkyl e.g., methylaminocyclohexyl, methylaminocyclopentyl, etc., and also including dialkylaminocycloalkyl, e.g., diethylaminocyclohexyl, dimethylaminocyclobutyl, dipropylaminocyclooctyl, etc.,
   - g. arylaminocycloalkyl, e.g., phenylaminocyclohexyl, diphenylaminocyclohexyl, N-phenyl-N-ethylaminocyclopentyl, N-phenyl-N-methylaminocyclohexyl, naphthylaminocyclopentyl, etc.,
   - h. nitrocycloalkyl, e.g., nitrocyclobutyl, nitrocyclohexyl, nitrocyclopentyl, etc.,
   - i. cyanocycloalkyl, e.g., cyanocyclohexyl, cyanocyclobutyl, cyanocyclopentyl, etc.,
   - j. halocycloalkyl e.g., chlorocyclohexyl, bromocyclopentyl, chlorocyclooctyl, etc.,
   - k. cycloalkyl substituted with an acyl group having the formula



$$-\overset{\overset{\large O}{\|}}{C}-R$$

wherein R is hydroxy, hydrogen, aryl, e.g., phenyl, naphthyl, etc., amino including substituted amino, e.g., diloweralkylamino, loweralkoxy having one to eight carbon atoms, e.g., butoxy, methoxy, etc., aryloxy, e.g., phenoxy, naphthoxy, etc., lower alkyl having one to eight carbon atoms, e.g., methyl, ethyl, propyl, butyl, etc.;

3. a cycloalkenyl group having four to eight carbon atoms in the cyclic nucleus, e.g., cyclohex-3-enyl, cyclopent-3-enyl, cyclobut-2-enyl, cyclohex-2-enyl, etc., including a substituted cycloalkenyl group such as
   - a. alkoxycycloalkenyl e.g., ethoxycyclohex-3-enyl, methoxycyclobut-2-enyl, propoxycyclohex-3-enyl, etc.,
   - b. aryloxycycloalkenyl, e.g., phenoxycyclohex-3-enyl, phenoxycyclopent-3-enyl, naphthoxycyclohex-3-enyl, etc.,
   - c. aminocycloalkenyl e.g., aminocyclobut-2-enyl, aminocyclohex-3-enyl, aminocyclopent-2-enyl,
   - d. hydroxycycloalkenyl, e.g., hydroxycyclohex-3-enyl, hydroxycyclopent-2-enyl, hydroxycyclobut-2-enyl, etc.,
   - e. arylcycloalkenyl, e.g., phenylcyclohex-3-enyl, phenylcyclobut-2-enyl, etc.,
   - f. alkylaminocycloalkenyl e.g., methylaminocyclohex-3-enyl, methylaminocyclopent--2-enyl, etc., and also including dialkylaminocycloalkenyl, e.g., diethylaminocyclohex-3-enyl, dimethylaminocyclobut-2-enyl, dipropylaminocyclooct-3-enyl, etc.,
   - g. arylaminocycloalkenyl, e.g., phenylaminocyclohex-3-enyl, diphenylaminocyclohex-b 3-enyl, N-phenyl-N-ethylaminocyclopent-2-enyl, etc.,
   - h. nitrocycloalkenyl, e.g., nitrocyclobut-2-enyl, nitrocyclohex-3-enyl, nktrocyclopent-2-enyl, etc.,
   - i. cyanocycloalkenyl, e.g., cyanocyclohex-3-enyl, cyanocyclobut-2-enyl, cyanocyclopent-2-enyl, etc.,
   - j. halocycloalkenyl e.g., chlorocyclohex-3-enyl, bromocyclopent-2-enyl, chlorocyclooct-3-enyl, etc.,
   - k. cycloalkenyl substituted with an acyl group having the formula



$$-\overset{O}{\overset{\|}{C}}-R_8$$

wherein R_8 is hydroxy, halogen, e.g., chlorine, bromine, etc., hydrogen, aryl, e.g., phenyl, naphthyl, etc., amino including substituted amino e.g., diloweralkylamino, loweralkoxy having one to eight carbon atoms, e.g., butoxy, methoxy, etc., aryloxy, e.g., phenoxy, naphthoxy, etc., lower alkyl having one to eight carbon atoms, e.g., methyl, ethyl, propyl, butyl, etc.

Typical compounds which belong to the herein described general class of photoconductive materials include the following compounds listed in Table I below.

TABLE I

I. 1,1-Bis(4-N,N-diethylamino-2-chlorophenyl)-2-phenylethane
II. 1,1-Bis(4-N,N-diethylamino-2-methoxyphenyl)-2-phenylethane
III. Bis(4-N,N-diethylaminophenyl)cyclopent-2-enyl methane
IV. Bis(4-N,N-diethylamino-2-methylphenyl)cyclobut-2-enyl methane
V. 1,1-Bis(4-N,N-diethylaminophenyl)-3-phenylpropane
VI. 1,1-Bis(4-N,N-diethylaminophenyl)-2-phenylethane
VII. 1,1-Bis(4-N,N-diethylaminophenyl)butane
VIII. Bis(4-N,N-diethylaminophenyl)cyclohexylmethane
IX. 1,1-Bis(4-N,N-diethylaminophenyl)-2-methylpropane
X. 1,1-Bis(4-N,N-diethylaminophenyl)heptane
XI. Bis(4-N,N-diethylaminophenyl)cyclohex-3-enylmethane
XII. 1,1-Bis(4-N,N-diethylaminophenyl)-2-ethylhexane
XIII. 1,1-Bis(4-N,N-diethylamino-2-methylphenyl)-3-phenylpropane
XIV. 1,1-Bis(4-N,N-diethylamino-2-methylphenyl)-2-phenylethane
XV. 1,1-Bis(4-N,N-diethylamino-2-methylphenyl)butane
XVI. 1,1-Bis(4-N,N-diethylamino-2-methylphenyl)cyclohexylmethane
XVII. 1,1-Bis(4-N,N-diethylamino-2-methylphenyl)-2-methylpropane
XVIII. 1,1-Bis(4-N,N-diethylamino-2-methylphenyl)heptane
XIX. 1,1,5,5-Tetrakis(4-N,N-diethylamino-2-methylphenyl)pentane
XX. Bis(4-N,N-diethylamino-2-methylphenyl)cyclohex-3-enylmethane
XXI. 1,1,2,2-Tetrakis(4-N,N-diethylamino-2-methylphenyl)ethane

Electrophotographic elements of the invention can be prepared with the photoconducting compounds of the invention in the usual manner, i.e., by blending a dispersion or solution of a photoconductive compound together with a binder, when necessary or desirable, and coating or forming a self-supporting layer with the photoconductor-containing material. Mixtures of the photoconductors described herein can be employed. Likewise, other photoconductors known in the art such as those described in Light Belgian Pat. No. 705,117 dated Apr. 16, 1968 can be combined with the present photoconductors. In addition, supplemental materials useful for changing the spectral sensitivity or electrophotosensitivity of the element can be added to the composition of the element when it is desirable to produce the characteristic effect of such materials.

The photoconductive layers of the invention can also be sensitized by the addition of effective amounts of sensitizing compounds to exhibit improved electrophotosensitivity. Sensitizing compounds useful with the photoconductive compounds of the present invention can be selected from a wide variety of materials, including such materials as pyrylium dye salts including thiapyrylium dye salts and selenapyrylium dye salts disclosed in VanAllan et al. U.S. Pat. No. 3,250,615; fluorenes, such as 7,12-dioxo-13-dibenzo(a,h)fluorene, 5,-10-dioxo-4a,11-diazabenzo(b)fluorene, 3,13-dioxo-7-oxadibenzo(b,g)fluorene, and the like; aggregate-type sensitizers of the type described in Belgian Pat. No. 705,117 dated Apr. 16, 1968; aromatic nitro compounds of the kind described in U.S. Pat. No. 2,610,120; anthrones like those disclosed in U.S. Pat. No. 2,670,284; quinones, U.S. Pat. No. 2,670,286; benzophenones, U.S. Pat. No. 2,670,287; thiazoles, U.S. Pat. No. 2,732,301; mineral acids; carboxylic acids, such as maleic acid, di- and tri-chloroacetic acids, and salicyclic acid; sulfonic and phosphoric acids; and various dyes, such as cyanine (including carbocyanine), merocyanine, diarylmethane, thiazine, azine, oxazine, xanthene, phthalein, acridine, azo, anthraquinone dyes and the like and mixtures thereof. The sensitizers preferred for use with the compounds of this invention are selected from pyrylium salts including selenapyrylium salts and thiapyrylium salts, and cyanine dyes including carbocyanine dyes.

Where a sensitizing compound is employed with the binder and organic photoconductor to form a sensitized electrophotographic element, it is the normal practice to mix a suitable amount of the sensitizing compound with the coating composition so that, after thorough mixing, the sensitizing compound is uniformly distributed in the coated element. Other methods of incorporating the sensitizer or the effect of the sensitizer may, however, be employed consistent with the practice of this invention. In preparing the photoconductive layers, no sensitizing compound is required to give photoconductivity in the layers which contain the photoconducting substances, therefore, no sensitizer is required in a particular photoconductive layer. However, since relatively minor amounts of sensitizing compound give substantial improvement in speed in such layers, the sensitizer is preferred. The amount of sensitizer that can be added to a photoconductor-incorporating layer to give effective increases in speed can vary widely. The optimum concentration in any given case will vary with the specific photoconductor and sensitizing compound used. In general, substantial speed gains can be obtained where an appropriate sensitizer is added in a concentration range from about 0.0001 to about 30 percent by weight based on the weight of the film-forming coating composition. Normally, a sensitizer is added to the coating composition in an amount by weight from about 0.005 to about 5.0 percent by weight of the total coating composition.

Preferred binders for use in preparing the present photoconductive layers are film-forming, hydrophobic polymeric binders having fairly high dielectric strength which are good electrically insulating film-forming vehicles. Materials of this type comprise styrene-butadiene copolymers; silicone resins; styrene-alkyd resins; silicone-alkyd resins; soya-alkyd resins; poly(vinyl chloride); poly(vinylidene chloride); vinylidene chloride-acrylonitrile copolymers; poly(vinyl acetate); vinyl acetate-vinyl chloride copolymers; poly(vinyl acetals), such as poly(vinyl butyral); polyacrylic and methacrylic esters, such as poly(methyl methacrylate), poly(n-butyl methacrylate), poly(isobutyl methacrylate), etc.; polystyrene; nitrated polystyrene; polymethylstyrene; isobutylene polymers; polyesters, such as poly[ethylene-co-alkylenebis(alkyleneoxyaryl)-phenylenedicarboxylate]; phenolformaldehyde resins; ketone resins; polyamides; polycarbonates; polythiocarbonates; poly[ethylene-co-iospropylidene-2,2-bis(ethyleneoxyphenylene)terephthalate]; copolymers of vinyl haloarylates and vinyl acetate such as poly(vinyl-m-bromobenzoate-co-vinyl acetate); etc. Methods of making resins or this type have been described in the prior art, for example, styrene-alkyd resins can be prepared according to the method described in U.S. Pat. Nos. 2,361,019 and 2,258,423. Suitable resins of the type contemplated for use in the photoconductive layers of the invention are sold under such tradenames as Vitel PE-101, Cymac, Piccopale 100, Saran F-220, Lexan 105 and Lexan 145. Other types of binders which can be used in the photoconductive layers of the invention include such materials as paraffin, mineral waxes, etc.

Solvents useful for preparing coating compositions with the photoconductors of the present invention can include a wide variety of organic solvents for the components of the coating composition. For example, benzene; toluene; acetone; 2-butanone; chlorinated hydrocarbons such as methylene chloride; ethylene chloride; and the like; ethers, such as tetrahydrofuran and the like, or mixtures of such solvents can advantageously be employed in the practice of this invention.

In preparing the coating compositins utilizing the photoconducting compounds disclosed herein useful results are obtained where the photoconductive substance is present in an amount equal to at least about 1 weight percent of the coating composition. The upper limit in the amount of photoconductive material present can be widely varied in accordance with usual practice. It is normally required that the photoconductive material be present in an amount ranging from about 1 weight percent of the coating composition to about 99 weight percent of the coating composition. A preferred weight range for the photoconductive material in the coating composition is from about 10 weight percent to about 60 weight percent.

Coating thicknesses of the photoconductive composition on a support can vary widely. Normally, a wet coating thickness in the range of about 0.001 inch to about 0.01 inch is useful in the practice of the invention. A preferred range of coating thickness is from about 0.002 inch to about 0.006 inch before drying although such thicknesses can vary widely depending on the particular application desired for the electrophotographic element.

Suitable supporting materials for the photoconductive layers of the present invention can include any of the electrically conducting supports, for example, various conducting papers; aluminum-paper laminates; metal foils, such as aluminum foil, zinc foil, etc.; metal plates, such as aluminum, copper, zinc, brass, and galvinized plates, vapor deposited metal layer such as silver, nickel or aluminum on conventional film supports such as cellulose acetate, poly(ethylene terephthalate), polystyrene and the like conducting supports.

An especially useful conducting support can be prepared by coating a transparent film support material such as poly(ethylene terephthalate) with a layer containing a semiconductor dispersed in a resin. A suitable conducting coating can be prepared from the sodium salt of a carboxyester lactone of a maleic anhydride-vinyl acetate copolymer, cuprous iodide and the like. Such conducting layers and methods for their optimum preparation and use are disclosed in U.S. Pat. Nos. 3,007,901, 3,245,833 and 3,267,807.

The compositions of the present invention can be employed in photoconductive elements useful in any of the well known electrophotographic processes which require photoconductive layers. One such process is the xerographic process. In a process of this type, an electrophotographic element held in the dark, is given a blanket positive or negative electrostatic charge as desired, by placing it under a corona discharge to give a uniform charge to the surface of the photoconductive layer. This charge is retained by the layer owing to the substantial dark insulating property of the layer, i.e., the low conductivity of the layer in the dark. The electrostatic charge formed on the surface of the photoconductive layer is then selectively dissipated from the surface of the layer by imagewise exposure to light by means of a conventional exposure operation such as for example, by a contact-printing technique, or by lens projection of an image, or reflex or bireflex techniques and the like, to thereby form a latent electrostatic image in the photoconductive layer. Exposing the surface in this manner forms a pattern of electrostatic charge by virtue of the fact that light energy striking the photoconductor causes the electrostatic charge in the light struck areas to be conducted away from the surface in proportion to the illuminance on a particular area.

The charge pattern produced by exposure is then developed or transferred to another surface and developed there, i.e., either the charge or uncharged areas are rendered visible, by treatment with a medium comprising electrostatically responsive particles having optical density. The developing electrostatically responsive particles can be in the form of a dust, or powder and generally comprise a pigment in a resinous carrier called a toner. A preferred method of applying such a toner to a latent electrostatic image for solid area development is by the use of a magnetic brush. Methods of forming and using a magnetic brush toner applicator are described in the following U.S. Pat. Nos. 2,786,439; 2,786,440; 2,786,441; 2,811,465; 2,874,063; 2,984,163; 3,040,704; 3,117,884 and Re 25,779. Liquid development of the latent electrostatic image may also be used. In liquid development the developing particles are carried to the image-bearing surface in an electrically insulating liquid carrier. Methods of development of this type are widely known and have been described in the patent literature, for example, U.S. Pat. No. 2,297,691 and in Australian Pat. No. 212,315. In dry developing processes the most widely used method of obtaining a permanent record is achieved by selecting a developing particle which has as one of its components a low-melting resin. Heating the powder image then causes the resin to melt or fuse into or on the element. The powder is, therefore, caused to adhere permanently to the surface of the photoconductive layer. In other cases, a transfer of the charge image or powder image formed on the photoconductive layer can be made to a second support such as paper which would then become the final print after developing and fusing or fusing respectively. Techniques of the type indicated are well known in the art and have been described in a number of U.S. and foreign patents, such as U.S. Pat. Nos. 2,297,691 and 2,551,582, and in "RCA Review," vol. 15 (1954) pages 469–484.

The compositions of the present invention can be used in electrophotographic elements having many structural variations. For example, the photoconductive composition can be coated in the form of single layers or multiple layers on a suitable opaque or transparent conducting support. Likewise, the layers can be contiguous or spaced having layers of insulating material or other photoconductive material between layers or overcoated or interposed between the photoconductive layer or sensitizing layer and the conducting layer. It is also possible to adjust the position of the support and the conducting layer by placing a photoconductor layer over a support and coating the exposed face of the support or the exposed or overcoated face of the photoconductor with a conducting layer. Configurations differing from those contained in the examples can be useful or even preferred for the same or different application for the electrophotographic element.

The following examples are included for a further understanding of this invention.

EXAMPLE I

The following composition is sheared in a Waring Blendor for 30 minutes at room temperature.

Binder — Lexan 145/(tradename of General Electric Company for a poly(4,4'-isopropylidenediphenylene carbonate)	1.0 g.
Sensitizer/2,6-diphenyl-4-(4-dimethylaminophenyl)thiapyrylium perchlorate	0.025 g.
Dichloromethane	9.6 g.

A photoconductor (0.25 g.) is then dissolved in the resultant heterogeneous mixture which is then coated at 0.004-inch wet thickness on a poly(ethyleneterephthalate) support which had been precoated with an evaporated nickel conducting layer. The element is then dried at 90°F. Several elements are prepared in this manner using various photoconductors of this invention. These electrophotographic elements are charged under a positive corona source until the surface potentials, as measured by en electrometer probe, reach about 600 volts. They are then subjected to exposure from behind a stepped density gray scale to a 3,000°K. tungsten source. The exposure causes reduction of the surface potentials of the elements under each step of the gray scale from their initial potential, V_0 to some lower potential, V whose exact value depends on the actual amount of exposure in meter-candle-seconds received by the areas. The results of the measurements are plotted on a graph of surface potential V vs. log exposure for each step. The toe speed is the numerical expression of 10^4 multiplied by the reciprocal of the exposure in meter-candle-seconds required to reduce the 600 volt charged surface potential to 100 volts. The speeds for the various photoconductors used are set forth in the following Table II.

Table II

Photoconductor Compound No.	Speed
VI	570
VII	660
IX	800
XI	560
XII	800
XIII	800
XIV	900
XV	630
XVI	1000
XVII	1200
XVIII	900
XIX	800
XX	710

EXAMPLE II

Example I is repeated except the sensitizer is replaced by 2,6-bis(4-ethylphenyl)-4-(amyloxyphenyl)-thiapyrylium perchlorate. Relatively good speeds are obtained. Similarly good results are obtained when 2,4-bis(4-ethylphenyl)-6-(4-styrylstyryl)pyrylium perchlorate is used.

EXAMPLE III

In order to demonstrate the increase in speed attainable using the instant photoconductor, Example I is repeated using a photoconductor of the type described in British Pat. Nos. 980,879 and 984,964. The photoconductor employed is bis(N,N-dimethylaminophenyl)methane. The speed obtained is 120 which is substantially lower than the speeds obtained using the photoconductors of this invention.

EXAMPLE IV

Another comparison is made using 1,1-bis(4-N,N-diethylamino-2-methylphenyl)methane as the photoconductor. The speed is determined in the same manner as Example I and is found to be 380.

EXAMPLE V

Coating dopes are prepared in the manner described in Example I using the materials set forth therein. The photoconductors employed are compounds I-XXI in Table I. In a darkened room, the surface of each of the photoconductive layers so prepared is charged to a potential of about +600 volts under a corona charger. The layer is then covered with a transparent sheet bearing a pattern of opaque and light transmitting areas and exposed to the radiation from an incandescent lamp with an illumination intensity of about 75 meter-candles for 12 seconds. The resulting electrostatic latent image is developed in the usual manner by cascading over the surface of the layer a mixture of negatively charged black thermoplastic toner particles on glass beads functioning as carriers for the toner particles. A good reproduction of the pattern results in each instance. Similar results are obtained using a liquid developer.

The photoconducting compounds of this invention can generally be prepared by synthesis familiar to those skilled in the art.

EXAMPLE VI

1,1-Bis(4-N,N-diethylaminophenyl)-3-phenylpropane, V

A mixture of dihydrocinnamaldehyde (1.0 mole), N,N-diethylaniline (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (25 mls.) is refluxed and then the cooled reaction mixture is made alkaline with aqueous sodium hydroxide solution. The precipitated organic material solidifies and is filtered off, dried and recrystallized from ethanol to give 250 g. of product, m.p. 62°–63°.

Analysis.

Calculated for $C_{29}H_{38}N_2$: C, 84.0; H, 9.19; N,6.77.

Found: C, 83.6; H, 9.0; N, 7.0.

Molecular weight.

Calculated 414. Found 405.

EXAMPLE VII

1,1,-Bis(4-N,N-diethylaminophenyl)-2-phenylethane, VI.

A mixture of phenylacetaldehyde (0.75 mole) in isopropanol (90 g.), N,N-diethylaniline (2.0 moles) concentrated hydrochloric acid (100 mls.) and ethanol (25 mls.) is refluxed and then is poured onto ice, made basic with sodium hydroxide, and extracted with methylene chloride. The methylene chloride layer is steam distilled and the organic residue is again extracted with methylene chloride, dried ($MgSO_4$), and concentrated by solvent evaporation. The solid residue is recrystallized twice from ethanol to give 35 g. of product, m.p. 68°–69°.

Analysis.

Calculated for $C_{28}H_{36}N_2$: C, 84.0; H, 9.0; N, 7.0.

Found: C, 84.4; H, 8.8; N, 7.4.

Molecular weight.

Calculated 400. Found 397.

EXAMPLE VIII

1,1-Bis(4-N,N-diethylaminophenyl)butane, VII

A mixture of n-butyraldehyde (1.0 mole), N,N-diethylaniline (2.0 moles) concentrated hydrochloric acid (100 mls.) and ethanol (15mls.) is refluxed, and then is cooled and made acid with dilute hydrochloric acid. The acid solution is extracted with ether and then made alkaline with sodium hydroxide. The precipitated organic phase is extracted into ether and separated off. The ether is then evaporated and the residue is steam distilled to remove unreacted N,N-diethylaniline. The organic residue is taken up in ether, dried (Na_2CO_3) and concentrated by solvent evaporation. The residue is distilled under reduced pressure to give 100 g. of a product b.p. 179°–194°/0.25 mm. which solidifies on standing.

Analysis.

Calculated for $C_{24}H_{36}N_2$: C, 81.8; H, 10.3; N, 7.9.

Found: C, 81.3; H, 10.3; N, 8.1.

Molecular weight.

Calculated 352. Found 347.

EXAMPLE IX

Bis(4-N,N-diethylaminophenyl)cyclohexylmethane, VIII

A mixture of cyclohexanecarboxaldehyde (1 mole), N,N-diethylaniline (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (20 mls.) is refluxed and then is cooled, made acid with dilute hydrochloric acid and extracted with methylene chloride. The aqueous layer is made basic with sodium hydroxide and the organic precipitate is extracted into methylene chloride, dried (Na_2CO_3) and concentrated by solvent evaporation. The solid residue is recrystallized twice from 2-methoxyethanol to give 150 g. of product, m.p. 125°–126°.

Analysis.

Calculated for $C_{27}H_{40}N_2$: C, 82.7; H, 10.2; N, 7.1.

Found: C, 82.7; H, 9.8; N, 7.5

Molecular weight.

Calculated 392. Found 381.

EXAMPLE X

1,1-Bis(4-N,N-diethylaminophenyl)-2-methylpropane IX

A mixture of iso-butyraldehyde (1 mole) N,N-diethylaniline (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (15 mls.) is refluxed and then cooled, made acid with dilute hydrochloric acid and extracted with ether. The aqueous layer is made alkaline with sodium hydroxide and the resulting organic precipitate is extracted into ether. The ether is evaporated off and the residue is steam distilled to remove unreacted N,N-diethylaniline. The organic residue is extracted into ether, dried (Na_2CO_3), and concentrated by solvent evaporation. The residue is recrystallized from ethanol to give 180 g. of product, m.p. 70°–71°.

Analysis.

Calculated for $C_{24}H_{36}N_2$: C, 81.9; H, 10.2; N, 7.95

Found: C, 81.8; H, 10.0; N, 8.4.

Molecular weight.

Calculated 352. Found 346.

EXAMPLE XI

1,1-Bis(4-N,N-diethylaminophenyl)heptane, X

A mixture of N-heptaldehyde (1 mole), N,N-diethylaniline (2.0 moles, concentrated hydrochloric acid (100 mls.) and ethanol (15 mls.) is refluxed and then is poured onto ice, made acid with dilute hydrochloric acid and extracted with ether. The aqueous layer is made basic with sodium hydroxide and the organic precipitate is extracted into ether. The solvent is evaporated and the residue is steam distilled to remove unreacted N,N-diethylaniline. The organic residue is distilled to give 210 g. of a fraction b.p. 182°–186°/5μ Hg.

Analysis.

Calculated for $C_{27}H_{42}N_2$: C, 82.2; H, 10.7; N, 7.1.

Found: C, 82.5; H, 10.6; N, 7.4.

Molecular weight.

Calculated 394. Found 389.

EXAMPLE XII

Bis(4-N,N-diethylaminophenyl)cyclohex-3-enylmethane, XI

A mixture of 3-cyclohexenylcarboxaldehyde (1 mole), N,N-diethylaniline (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (15 mls.) is refluxed and then poured into water, made acid with hydrochloric acid and extracted with methylene chloride. The aqueous layer is made basic with sodium hydroxide. The organic precipitate solidifies and is filtered off, dried and crystallized from 2-methoxyethanol with charcoal treatment and hot filtration. The product is crystallized again from the same solvent to give 225 g. of material m.p. 137°–138°.

Analysis.

Calculated for $C_{27}H_{38}N_2$: C, 83.1; H, 9.7; N, 7.2.

Found: C, 82.7; H, 9.8; N, 7.5.

EXAMPLE XIII

1,1-Bis(4-N,N-diethylaminophenyl)-2-ethylhexane, XII

A mixture of 2-ethylhexanal (1.0 mole), N,N-diethylaniline (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (15 mls.) is refluxed and then poured into water, made acid with hydrochloric acid and extracted with methylene chloride. The aqueous layer is made basic with sodium hydroxide and the organic precipitate separated off and steam distilled. The organic residue is extracted into methylene chloride, dried (Na_2CO_3) and concentrated by solvent evaporation. The residue is crystallized from ethanol, with charcoal treatment and hot filtration, to give 10 g. of product m.p. 51.8°–53.9°.

Analysis.

Calculated for $C_{28}H_{44}N_2$: C, 82.4; H, 10.7; N, 6.8.

Found: C, 82.5; H, 10.8; N, 7.1.

Molecular weight.

Calculated 408. Found 401.

EXAMPLE XIV

1,1-Bis(4-N,N-diethylamino-2-methylphenyl)-3-phenylpropane, XIII

A mixture of dihydrocinnamaldehyde (1 mole), N,N-diethyl-m-toluidine (2 moles), concentrated hydrochloric acid (100 mls.) and ethanol (15 mls.) is refluxed and then poured into water, made acid with hydrochloric acid and extracted with methylene chloride. The aqueous layer is made basic with sodium hydroxide and the organic layer which forms is separated off and steam distilled. The organic residue is extracted into ether, dried (Na_2CO_3) and concentrated by solvent evaporation. The residue is recrystallized three times from ethanol to give 215 g. of product m.p. 77°–78°.

Analysis.

Calculated for $C_{31}H_{42}N_2$: C, 84.2; H, 9.5; N, 6.3.

Found: C, 83.8; H, 9.2; N, 6.7.

Molecular weight.

Calculated 442. Found 415.

EXAMPLE XV

1,1-Bis(4-N,N-diethylamino-2-methylphenyl)-2-phenylethane XIV

A mixture of phenylacetaldehyde (1 mole), N,N-diethyl-m-toluidine (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (15 mls.) is refluxed and then poured into water, made acid with hydrochloric acid and extracted with methylene chloride. The aqueous layer is made basic with sodium hydroxide and the percipitated organic layer is separated and steam distilled. The organic residue is taken up in ether, dried (Na_2CO_3) and concentrated by solvent evaporation. The solid residue is recrystallized twice from ethanol to give 90 g. of product, m.p. 93°–94°.

Analysis.

Calculated for $C_{30}H_{40}N_2$: C, 84.1; H, 9.3; N, 6.5.

Found: C, 84.4; H, 9.6; N, 6.9.

Molecular weight.

Calculated 428. Found 424.

EXAMPLE XVI

1,1-Bis(4-N,N-diethylamino-2-methylphenyl)butane, XV

A mixture of n-butyraldehyde (1 mole), N,N-diethyl-m-toluidine (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (15 mls.) is refluxed and then is poured into water, made acid with hydrochloric acid, and extracted with methylene chloride. The aqueous layer is then made basic with sodium hydroxide and the precipitated organic layer is separated off and steam distilled. The organic residue is extracted into methylene chloride, dried (Na_2CO_3), and concentrated by solvent evaporation. The residue on distillation gives 200 g. of a product fraction, b.p. 169°–179°/6μHg.

Analysis.

Calculated for $C_{26}H_{40}N_2$: C, 82.1; H, 10.5; N, 7.36.

Found: C, 82.2; H, 10.3; N, 7.7.

Molecular weight.

Calculated 380. Found 379.

EXAMPLE XVII

1,1-Bis(4-N,N-diethylamino-2-methylphenyl)cyclohexylmethane XVI

A mixture of cyclohexanecarboxaldehyde (1.0 mole), N,N-diethyl-m-toluidine (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (10 mls.) is refluxed and then poured into water, made acid with hydrochloric acid, and extracted with methylene chloride. The aqueous layer is made basic with sodium hydroxide and the organic layer which precipitates is separated off and steam distilled. The organic residue is extracted into ether, dried (Na_2CO_3) and concentrated by solvent evaporation. The residue is crystallized from ethanol to give 180 g. of product, m.p. 91°–92°.

Analysis.

Calculated for $C_{29}H_{44}N_2$: C, 82.8; H, 10.46; N, 6.7.
Found: C, 82.2; H, 10.8; N, 7.0.

Molecular weight.

Calculated 420. Found 413.

EXAMPLE XVIII

1,1-Bis(4-N,N-diethylamino-2-methylphenyl)-2-methylpropane, XVII

A mixture of isobutyraldehyde (1.0 mole), N,N-diethyl-m-toluidine (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (15 mls.) is refluxed and then is poured into water, made acid with hydrochloric acid, and extracted with methylene chloride. The aqueous layer is made basic with sodium hydroxide and the organic layer which precipitates is separated off and steam distilled. The organic residue is extracted into ether, dried (Na_2CO_3), and concentrated by solvent evaporation. The residue is crystallized from ethanol to give 150 g. of product, m.p. 83°–84.5°.

Analysis.

Calculated for $C_{26}H_{40}N_2$: C, 82.0; H, 10.6; N, 7.36.
Found: C, 82.4; H, 10.6; N, 7.7.

Molecular weight.

Calculated 380. Found 367.

EXAMPLE XIX

1,1-Bis(4-N,N-diethylamino-2-methylphenyl)heptane, XVIII

A mixture of n-heptaldehyde (1 mole), N,N-diethyl-m-toluidine (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (10 mls.) is refluxed and then poured onto ice, made acid with hydrochloric acid and extracted with methylene chloride. The aqueous layer is made basic with sodium hydroxide, and the organic layer which precipitates is separated off and steam distilled. The organic residue, which solidifies on being cooled, is filtered off and recrystallized from ethanol to give 177 g. of product m.p. 58°–61°.

Analysis.

Calculated for $C_{29}H_{46}N_2$: C, 82.7; H, 10.9; N, 6.6.
Found: C, 82.7; H, 11.1; N, 7.1.

Molecular weight.

Calculated 422. Found 414.

EXAMPLE XX

1,1,5,5-Tetrakis(4-N,N-diethylamino-2-methylphenyl)pentane, XIX

A mixture of glutaraldehyde (0.5 mole), N-N-diethyl-m-toluidine (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (15 mls.) is refluxed and then is poured onto ice, made acid with hydrochloric acid, and extracted with methylene chloride. The aqueous layer is made basic with sodium hydroxide and the organic layer which precipitates is separated off and steam distilled. The organic residue is extracted into ether, dried (Na_2CO_3), and concentrated by solvent evaporation. The residue is crystallized twice from ethanol to give 115 g. of product, m.p. 119°–120°.

Analysis.

Calculated for $C_{49}H_{72}N_4$: C, 82.2; H, 10.0; N, 7.8.
Found: C, 81.9; H, 9.8; N, 8.2.

Molecular weight.

Calculated 717. Found 740.

EXAMPLE XXI

Bis(4-N,N-diethylamino-2-methylphenyl)cyclohex-3-enylmethane, XX

A mixture of 3-cyclohexenecarboxaldehyde (1 mole), N,N-diethyl-m-toluidine (2.0 moles), concentrated hydrochloric acid (100 mls.) and ethanol (15 mls.) is refluxed and then is poured onto ice, made acid with hydrochloric acid, and extracted with methylene chloride. The aqueous layer is made basic with sodium hydroxide and the precipitated organic layer is taken up in methylene chloride, dried (Na_2CO_3), and concentrated by solvent evaporation. The solid residue is recrystallized from ethanol, with charcoal treatment and hot filtration, and then crystallized again from the same solvent to give 235 g. of product, m.p. 102°–103°.

Analysis.

Calculated for $C_{29}H_{42}N_2$: C, 83.3; H, 10.0; N, 6.7.
Found: C, 83.2; H, 9.9; N, 7.0.

Molecular weight.

Calculated 418. Found 422.

EXAMPLE XXII

1,1,2,2-Tetrakis(4-N,N-diethylamino-2-methylphenyl)ethane XXI

A mixture of a 30 percent solution of glyoxal in water (25 mls.), N,N-diethyl-m-toluidine (72 g.), p-toluenesulphonic acid (63.4 g.) and ethanol (5 mls.) is heated in a pressure bottle on a steam bath. The reaction mixture is then cooled, made alkaline with 10 percent sodiumhydroxide solution and steam distilled to remove unreacted N,N-diethyl-m-toluidine. The cooled semisolid organic residue is filtered off and triturated with boiling methanol. The residual solid is filtered from the cooled mixture and recrystallized four times from ethanol-benzene to give 9.80 g. of product, m.p. 230.8°–232.9°.

Analysis.

Calculated for $C_{46}H_{66}N_4$: C, 81.8; H, 9.9; N, 8.30.
Found: C, 81.5; H, 9.8; N, 8.7.

Molecular weight.

Calculated 675. Found 629.

The invention has been described in detail with particular reference to preferred embodiments thereof, but, it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

We claim:

1. An electrophotographic element comprising a support having coated thereon a photoconductor composition comprising a polymeric film-forming binder and a photoconductor selected from the group consisting of (a) alkylbis(N,N-dialkylaminoaryl)methane, (b) cycloalkylbis(N,N-dialkylaminoaryl)methane and (c) cycloalkenylbis(N,N-dialkylaminoaryl)methane.

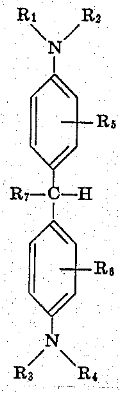
2. The electrophotographic element of claim **1** wherein said photoconductive composition contains a sensitizer for said photoconductor.

3. The electrophotographic element of claim **2** wherein the photoconductor is alkylbis(N,N-dialkylaminoaryl)methane.

4. The electrophotographic element of claim 2 wherein the photoconductor is cycloalkylbis(N,N-dialkylaminoaryl)methane.

5. The electrophotographic element of claim 2 wherein the photoconductor is cycloalkenylbis(N,N-dialkylaminoaryl)methane.

6. An electrophotographic element comprising a support having coated thereon a photoconductive composition comprising a polymeric film-forming binder and an organic photoconductor having the formula



wherein:

R_1, R_2, R_3 and R_4 are each lower alkyl groups having one to 18 carbon atoms,

R_5 and R_6 are each selected from the group consisting of a halogen atom, a hydrogen atom, an alkoxy group, and a lower aklyl group having one to 18 carbon atoms and

R_7 is selected from the group consisting of a lower alkyl group having one to 18 carbon atoms, a cycloalkyl group having four to eight carbon atoms and a cycloalkenyl group having four to eight carbon atoms.

7. The electrophotographic element as defined in claim 6 wherein said photoconductive composition contains a sensitizer for said photoconductor.

8. An electrophotographic element comprising a support having coated thereon a photoconductive composition comprising

a. from about 10 to about 60 percent by weight based on said photoconductive composition of 1,1-bis(4-N,N-diethylaminophenyl)-2-methylpropane as the organic photoconductor,

b. a film-forming polymeric binder for said photoconductor and

c. 0.005 percent to about 5 percent by weight based on said photoconductive composition of a sensitizer for said photoconductive composition.

9. An electrophotographic element comprising a support having coated thereon a photoconductive composition comprising

a. from about 10 to about 60 percent by weight based on said photoconductive composition of 1,1-bis(4-N,N-diethylamino-2-methylphenyl)2-phenylethane,

b. a film-forming polymeric binder for said photoconductor and

c. 0.005 percent to about 5 percent by weight based on said photoconductive composition of a sensitizer for said photoconductive composition.

10. An electrophotographic element comprising a support having coated thereon a photoconductive composition comprising

a. from about 10 to about 60 percent by weight based on said photoconductive composition of 1,1-bis(4-N,N-diethylamino-2-methylphenyl)cyclohexylmethane,

b. a film-forming polymeric binder for said photoconductor and

c. 0.005 percent to about 5 percent by weight based on said photoconductive composition of a sensitizer for said photoconductive composition.

11. An electrophotographic element comprising a support having coated thereon a photoconductive composition comprising

a. from about 10 to about 60 percent by weight based on said photoconductive composition of 1,1-bis(4-N,N-diethylamino-2-methylphenyl)-2-methylpropane,

b. a film-forming polymeric binder for said photoconductor and

c. 0.005 percent to about 5 percent by weight based on said photoconductive composition of a sensitizer for said photoconductive composition.

12. An electrophotographic element comprising a support having coated thereon a photoconductive composition comprising

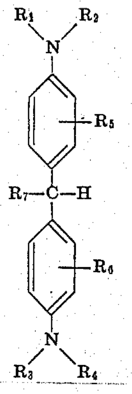
a. from about 10 to about 60 percent by weight based on said photoconductive composition of 1,1-bis(4-N,N-diethylamino-2-methylphenyl)heptane,

b. a film-forming polymeric binder for said photoconductor and

c. 0.005 percent to about 5 percent by weight based on said photoconductive composition of a sensitizer for said photoconductive composition.

13. A photoconductive composition comprising a polymeric film-forming binder and a photoconductor selected from the group consisting of (a) alkylbis(N,N-dialkylaminoaryl)methane, (b) cycloalkylbis(N,N-dialkylaminoaryl)methane and (c) cycloalkenylbis(N,N-dialkylaminoaryl)methane.

14. A photoconductive composition comprising a polymeric film-forming binder and an organic photoconductor having the formula



wherein:

R_1, R_2, R_3 and R_4 are each lower alkyl groups having one to 18 carbon atoms,

R_5 and R_6 are each selected from the group consisting of a halogen atom, a hydrogen atom, an alkoxy group, and a lower alkyl group having one to 18 carbon atoms and

R_7 is selected from the group consisting of a lower alkyl group having one to 18 carbon atoms, a cycloalkyl group having four to eight carbon atoms and a cycloalkenyl group having four to eight carbon atoms.

15. The composition of claim **14** wherein said photoconductive composition contains a sensitizer for said photoconductor.

16. In an electrophotographic process where an electrostatic charge pattern is formed on an electrophotographic element, the improvement characterized in that said photoconductive element has a photoconductive layer comprising a compound selected from the group consisting of (a) alkylbis(N,N-(dialkylaminoaryl)methane, (b) cycloalkylbis(N,N-dialkylaminoaryl)methane and (c) cycloalkenylbis(N,N-dialkylaminoaryl)methane.

* * * * *