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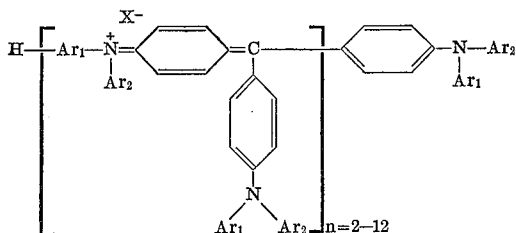
NOVEL ELECTROPHOTOGRAPHIC SENSITIZERS
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assignors to Eastman Kodak Company, Rochester, N.Y.
No Drawing. Continuation-in-part of applications Ser. No.
447,937, Mar. 16, 1965, now Patent No. 3,387,973, and
Ser. No. 687,503, Dec. 4, 1967, now Patent No.
3,488,705, which is a division of application Ser. No.
163,092, Dec. 29, 1961, now Patent No. 3,234,280.
This application Mar. 18, 1968, Ser. No. 714,091
Int. Cl. G03g 5/06

U.S. Cl. 96—1.6

19 Claims

ABSTRACT OF THE DISCLOSURE

Compounds having the structure



are sensitizers for photoconductors in electrophotographic elements.

This application is a continuation-in-part of Serial No. 687,503, filed Dec. 4, 1967, now U.S. Patent 3,488,705, and Serial No. 447,937, now U.S. Patent 3,387,973 which is a division of Serial No. 163,092, filed Dec. 29, 1961, now U.S. Patent 3,234,280, Mar. 16, 1965.

This invention relates to a novel class of organic compounds, the process for preparing these novel compounds and to their use as sensitizers in electrophotographic elements.

The process of xerography, as disclosed by Carlson in U.S. 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 actinic 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 the 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 in the absence of charge pattern as desired. The deposited marking material may 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 may similarly be fixed. Likewise, the electrostatic latent image 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 present-day document copying applications.

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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 are known to possess some degree of photoconductivity. Many organic compounds have revealed a useful level of photoconduction and have been incorporated into photoconductive compositions. Optically clear organic photoconductor-containing elements having desirable electrophotographic properties can be especially useful in electrophotography. Such electrophotographic elements may 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.

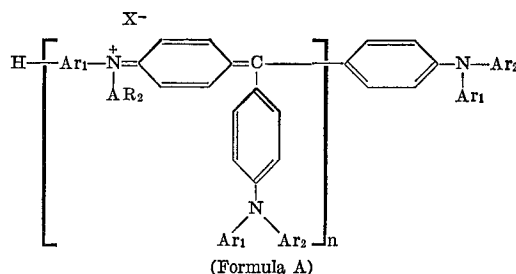
Although some of the organic photoconductors comprising the materials described are inherently light sensitive, their degree of sensitivity is usually low and in the short wave length portion of the spectrum so that it is common practice to add materials to increase the speed and to shift the sensitivity toward the longer wave length portion of the visible spectrum. Increasing the speed and shifting the sensitivity of such systems into the visible regions of the spectrum has several advantages: it makes available inexpensive and convenient light sources such as incandescent lamps; it reduces exposure time; it makes possible the recording of a wide range of colors in proper tonal relationship, and allows projection printing through various optical systems. By increasing the speed through the use of sensitizers, photoconductors which would otherwise have been unsatisfactory are useful in processes where high speeds are required such as document copying.

It is, therefore, an object of this invention to provide a novel class of organic compounds useful as sensitizers in combination with organic photoconductors.

A further object of this invention is to provide a novel process for preparing these compounds.

Another object of this invention is to provide novel sensitized photoconductive elements.

These and other objects of this invention are accomplished by novel compounds having the following structure:



where:

n is an integer from 2 to 12;

Ar_1 and Ar_2 are each aryl radicals, including substituted aryl radicals, such as a phenyl radical, a naphthyl radical, an alkylphenyl radical, a halophenyl radical, an aminophenyl radical, etc., and

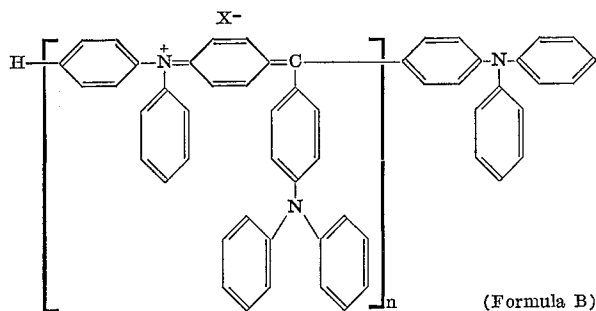
X is a halogen atom, e.g., chlorine, fluorine, bromine, etc. or the anion of an organic acid salt, e.g., an alkanoate radical having one to ten carbon atoms such as a formate, acetate, propionate or a butyrate radical including a substituted alkanoate radical such as a haloacetate, cyanoacetate or an oxalate radical; an aryloate radical such as a benzoate or a naphthoate radical and including substituted acryloate radical such as a salicylate or an anthranilate radical; an alkenoate radical having one to ten car-

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bon atoms such as an arylate, crotonate or vinylacetate radical; or an aryl or an alkane sulfonate radical such as a benzene sulfonate or a methylsulfonate radical.

These compounds are useful as sensitizers for organic photoconductors in electrophotographic elements. When they are used in this capacity, substantial increases are noted in the speeds of the elements.

The preferred sensitizers of this invention have the following formula:

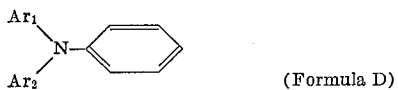


where n and X are the same as set forth above.

The novel compounds of this invention are prepared by reacting a stoichiometric excess of a carbonyl halide having the formula:



where Y is a halogen atom, with a triarylamine having the formula:



where Ar_1 and Ar_2 are aryl radicals as defined above.

The organic acid salt derivatives are obtained by converting the corresponding halide to the carbinol base by treating it in solution with dilute alkali. The carbinol base is treated in turn with the appropriate organic acid.

Typical compounds which belong to the herein described general class of sensitizing compounds include those represented by the above Formula B wherein X is the anion set forth in following Table I.

TABLE I

X	
Compound No.:	
I.....	Cl-
II.....	F-
III.....	Br-
IV.....	$H-\overset{\text{O}}{\parallel}{C}-O-$
V.....	$CH_3-\overset{\text{O}}{\parallel}{C}-O-$
VI.....	$CH_2Cl-\overset{\text{O}}{\parallel}{C}-O-$
VII.....	$CHCl_2-\overset{\text{O}}{\parallel}{C}-O-$
VIII.....	$CCl_3-\overset{\text{O}}{\parallel}{C}-O-$
IX.....	$CH_2F-\overset{\text{O}}{\parallel}{C}-O-$
X.....	$CHF_2-\overset{\text{O}}{\parallel}{C}-O-$
XI.....	$CF_3-\overset{\text{O}}{\parallel}{C}-O-$
XII.....	$CN-CH_2-\overset{\text{O}}{\parallel}{C}-O-$

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TABLE I—Continued

X	
Compound No.	
XIII.....	$HOOC-\overset{\text{O}}{\parallel}{C}-O-$
XIV.....	$C_6H_5SO_3-$
XV.....	CH_3SO_3-
XVI.....	
XVII.....	

As previously mentioned, these compounds are prepared by reacting a stoichiometric excess of a carbonyl halide such as phosgene with a triarylamine. Since the aryl groups of the triarylamine can be substituted, the nature and extent of this substitution will be dictated by the type of compound which is desired. Thus, when triphenylamine is used, the ultimate compound prepared has phenyl radicals which contain no substitution. The employment of 4 - methyltriphenylamine results in a compound having phenyl groups substituted by methyl radicals.

In order to obtain the recurring units depicted in Formula A, it is generally necessary to use a stoichiometric excess of the carbonyl halide, i.e., more than one mole of carbonyl halide for three moles of triarylamine. Thus, the molar ratio of carbonyl halide to triarylamine is suitably 1:2 to 2:1 and preferably 1:1.

The reaction temperature is maintained below 250° C. and preferably between 20° C. and 250° C. The reaction is carried out at elevated pressures between 1.0 and 100 p.s.i.g. When an autoclave is employed, autogenous pressure is sufficient. The reaction time can vary from a few minutes to several hours, the preferred times being 0.1 to 10 hours.

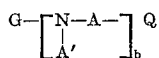
The recovery of those compounds in which X is halogen can be accomplished according to conventional work-up techniques. Thus, successive extractions with solvents such as chloroform, diethyl ether and acetone effectively isolate the various molecular weight fractions of the compound. In order to prepare the organic acid salt derivatives, the halogen derivative is converted to the corresponding carbinol base. This is accomplished either by continuously washing the material with water or by treating it with dilute alkali. The appropriate organic acid is then added to the carbinol base and the organic acid salt derivative recovered according to conventional techniques.

Electrophotographic elements of the invention can be prepared with any organic photoconductive compound and the novel sensitizing compounds of this invention in the usual manner, i.e., by blending a dispersion or solution of the photoconductive compound together with a binder, when necessary or desirable, and coating or forming a self-supporting layer with the photoconductive composition. Generally, a suitable amount of the sensitizing compound is mixed with the photoconductive coating composition so that, after thorough mixing, the sensitizing compound is uniformly distributed throughout the desired layer of the coated element. 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 per-

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cent by weight based on the weight of the film-forming coating composition. Normally, a sensitizer is added to the coating composition in an amount from about 0.005 to about 5.0 percent by weight of the total coating composition.

The sensitizers of this invention are effective for enhancing the electrophotosensitivity of a wide variety of photoconductors. The preferred photoconductors are those organic compounds which exhibit an electrophotosensitivity to light and are capable of forming transparent elements. An especially useful class of organic photoconductors is referred to herein as "organic amine" photoconductors. Such organic photoconductors have as a common structural feature at least one amino group. Useful organic photoconductors which can be spectrally sensitized in accordance with this invention include, therefore, arylamine compounds comprising (1) diarylamines such as diphenylamine, dinaphthylamine, N,N'-diphenylbenzidine, N-phenyl-1-naphthylamine; N-phenyl-2-naphthylamine; N,N'-diphenyl-p-phenylenediamine; 2-carboxy-5-chloro-4'-methoxydiphenylamine; p-anilinophenol; N,N'-di-2-naphthyl-p-phenylenediamine; those described in Fox U.S. Pat. 3,240,597 issued Mar. 15, 1966, and the like, and (2) triarylamines including (a) nonpolymeric triarylamines, such as triphenylamine, N,N,N',N'-tetraphenyl-m-phenylenediamine; 4-acetyltriphenylamine, 4-hexanoyltriphenylamine; 4-lauroyltriphenylamine; 4-hexyltriphenylamine, 4-dodecyltriphenylamine, 4,4'-bis(diphenylamino)benzyl, 4,4'-bis(diphenylamino)-benzophenone, and the like, and (b) polymeric triarylamines such as poly[N,4'-(N,N',N'-triphenylbenzidine)]; polyadipyltriphenylamine, polysebacyltriphenylamine; polydecanetylenetriphenylamine; poly-N-(4-vinylphenyl)diphenylamine, poly-N-(vinylphenyl)- α,α' -dinaphthylamine and the like. Other useful amine-type photoconductors are disclosed in U.S. Pat. 3,180,730 issued Apr. 27, 1965. In addition, photoconductive substances capable of being spectrally sensitized in accordance with this invention are disclosed in Fox U.S. Pat. 3,265,496 issued Aug. 9, 1966, and include those represented by the following general formula:



wherein A represents a mononuclear or polynuclear divalent aromatic radical, either fused or linear (e.g., phenyl, naphthyl, biphenyl, binaphthyl, etc.), or a substituted divalent aromatic radical of these types wherein said substituent can comprise a member such as an acyl group having from 1 to about 6 carbon atoms (e.g., acetyl, propionyl, butyryl, etc.), an alkyl group having from 1 to about 6 carbon atoms (e.g., methyl, ethyl, propyl, butyl, etc.), an alkoxy group having from 1 to about 6 carbon atoms (e.g., methoxy, ethoxy, propoxy, pentoxy etc.), or a nitro group; A' represents a mononuclear or polynuclear monovalent aromatic radical, either fused or linear (e.g., phenyl, naphthyl, biphenyl, etc.); or a substituted monovalent aromatic radical wherein said substituent can comprise a member, such as an acyl group having from 1 to about 6 carbon atoms (e.g., acetyl, propionyl, butyryl, etc.), an alkyl group having from 1 to about 6 carbon atoms (e.g., methyl, ethyl, propyl, butyl, etc.), an alkoxy group having from 1 to about 6 carbon atoms (e.g., methoxy, propoxy, pentoxy, etc.), or a nitro group; Q can represent a hydrogen atom, a halogen atom or an aromatic amino group, such as A'NH—; b represent an integer from 1 to about 12, and G represents a hydrogen atom, a mononuclear or polynuclear aromatic radical, either fused or linear (e.g., phenyl, naphthyl, biphenyl, etc.), a substituted aromatic radical wherein said substituent comprises an alkyl group, an alkoxy group, an acyl group, or a nitro group, or a poly(4'-vinylphenyl) group which is bonded to the nitrogen atom by a carbon atom of the phenyl group.

Polyaryllalkane photoconductors are particularly useful in producing the present invention. Such photoconductors

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are described in U.S. Pat. 3,274,000; French Pat. 1,383,461 and in copending application of Seus and Goldman entitled "Photoconductive Elements Containing Organic Photoconductors," filed Apr. 3, 1967. These photoconductors include leuco bases of diaryl or triarylmethane dye salts, 1,1,1-triaryllalkanes wherein the alkane moiety has at least two carbon atoms and tetraarylmethanes, there being substituted an amine group on at least one of the aryl groups attached to the alkane and methane moieties of the latter two classes of photoconductors which are non-leuco base materials.

Preferred polyaryllalkane photoconductors can be represented by the formula:



wherein each of D, E and G is an aryl group and J is a hydrogen atom, an alkyl group, or an aryl group, at least one of D, E and G containing an amino substituent. The aryl groups attached to the central carbon atom are preferably phenyl groups, although naphthyl groups can also be used. Such aryl groups can contain such substituents as alkyl and alkoxy typically having 1 to 8 carbon atoms, hydroxy, halogen, etc. in the ortho, meta or para positions, ortho-substituted phenyl being preferred. The aryl groups can also be joined together or cyclized to form a fluorene moiety, for example. The amino substituent can be represented by the formula



wherein each L can be an alkyl group typically having 1 to 8 carbon atoms, a hydrogen atom, an aryl group, or together the necessary atoms to form a heterocyclic amino group typically having 5 to 6 atoms in the ring such as morpholino, pyridyl, pyrrol, etc. At least one of D, E, and G is preferably p-dialkylaminophenyl group. When J is an alkyl group, such as alkyl group more generally has 1 to 7 carbon atoms.

Representative useful polyaryllalkane photoconductors include the compounds listed below:

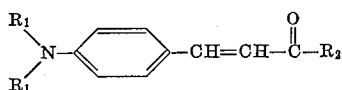
TABLE A

Compound No.	Compound name
1.....	4,4'-benzylidene-bis(N,N-diethyl-m-toluidine).
2.....	4',4''-diamino-4-dimethylamino-2',2''-dimethyltriphenylmethane.
3.....	4',4''-bis(diethylamino)-2,6-dichloro-2',2''-dimethyltriphenylmethane.
4.....	4',4''-bis(diethylamino)-2',2''-dimethyl-diphenyl-naphthylmethane.
5.....	2',2''-dimethyl-4,4',4''-tris(diethylamino)triphenylmethane.
6.....	4',4''-bis(diethylamino)-4-dimethylamino-2',2''-dimethyltriphenylmethane.
7.....	4',4''-bis(diethylamino)-2-chloro-2',2''-dimethyl-4-dimethylaminotriphenylmethane.
8.....	4',4''-bis(diethylamino)-4-dimethylamino-2,2',2''-trimethyltriphenylmethane.
9.....	4',4''-bis(diethylamino)-2-chloro-2',2''-dimethyltriphenylmethane.
10.....	4',4''-bis(diethylamino)-2',2''-dimethyl-4-methoxytriphenylmethane.
11.....	Bis(4-diethylamino)-1,1,1-triphenylethane.
12.....	Bis(4-diethylamino)tetraphenylmethane.
13.....	4',4''-bis(benzylethylamino)-2',2''-dimethyltriphenylmethane.
14.....	4',4''-bis(diethylamino)-2',2''-diethoxytriphenylmethane.
15.....	4,4'-bis(diethylamino)-1,1,1-triphenylethane.
16.....	1-(4-N,N-dimethylaminophenyl)-1,1-diphenylethane.
17.....	4-dimethylaminotetraphenylmethane.
18.....	4-diethylaminotetraphenylmethane.

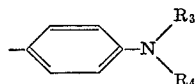
Additional organic photoconductors which can be employed with the sensitizing compounds described herein are non-ionic cycloheptenyl compounds such as those described in copending application Ser. No. 654,091, filed July 18, 1967; the N,N-bicarbazyls and tetra-substituted hydrazines; the 3,3'-bis-1,5-diarylpzazolines; triarylamines having at least one of the aryl radicals substituted by either a vinyl radical, or a vinylene radical having

at least one active hydrogen-containing group such as p-diphenylaminocinnamic acid; triarylamines substituted by an active hydrogen-containing group, e.g., 4-carboxy-triphenylamine; and those described in Australian Pat. 248,402. Other organic photoconductors that can be sensitized in accordance with the invention include organo-metallic compounds which are the organic derivatives of Group IVa and Va metals such as those having at least one aminoaryl group attached to the metal atom as described in Ser. No. 650,664 filed July 3, 1967. Exemplary organo-metallic compounds are the triphenyl-p-dialkylaminophenyl derivatives of silicon, germanium, tin and lead and the tri-p-dialkylamino-phenyl derivatives of arsenic, antimony, phosphorous and bismuth.

Another class of photoconductors useful in this invention are the 4-diarylamino-substituted chalcones. Typical compounds of this type are low molecular weight non-polymeric ketones having the general formula:



wherein R_1 and R_2 are each phenyl radicals including substituted phenyl radicals and particularly when R_2 is a phenyl radical having the formula:



where R_3 and R_4 are each aryl radicals, aliphatic residues of 1 to 12 carbon atoms such as alkyl radicals preferably having 1 to 4 carbon atoms or hydrogen. Particularly advantageous results are obtained when R_1 is a phenyl radical including substituted phenyl radicals and where R_2 is diphenylamino, dimethylamino or hydrogen.

Preferred binders for use in preparing the present photoconductive layers comprise polymers 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(methylmethacrylate), poly(n-butylmethacrylate), poly(isobutylmethacrylate), etc.; polystyrene; nitrated polystyrene; polymethylstyrene; isobutylene polymers; polyesters, such as poly(ethylenealkaryloxyalkylene terephthalate); phenol-formaldehyde resins; ketone resins; polyamides; polycarbonates; polythiocarbonates; poly(ethyleneglycol-co-bis-hydroxyethoxyphenyl propane terephthalate); nuclear substituted polyvinyl haloarylates; etc. Methods of making resins of 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. Pats. 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 trade names as Vitel PE-101, Cymac, Piccopale 100, Saran F-220 and Lexan 105. Other types of binders which can be used in the photoconductive layers of the invention include such materials as paraffin, mineral waxes, etc.

Solvents of choice for preparing coating compositions of the present invention can include a number of solvents such as benzene, toluene, acetone, 2-butanone, chlorinated hydrocarbons, e.g., methylene chloride, ethylene chloride, etc., ethers e.g., tetrahydrofuran, or mixtures of these solvents, etc.

In preparing the coating composition useful results are obtained where the photoconductor 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 photoconductor substance present can be widely varied in accordance with usual practice. In those cases where a binder is employed, it is normally required that the photoconductor substance be present in an amount from about 1 weight percent of the coating composition to about 99 weight percent of the coating composition. A preferred weight range for the photoconductor substance 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 coating in the range of about 0.001 inch to about 0.01 inch before drying is useful for the practice of this invention. The preferred range of coating thickness was found to be in the range from about 0.002 inch to about 0.006 inch before drying although useful results can be obtained outside of this range.

Suitable supporting materials for coating the photoconductive layers of the present invention can include any of a wide variety of electrically conducting supports, for example, paper (at a relative humidity above 20 percent); aluminum-paper laminates; metal foils such as aluminum foil, zinc foil, etc.; metal plates, such as aluminum, copper, zinc, brass, and galvanized plates; vapor deposited metal layers such as silver, nickel, aluminum and the like coated on paper or conventional photographic film bases. An especially useful conducting support can be prepared by coating a support material such as polyethylene terephthalate with a layer containing a semiconductor dispersed in a resin. Such conducting layers both with and without insulating barrier layers are described in U.S. Patent 3,245,833. Likewise, a suitable conducting coating can be prepared from the sodium salt of a carboxyester lactone of maleic anhydride and a vinyl acetate polymer. Such kinds of conducting layers and methods for their optimum preparation and use are disclosed in U.S. 3,007,901 and 3,267,807.

The elements of the present invention can be employed in any of the well-known electrophotographic processes which require photoconductive layers. One such process is the aforementioned xerographic process. As explained previously, in a process of this type the electrophotographic element is given a blanket electrostatic charge by placing the same under a corona discharge which serves to give a uniform charge to the surface of the photoconductive layer. This charge is retained by the layer owing to the substantial 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 photoconducting layer is then selectively dissipated from the surface of the layer by exposure to light through an image-bearing transparency by a conventional exposure operation such as, for example, by contact-printing technique, or by lens projection of an image, etc., to form a latent image in the photoconducting layer. By exposure of the surface in this manner, a charged pattern is created by virtue of the fact that light causes the charge to be conducted away in proportion to the intensity of the illumination in a particular area. The charge pattern remaining after exposure is then developed, i.e., rendered visible, by treatment with a medium comprising electrostatically attractable particles having optical density. The developing electrostatically attractable particles can be in the form of a dust, e.g., powder, a pigment in a resinous carrier, i.e., toner, or a liquid developer may be used in which the developing particles are carried in an electrically insulating liquid carrier. Methods of development of this type are widely known and have been described in the patent literature in such patents, for example, as U.S. 2,297,691 and in Australian Pat. 212,315. In processes of electrophotographic reproduction such as in xerography, by selecting a developing particle which has as one of its components, a low-melting resin, it is possible to treat the developed photoconductive material with heat and cause the powder to adhere permanently to the surface of the photoconductive layer. In other cases, a transfer of the

image formed on the photoconductive layer can be made to a second support, which would then become the final print. 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. Pats. 2,297,691 and 2,551,582, and in "RCA Review," vol. 15 (1954), pages 469-484.

The present invention is not limited to any particular mode of use of the new electrophotographic materials, and the exposure technique, the charging method, the transfer (if any), the developing method, and the fixing method as well as the material used in these methods can be selected and adapted to the requirements of any particular technique.

Electrophotographic materials according to the present invention can be applied to reproduction techniques wherein different kinds of radiations, i.e., electromagnetic radiations as well as nuclear radiations, can be used. For this reason, it is pointed out herein that although materials according to invention are mainly intended for use in connection with methods comprising an exposure, the term "electrophotography" wherever appearing in the description and the claims, is to be interpreted broadly and understood to comprise both xerography and xero-radiography.

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

EXAMPLE 1

Preparation of Compound I

A mixture of 29.4 grams of triphenylamine and 12 grams of liquid phosgene are heated in a sealed autoclave at 200° C. for 4 hours with agitation. At the end of this period the autoclave is cooled and the crude solid product is dissolved in 100 ml. of chloroform. The remaining insoluble material is filtered and the mother liquor containing soluble product is separated into fractions in the manner set forth below. The chloroform solution is added to two liters of ether causing the coprecipitation of fractions C and D. The coprecipitate is filtered and washed. Fraction B is isolated by evaporation of the solvent from the filtrate. The fraction containing C and D combined is extracted with acetone to provide the acetone-soluble fraction D and the acetone-insoluble fraction C which remains as the residue. These fractions are fully described in the following Table II.

TABLE II

Fraction	Solubility	Elemental analysis					M.P., ° C.
		C	H	N	Cl	MW	
B	Soluble diethyl ether	84.3	5.7	5.2	3.2	458	75
C	Soluble chloroform, insoluble acetone, insoluble ether	82.4	5.5	4.8	2.7	4,600	275
D	Soluble acetone, insoluble diethyl ether	80.6	5.5	4.6	6.9	1,050	210

EXAMPLE 2

Preparation of Compounds II and III

Compounds II and III are prepared in the same manner as Compound I except that carbonyl fluoride and carbonyl bromide are used as starting materials instead of phosgene. Good yields of both products are obtained.

EXAMPLE 3

Preparation of Compound XI

15.2 grams of the above described fraction C is converted to the carbinol base by washing a dichloromethane solution of the material with distilled water for 24 hours. The resultant material is then treated with 2.28 grams of trifluoroacetic acid. Evaporation of the solvent yields a blue solid containing a 6.7% fluorine.

EXAMPLE 4

Preparation of Compounds IV-X and XII-XVII

These compounds are all prepared in the manner described in Example 3 using the following acids in place of the trifluoroacetic acid:

Table III

Compound prepared:	Acid
IV	Formic.
V	Acetic.
VI	Chloroacetic.
VII	Dichloroacetic.
VIII	Trichloroacetic.
IX	Fluoroacetic.
X	Difluoroacetic.
XII	Cyanoacetic.
XIII	Oxalic.
XIV	Phenylsulfonic.
XV	Methylsulfonic.
XVI	Salicylic.
XVII	Diphenylanthranilic.

Good yields are obtained in each instance.

EXAMPLE 5

Sensitization of organic photoconductor coatings

In order to demonstrate the effectiveness of the compounds of this invention as sensitizers in electrophotographic elements, the following photoconductive composition is prepared:

Organic photoconductor: 1.0 g.
Binder: 1.5 g.
Sensitizing compound: 0.08 g.
Thiapyrylium perchlorate: 0.04 g.
Solvent: 13 ml.

The photoconductor is 1,3,5-triphenyl-2-pyrazoline, the solvent is dichloromethane, the sensitizer is Compound I and the binder is Vitel 101, a polyester of terephthalic acid and a mixture of ethylene glycol (1 part by weight) and 2,2-bis[4-(β -hydroxyethoxy)phenyl]propane (9 parts by weight) manufactured by Goodyear Tire and Rubber Co. The resulting dope is then coated at 0.004 inch thickness on the aluminum surface of a paper-backed aluminum foil at 11° F. The coating is concurrently dark conditioned and cured at 47° C. for 15 hours. The sample

is charged positively under a corona discharge unit to 600 volts above ground potential. The charged element is then exposed for 3 seconds through a step tablet to a tungsten source at 3000° K. and of 19 ± 1 foot-candle intensity at the point of exposure. The step tablet consists of 0.1 log E increments. After exposure the latent image is fringe developed using a mixture of negatively charged black thermoplastic toner particles and glass beads. Twenty-two clear steps are produced. When the sensitizing compound is omitted, only twelve clear steps are produced. Similar results are obtained for Compounds II to XVII (Table I) for both positively and negatively charged elements.

EXAMPLE 6

Coating compositions containing the sensitizing compounds of this invention are prepared and coated in the

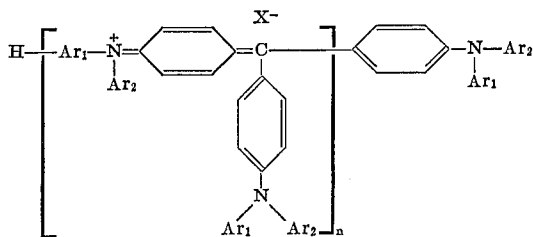
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manner described in Example 5. In a darkened room, the surface of each of the photoconductive layers so prepared is charged to a potential of about +600 volts under a corona charger. The layer is then covered with a transparent sheet bearing a pattern of opaque and light transmitting areas and exposed to the radiation from an incandescent lamp with an illumination intensity of about 19 ± 1 foot-candles for 3 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 and glass beads. A good reproduction of the pattern results in each instance.

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

We claim:

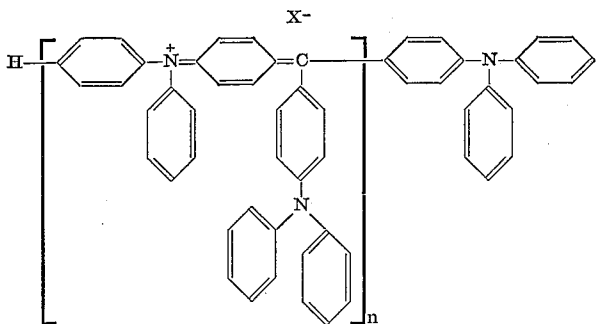
1. An electrophotographic element comprising a support having coated thereon a photoconductive composition comprising an organic photoconductor and a sensitizer having the formula:



wherein n is an integer from 2 to 12; X is selected from the group consisting of a halogen atom and the anion of an organic acid salt; and Ar_1 and Ar_2 are each aryl radicals.

2. The electrophotographic element of claim 1 wherein X is selected from the group consisting of a chlorine atom, an alkanolate radical, an aryloate radical, an alkenolate radical, an aryl sulfonate radical and an alkane sulfonate radical.

3. An electrophotographic element comprising a support having coated thereon a photoconductive composition comprising an organic photoconductor and a sensitizer having the formula:



wherein n is an integer from 2 to 12 and X is selected from the group consisting of a halogen atom, a formate radical, an acetate radical, a salicylate radical, an oxalate radical, an aryl sulfonate radical, an alkane sulfonate radical and a malonate radical.

4. The electrophotographic element of claim 3 wherein X is a chlorine atom.

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5. The electrophotographic element of claim 3 wherein X is a bromine atom.

6. The electrophotographic element of claim 3 wherein X is an acetate radical.

7. The electrophotographic element of claim 3 wherein X is a fluorine atom.

8. The electrophotographic element of claim 3 wherein X is a chloroacetate radical.

9. The electrophotographic element of claim 3 wherein X is a dichloroacetate radical.

10. The electrophotographic element of claim 3 wherein X is a fluoroacetate radical.

11. The electrophotographic element of claim 3 wherein X is a difluoroacetate radical.

12. The electrophotographic element of claim 3 wherein X is a trifluoroacetate radical.

13. The electrophotographic element of claim 3 wherein X is a cyanoacetate radical.

14. The electrophotographic element of claim 3 wherein X is a salicylate radical.

15. The electrophotographic element of claim 3 wherein X is an oxalate radical.

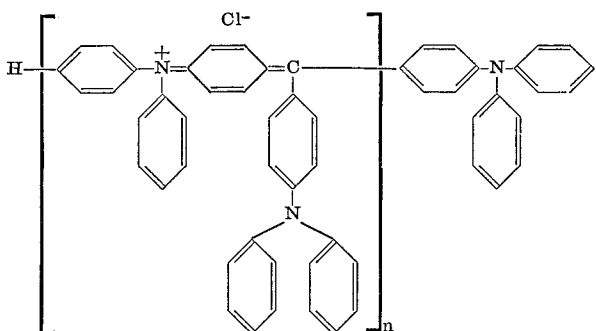
16. The electrophotographic element of claim 3 wherein X is a benzenesulfonate radical.

17. The electrophotographic element of claim 3 wherein X is a methylsulfonate radical.

18. The electrophotographic element of claim 3 wherein X is a monoformate radical.

19. A photoconductive element for use in electrophotography comprising a support having coated thereon a photoconductive composition comprising:

- (a) about 10 to 60%, by weight, based on said photoconductive composition of an organic photoconductor,
- (b) a film-forming polymeric binder for said photoconductor, and
- (c) 0.005 to 5% of a sensitizer having the formula:



wherein n is an integer from 2 to 12.

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96—1.5; 260—391