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SENSITIZABLE COATED PAPER SHEET ADAPTED
FOR PHOTOELECTROSTATIC REPRODUCTION
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3,697,267

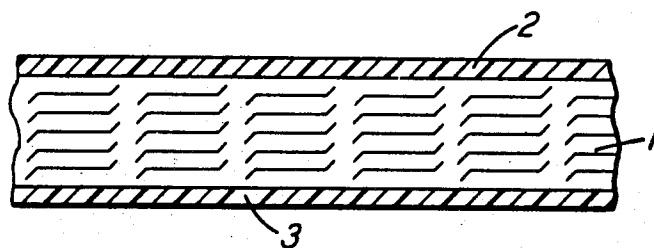


FIG. 1

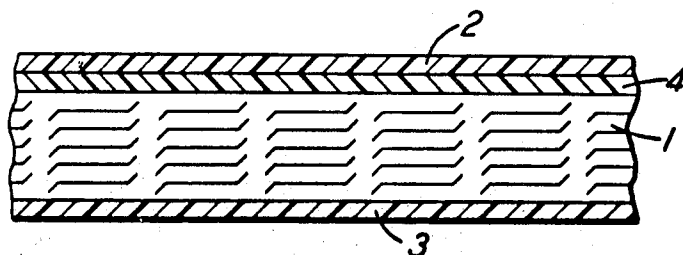


FIG. 2

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SENSITIZABLE COATED PAPER SHEET ADAPTED FOR PHOTOELECTROSTATIC REPRODUCTION

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Continuation of application Ser. No. 541,866, Jan. 27 1966, which is a continuation-in-part of application Ser. No. 162,657, Dec. 28, 1961. This application Mar. 7, 1967, Ser. No. 621,365

Int. Cl. G03g 5/00; C03c 5/00; D21h 5/00
U.S. Cl. 96—1.8 8 Claims

ABSTRACT OF THE DISCLOSURE

A photosensitive paper sheet which is useful in an electrophotographic process wherein a liquid toner is employed, said sheet having a coating on one side thereof which comprises a finely divided, photoconductive, inorganic pigment dispersed in a film-forming, electrically insulating binder material, and a coating on the other side thereof which acts as a barrier coat, to prevent retention of the liquid toner on the back of the sheet. A photosensitive paper sheet having a barrier coating on both sides thereof is also disclosed.

This invention relates to a photosensitive paper sheet adapted for electrophotographic reproduction of images and more particularly, to a paper sheet carrying a photosensitive coating which is particularly well adapted for use in the production of a copy by an electrophotographic process which utilizes a liquid toner. This application is a continuation-in-part of Ser. No. 162,657, filed Dec. 28, 1961 and now abandoned, and is a continuation of Ser. No. 541,866, filed Jan. 27, 1966, and also now abandoned.

In electrophotographic reproduction, an image is reproduced directly on a film or coating of a photoconductive pigment, such as zinc oxide, dispersed in an insulating matrix, such as a synthetic resin, carried by a sheet of paper or other electrically conductive backing. In this process, the electrophotographic coating is given a negative electrostatic charge while protected from light, and then exposed to an optical light image of the subject matter to be reproduced. The electrostatic charge on the coating is discharged in the areas struck by light, while being retained in the areas protected from light, thereby producing an electrophotographic reproduction of the optical image.

Although specific reference is made to electrophotographic coatings containing zinc oxide as the photoconductive pigment, it will be understood that not only can other photoconductive pigments be substituted for the zinc oxide, but also other types of photoconductive coatings can be employed. Such other coatings may consist of organic photoconductors dispersed or dissolved in a resinous binder, or they may consist either partially or entirely of photoconductive polymers.

In order to sensitize effectively the electrophotographic coating on the copy paper by the application of a blanket, negative electrostatic charge, it is necessary for the base sheet to have a minimal electrical conductivity.

Thus the photoconductive pigmented sheet in many respects performs similar functions to the selenium drum of the well-known xerographic process.

Electrophotographic images are converted into visible images by either of two toning methods. In one toning method, the electrophotographic image is treated with a powdered, solid resinous toner carrying a positive electrostatic charge. The toner adheres to the areas of the coating carrying a negative electrostatic charge to give a

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reproduction of the original optical image. This visible toner image is made permanent by subjecting it to heat to fuse the resinous powder.

In an alternate toning method, the electrophotographic image is treated with a colored, resinous liquid toner carried by volatile organic solvents. The excess toner is removed from the sheet by squeeze rolls and the volatile organic solvent permitted to evaporate to make the image permanent.

A cursorily inspected zinc oxide coated electrophotographic sheet appears to be very simple, because a sheet of acceptable quality may seem to be easily obtained in view of many known coatings and coating processes. However, this impression is far removed from the facts. The performance requirements in general are as high, in their own way, as those in the selenium branch of xerography. At the same time, this high performance item must be mass produced in very large quantities at a very nominal cost.

The paper-base electrophotographic sheets which have heretofore been produced have not been fully satisfactory in the production of copies by processes which utilize a liquid toner. Among other things, the back of the sheet carries unsightly and undesirable lines or streaks. These lines or streaks are caused by an uneven retention of the liquid toner by the back of the sheet. Further, the back of the sheet is darkened by the absorption of the toner, reducing the contrast in the image on the opposite side of the sheet.

Basically, a paper-base electrophotographic sheet should have a high degree of contrast between the print areas and the background or non-image areas. Obviously, any advance that would allow the optimization of contrast between the image and background would be an improvement, as the total appearance of the end product ideally should resemble the highest quality prints obtainable by any of the known printing methods.

Prior art attempts to produce a high-quality sheet by optimizing this contrast have been exemplified by different approaches. British Pat. 873,080 shows an attempt to obtain contrast between image and background by using a bias voltage during the toning process. This patent focuses only on the surface toning problem because, as stated in the patent, the problem was believed to be associated with the surface electrophotographic layer of the base sheet.

Another approach in improving images in the liquid toning process of latent electrophotographic images is illustrated by Dirks U.S. Pat. 3,155,546, Nov. 3, 1964. In this patent the approach has been essentially through changes in apparatus and in the manner the bias voltage has been used in a modified apparatus.

Despite these meritorious modifications in an apparatus giving an improved image and background contrast, further improvements have been desired because certain problems have still persisted, such as streaking on the back of the sheet and other problems further discussed herein.

It is an object of this invention to provide a paper-base electrophotographic sheet which avoids the aforementioned undesirable problems such as streaking on the back or reverse surface when used to produce a copy by a process involving the use of the liquid toner, while being entirely satisfactory for use in the production of a copy by a process which utilizes a dry, powdered toner.

It is another object of this invention to provide a high contrast producing paper-base electrophotographic sheet which both avoids the undesirable streaking and darkening of the back or reverse surface when used to produce a copy by a process involving the use of a liquid toner and produces satisfactory copies under a wide range of

atmospheric humidity conditions in processes using either a liquid or a dry toner.

Other objects of this invention and its various advantageous features will become apparent from the detailed description of this invention which follows.

The present invention is achieved by recognizing that instead of modifying the apparatus and/or using bias voltage, specific attention must be given to the construction of the electrophotographic paper sheet (copy paper).

In particular, in arriving at an acceptable copy paper ways must be found to prevent objectionable absorption of the binder for the zinc oxide into it. Moreover, the absorption of liquid toner in the back side of the copy paper during use in the electrostatic copier must be prevented also.

This reduction in absorption must be accomplished without interfering with the normal handling of the sheet either during its manufacture or its use. For example, the reduction in absorption on the face side of the sheet must not interfere with the adhesion of the zinc oxide coating over a wide range of temperature and humidity conditions.

The means used to reduce absorption of liquid toner on the back side of the sheet should neither interfere with proper electrical grounding in the copier nor result in abnormal tackiness. Tackiness not only can result in multiple feeding in the electrostatic copier, but also it can cause the face side of one sheet to stick to the back side of another when in juxtaposition. Such sticking can result in coating pick-off when the sheets are separated or when a roll of coated material is unwound. Furthermore, the materials used to impart solvent resistance as well as those used to provide electrical conductivity must not transfer to the zinc oxide coating on the face side when in face-to-back contact. To do so would destroy the photoconductivity of the zinc oxide coating and thus render the product useless.

It has now been found that in the design of this electrophotographic sheet, consideration must be given to the following:

(a) Toner streaks on the back of the imaged sheet should be minimized, as determined by visual inspection.

(b) A mottled image effect should be minimized. Mottle is defined as non-uniformity in image density, and it is determined by visual observation of an electrostatic copy of a half-tone wedge having 10 steps of .10 increment per step. The half-tone steps should be reproduced with uniform density through out the entire wedge area.

(c) Unightly toner deposits should not be present on the back of the sheet.

(d) Absorption of the toner liquid in the copy paper should be minimal. The "hold-out" of such liquids can be determined by weighing an 8½" x 11" sheet of the copy paper before imaging and after imaging. A sheet of the present invention will absorb less than 0.3 gram per sheet. A sheet having a hold-out of less than 0.2 gram is preferred.

(e) Background (non-image area) density of the imaged sheet should not exceed a value of 0.10 on the Kodak Gray Scale (Series V:7-61-CH).

(f) Image density should be above a value of 0.90 on the Kodak Gray Scale, and a density value of more than 1.00 is preferred.

(g) The Gurley density of the sheet to which the zinc oxide coating is applied should be in the range of 1000 to 5000 secs./10 ccs. (high-density method) for proper toner liquid and resin solvent hold-out. A Gurley density of from about 1500 to 4500 secs./10 ccs. is preferred.

(h) The thickness uniformity of the zinc oxide coating will be enhanced if the sheet to which it is applied has a Sheffield Smoothness of from about 50 cc./sec. to about 130 cc./sec.

The Gurley density and smoothness levels indicated can be attained by applying barrier coatings of the types described later in this patent, followed by proper calendering.

(i) The adhesion of the zinc oxide coating to the support sheet should be good. Otherwise this coating will flake off or become dislodged readily. Consequently, it is important to select barrier coating materials that will permit satisfactory adhesion. The degree of the zinc oxide coating adhesion to the support sheet can be determined readily by the well known Scotch Tape test. In making this test, the tape is applied to the coating with enough pressure to insure good uniform contact. The tape is then pulled away from the coating. The amount of coating sticking to the tape is a measure of its adhesion to the support sheet.

(j) The copy paper should have minimal curl both before and after imaging. Under TAPPI Standard Conditions, no edge of an 8½" x 11" sheet should be more than 0.50 inch above the flat horizontal surface on which it rests.

(k) The copy paper should be made in such a manner that fast and uniform dissipation of the electrostatic charge is achieved in areas exposed to light.

(l) The specific electrical resistivity of the sheet to which the zinc oxide coating is applied should be no higher than 10¹³ ohm-cm. at 15% relative humidity.

(m) The barrier coatings that are applied to enhance solvent hold-out should neither dissolve nor soften unduly in aliphatic hydrocarbons, aromatic hydrocarbons, halogenated aliphatic hydrocarbons or in mixtures thereof.

(n) Tacky coatings as well as those having objectionable odors should be avoided. The sheets of copy paper should slide over one another readily. There should be no sticking nor dragging that could result in multiple sheet pick-up in the copy machine.

(o) The barrier coated sheet should retain unchanged the same sensitivity to moisture as uncoated cellulosic paper.

In making the above tests, a properly adjusted SCM Model 33 electrostatic copier is used wherever applicable.

Thus, the present invention is achieved by designing an appropriate barrier coating which is applied at least to the back of the base sheet and in the preferred design is applied to both sides of the sheet. This barrier coating, because of its physical and chemical nature, allows the deposition thereon of a well bonded photosensitive zinc oxide coating that is smooth and uniform in thickness. By practicing this invention a copy paper has been produced which is free of streaky and blotchy patterns on the back side when exposed to liquid toners during image development, gives copy of higher contrast, and minimizes toner liquid absorption.

All of the problems defined above have been either minimized or eliminated by combining in a coating whole the various components of this invention.

As a result of the fortuitous cooperation of the elements of this novel composition, prior art problems such as poor zinc oxide coating adhesion, image mottle, toner streaks, and other non-uniformities in the imaged copy paper either have been eliminated or minimized, and copy contrast has been improved.

The photosensitive copy paper made in accordance with this invention comprises a sheet of paper which carries on one of its surfaces a coating of a photoconductive, finely-divided inorganic pigment dispersed throughout a matrix of a film-forming electrically insulating material which bonds the inorganic pigment particles to each other as well as to the outer surface of the sheet. This copy paper carries at least on its reverse side a barrier coating of a film-forming material which is capable of deposition from an aqueous medium and which is insoluble in or relatively resistant to softening by volatile aliphatic hydrocarbons, volatile aromatic hydrocarbons, volatile halogenated aliphatic hydrocarbons, or mixtures thereof.

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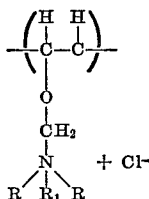
Additionally, the objectives of this invention are accomplished when coatings are applied to both sides of the sheet used as the base for the photosensitive copy paper that are insoluble in volatile hydrocarbon solvents and volatile halogenated hydrocarbon solvents. Suitable coating materials in this class are casein, soy protein, starch, oxidized starch, Dow Resin 2611.7 (described below), locust bean gum, polyacrylamide, or any other natural or synthetic resins that are relatively unaffected by volatile hydrocarbon and halogenated hydrocarbon solvents or mixtures thereof either because of their inherent resistance to these solvents or because of cross-linking that may take place after the coatings are applied. The coatings may be pigmented or unpigmented. Pigmented coatings are preferred because often they are less tacky than unpigmented coatings. Also the pigment helps to improve the smoothness of the sheet. Clay is the preferred pigment from the standpoints of performance as well as cost, although calcium carbonate, satin white, and barytes also are useful.

This copy paper, in its preferred embodiment, carries an intermediate coating between the paper surface and the photosensitive coating.

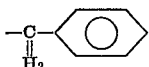
In the preferred embodiment of this invention, the barrier coated base sheet is impregnated throughout with an electrically conductive material. This material may be an inorganic salt, a conductive organic compound, conductive pigment, or a combination of two or more of these materials. Examples of suitable inorganic salts are lithium chloride, calcium chloride, trisodium phosphate, zinc nitrate, and potassium carbonate. Examples of suitable pigments are conductive carbon black, conductive zinc oxide, cuprous iodide, and copper oxide.

The barrier coated base paper may contain from about 0.1% to about 5% of either the conductive inorganic salts or the conductive organic compounds. On the other hand, if conductive pigments are used, their content in the copy paper may range from about 1% to about 20% of the barrier coated base paper weight, depending upon individual conductivity and specific gravity characteristics.

Suitable organic compounds such as those mentioned in Gess U.S. Pat. 3,216,853, Nov. 9, 1965, also may be employed. A particularly effective ingredient for rendering the substrate (including the base paper plus any barrier coating on it) electrically conductive in a uniform manner is a resin produced by Dow Chemical Company, known as Dow Resin X-2611.7, which is sold as an aqueous solution carrying approximately 28½% film-forming solids. Dow Resin X-2611.7 is reputedly a polymer of the formula



where R is lower alkyl such as —CH₃ and R₁ may be lower alkyl or



and which can be used as a replacement of from about 10%, by weight, to about 95%, by weight, of the film-forming material of the barrier coating, since it is itself a film-forming material which seals the sheet against the penetration of the volatile components of liquid toner compositions.

Although no attempt is made to give an explanation as to why the barrier coating on the back side of the photosensitive copy paper minimizes unsightly toner deposits (streaks and the like), it is thought that both elec-

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trical conductivity and solvent barrier properties play significant roles. This apparent coaction of diverse properties emphasizes the co-operating effect of the members of this combination and the achievements which have been effected without detrimentally affecting the overall performance of the copy paper in either the wet or the dry toning process.

The products made in accordance with this invention are diagrammatically illustrated by the accompanying drawing, in which like reference characters are used to refer to like parts wherever they occur. In the drawing:

FIG. 1 is a magnified, broken cross-section of photoelectrostatic sheet in accordance with this invention; and

FIG. 2 is a magnified, broken, cross-section of a preferred photoelectrostatic sheet in accordance with this invention.

Referring specifically to FIGS. 1 and 2, the numeral 1 designates a copy paper carrying on its surface a photosensitive layer 2, and on its reverse surface a barrier coating 3 of a film-forming material which is capable of deposition from an aqueous medium and which is insoluble in volatile aliphatic hydrocarbons, volatile aromatic hydrocarbons, volatile halogenated aliphatic hydrocarbons, or in mixtures thereof. The barrier coated sheet 1 may have a basis weight within the range of 30 lbs. to 70 lbs. per ream of 3000 square feet and will preferably have a basis weight within the range of about 35 lbs. to about 60 lbs. per ream of 3000 square feet.

It will be noted that the embodiment of this invention illustrated by FIG. 2 shows an intermediate layer 4 beneath the photosensitive coating. This intermediate layer 4, like layer 3 on the reverse surface of the sheet, preferably is deposited from an aqueous medium, and it is insoluble in volatile aliphatic hydrocarbons, volatile aromatic hydrocarbons, volatile halogenated aliphatic hydrocarbons, or in mixtures thereof.

The barrier coatings 3 and 4 may be, for example, casein, soy protein, oxidized starch, or a water-soluble gum such as locust gum. Furthermore, these coatings may include a latex, such as a butadiene-styrene latex, in a proportion below that which renders the coatings sensitive to volatile aliphatic hydrocarbons, volatile aromatic hydrocarbons, or volatile halogenated aliphatic hydrocarbons. These coatings may carry no pigment, be lightly pigmented, or may carry a normal pigment content. The pigment carried by these coatings may be, for example, barium sulfate, calcium carbonate, calcium sulfate, clay, or satin white. When a pigment is included in the coatings 3 and 4, it will ordinarily be present within the range of about 0.1 part to about 10 parts by weight for each part of the film-forming material therein. The examples which follow specifically illustrate coating compositions which are suitable for the deposition of the barrier coatings 3 and 4 on a paper sheet in the production of the photosensitive copy paper in accordance with this invention. It will be understood that the composition of the barrier coating which is deposited by these various compositions is identical with the composition of the non-volatile components therein, i.e., all the ingredients except the water of the composition.

EXAMPLE I

Oxidized starch coating

55	Oxidized starch dispersion (25% solids 160 lbs. dry starch) -----	lbs.	640
	Calcium chloride -----	lbs.	80
	Clay -----	lbs.	800
	Calcium carbonate -----	lbs.	200
70	Soda ash -----	lbs.	1
	Sodium metaphosphate -----	lbs.	4
	Pine oil -----	pt.	1
	Soap solution (10%) -----	gals.	5
75	Water -----	gals.	35

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EXAMPLE II

Enzyme converted starch coating

Starch	lbs.	600
Amylolytic enzyme	grams	180
Clay	lbs.	1900
Titanium dioxide	lbs.	100
Sodium silicate	lbs.	20
Tetrasodium pyrophosphate	lbs.	4
Water	lbs.	2000
Alum or soda ash to adjust pH to 7.2-7.7 before cooking.		

EXAMPLE III

Casein coating

Casein solution ¹	gals.	120
Calcium carbonate	lbs.	200
Clay	lbs.	1400
Trisodium phosphate	lbs.	50
Water	gals.	110

¹ The casein solution had the following composition:

Casein	lbs.	200
Borax	lbs.	20
Ammonia (28%)	qts.	2
Water to make total volume 120 gals.		

EXAMPLE IV

Soy protein coating

Isolated soy protein (low viscosity)	lbs.	80
Coating clay	lbs.	80
Ammonia (26° Be.)	lbs.	11.2
Formaldehyde donor (Hexamine)	lbs.	3.2
Defoamer	lbs.	.08
Lubricant (50% dispersion)	lbs.	2.4
Water to make total volume of 60 gals.		

These coating compositions may be applied to one side of a paper sheet by the usual paper-mill coating technique in the production of the photosensitive copy paper illustrated by FIG. 1, or to both sides of the sheet in the production of the photosensitive copy paper illustrated by FIG. 2. Thus, they may be applied on the paper machine or in a separate coating operation. The weight of coating applied to form either the layer 3 of FIG. 1, or the films 3 and 4 of FIG. 2, will fall within the range of about 3 bs. to about 12 lbs. per ream of 3000 square feet. The coating is preferably calendered, or even supercalendered, to give it a smooth surface. Alternatively, it may be applied by one of the casting techniques which produces a very smooth surface.

The photosensitive coating 2 of both FIGS. 1 and 2 consists of a powdered photoconductor dispersed in an insulating matrix of a film-forming material such as, for example, silicone resin, polyvinyl chloride resin, polyethylene, phenolic resins, polyester resin, methacrylate resin, polystyrene resin, styrenated alkyl resin, and vinylacetate-vinylchloride copolymer resin.

The powdered inorganic photoconductor used in the photosensitive coating 2 may be almost any photoconductor having a sufficiently high value of photoconductivity. For example, the photoconductive oxides, sulphides, selenides, tellurides and iodides of cadmium, mercury, antimony, bismuth, thallium, molybdenum, aluminum, lead and zinc may be used. Also, arsenic trisulfide, cadmium arsenide, lead chromate and selenium are useful for this purpose. Mixtures of two or more photoconductors may be used.

The powdered inorganic photoconductor which is particularly suitable for use in this film is zinc oxide. A satisfactory zinc oxide for this purpose is that sold under the trade name of "Florence Green Seal No. 8." This zinc oxide meets both ASTM specification D79-

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44 and Federal specification TT-Z301, and has the following analysis:

	Percent
Insoluble in HCl	maximum-- 103
Loss at 110° C.	do-- .25
Total sulfur as SO ₃	do-- .04
Lead oxide (PbO)	do-- .01
Total zinc oxide as ZnO	minimum-- 99.5

The amount of the photoconductor which is included in the film 2 will depend upon its specific gravity and can be varied over a relatively wide range. In the case of zinc oxide, about 1 part, by weight, of the film-forming insulating matrix may be used with an amount of zinc oxide within the range of about 2.6 parts, by weight, to about 10.0 parts, by weight, and we prefer to use about 1 part, by weight, of the film-forming material with an amount of zinc oxide within the range of about 2.8 parts, by weight, to about 7.0 parts, by weight.

The examples which follow specifically illustrate coating compositions which are suitable for the deposition of the photosensitive coatings 2 of the embodiments of this invention illustrated by FIGS. 1 and 2. It will be understood that the compositions of the photosensitive coatings deposited by these various compositions are identical with the composition of the non-volatile components therein, i.e., all of the ingredients except the volatile solvent or solvents in the composition.

EXAMPLE V

	Parts by weight
Silicone resin solution (G.E.-SR-82)	26
Zinc oxide (Florence Green Seal No. 8)	39
Toluene	35
Total	100

EXAMPLE VI

	Parts by weight
Silicone resin solution (G.E.-SR-82)	17
Zinc oxide (Florence Green Seal No. 8)	50
Toluene	33
Total	100

The silicone resin solution used in this composition contained 60% solids, by weight, and 40%, by weight, of xylene. The solution had a viscosity within the range of about 5 to 30 centipoises at 25° C. and was straw in color.

EXAMPLE VII

	Parts by weight
Copolymer of n-butyl methacrylate and iso-butyl methacrylate (Lucite 46)	12.25
Zinc oxide (Florence Green Seal No. 8)	43.
Toluene	56.25
Total	111.5

EXAMPLE VIII

	Parts by weight
Copolymer of n-butyl methacrylate and iso-butyl methacrylate (Lucite 46)	10
Zinc oxide (Florence Green Seal No. 8)	50
Toluene	40
Total	100

The copolymer of n-butyl methacrylate and iso-butyl methacrylate used in this composition was prepared by the use of equal parts, by weight, of the two monomers and has a density of 1.05 and a refractive index at 25° C. of 1.4778.

EXAMPLE IX

	Parts by weight
Polymerized iso-butyl methacrylate (Lucite 45) --	12.25
Zinc oxide (Florence Green Seal No. 8) -----	43.
Toluene -----	56.25
Total -----	111.5

EXAMPLE X

	Parts by weight
Polymerized iso-butyl methacrylate (Lucite 45) --	12.25
Zinc oxide (Florence Green Seal No. 8) -----	73.50
Toluene -----	85.75
Total -----	171.50

The polymerized iso-butyl methacrylate used in this composition had a density of 1.05, a refractive index of 1.477 and a dielectric constant of 2.5.

EXAMPLE XI

	Parts by weight
Styrene butadiene copolymer (Pliolite S5B) -----	10.
Zinc oxide (Florence Green Seal No. 8) -----	34.
Toluene -----	71.5
Total -----	115.5

EXAMPLE XII

	Parts by weight
Styrene butadiene copolymer (Pliolite S5B) -----	10
Zinc oxide (Florence Green Seal No. 8) -----	54
Toluene -----	64
Total -----	128

The styrene-butadiene copolymer used in this composition was high in styrene, had a softening point of $50^{\circ}\text{C} \pm 3^{\circ}\text{C}$., a solution viscosity within the range of about 160 to about 195 seconds as measured by a No. 4 Ford Cup on an xylene solution containing 33 $\frac{1}{3}$ %, by weight, of the resin, a specific gravity of 1.05, a refractive index of 1.585, a specific resistivity of approximately 10^{16} ohm-cm., and a dielectric constant of 2.56 at 1000 cycles.

EXAMPLE XIII

	Percent by wt.
Styrenated alkyd copolymer solution (Cycopol S-101-1) -----	24.0
Zinc oxide (Florence Green Seal No. 8) -----	42.5
Xylene -----	33.5
Total -----	100.0

The styrenated alkyd copolymer resin solution used in this composition contained $50\% \pm 1\%$, by weight, of solids dissolved in petroleum spirits. The solution had a color of 7.0 (Gardner 1933), a viscosity at 25°C . of 22 and weighed 7.6 lbs. per gallon. The solid resin had an acid number of 5.

The photosensitive coatings 2, illustrated by FIGS. 1 and 2, may be applied by the use of any of the various types of paper coating machines adapted to handle organic solvent coatings. The dry weight of the coating applied will ordinarily fall within the range of about 10 lbs. to about 45 lbs. per ream of 3000 square feet. It will ordinarily have a thickness within the range of about 0.3 mil to about 1.0 mil after solvent removal.

Images may be reproduced on the photosensitive sheets in accordance with this invention in the same manner that images have been reproduced on the prior art paper-base photosensitive sheets, either by a process using dry toning or liquid toning. The sheets are entirely suitable for use in a process in which dry toning is used, and are particularly advantageous in a liquid toning process.

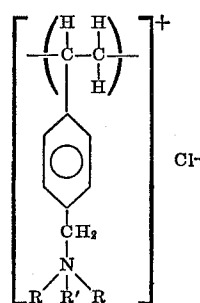
In the foregoing, details and specific illustrations of compositions suitable for use in the production of the photosensitive copy paper in accordance with this inven-

tion have been given for the purpose of fully explaining the invention. However, it will be understood that many variations can be made in the details which have been given, without departing from the spirit of the invention or the scope of the following claims.

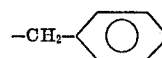
What we claim is:

1. A photosensitive paper sheet adapted for use in an electrophotographic process which utilizes a liquid toner to produce a visible image, one surface of said sheet having a coating thereon of a photoconductive, finely-divided, inorganic pigment dispersed throughout a matrix of a film-forming, electrically insulating material which bonds the photoconductive inorganic pigment to said surface, the other surface of said sheet having a barrier coating thereon of a film-forming material which is capable of deposition from an aqueous medium and which is relatively impervious to volatile organic solvents selected from the class consisting of aliphatic hydrocarbons, aromatic hydrocarbons and halogen-substituted aliphatic hydrocarbons.

2. A photosensitive paper sheet as claimed in claim 1 wherein the coating on one surface of said sheet has a dry weight of from about 10 pounds to about 45 pounds per ream of 3000 square feet of paper and comprises finely-divided photoconductive zinc oxide dispersed throughout the matrix of the film-forming, electrically insulating material which bonds said photoconductive, zinc oxide to the surface of said sheet, said film-forming, electrically insulating material being selected from the class consisting of silicone resins, polyvinyl chloride resins, polyethylene, phenolic resins, polyester resins, methacrylate resins, polystyrene resins, styrenated alkyd resins, vinylacetate-vinylchloride copolymer resins and styrene-butadiene copolymer resins, said photoconductive zinc oxide being present in said coating in an amount of from about 2.6 to about 10 parts by weight per 1 part by weight of said film-forming, electrically insulating material; and wherein the barrier coating on the other surface of said sheet has a weight of from about 3 pounds to about 12 pounds per ream of 3000 square feet of paper and comprises a film-forming material selected from the class consisting of casein, soy protein, starch, oxidized starch, locust bean gum, polyacrylamide, a butadiene-styrene latex, and a polymeric resin containing units of the formula:



wherein R is a lower alkyl group and R' is a lower alkyl group or group having the formula



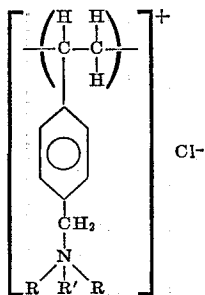
3. A photosensitive paper sheet as claimed in claim 2 wherein the barrier coating comprises as an additional component at least one pigment selected from the class consisting of barium sulfate, calcium carbonate, calcium sulfate, clay and satin white, said pigment being present

in an amount of from about 0.1 part by weight per part of a film-forming material in said barrier coating to about 10 parts by weight per part of the film-forming material in said barrier coating.

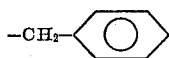
4. A photosensitive paper sheet as claimed in claim 3 wherein the paper sheet and the barrier coating thereon are impregnated with an electrically conductive material selected from the class consisting of inorganic salts, conductive organic compounds and conductive pigments.

5. A photosensitive paper sheet adapted for use in an electrophotographic process which utilizes a liquid toner to produce a visible image, each surface of said sheet having a barrier coating thereon of a film-forming material which is capable of deposition from an aqueous medium and which is relatively impervious to volatile organic solvents selected from the class consisting of aliphatic hydrocarbons, aromatic hydrocarbons and halogen-substituted aliphatic hydrocarbons, one of the surfaces of said sheet having an additional exterior coating thereon of a photoconductive, finely-divided, inorganic pigment dispersed throughout a matrix of a film-forming, electrically insulating material which bonds the photoconductive, inorganic pigment to the intermediate barrier coating.

6. A photosensitive paper sheet as claimed in claim 5 wherein each of the barrier coatings has a weight of from about 3 pounds to about 12 pounds per ream of 3000 square feet of paper and comprises a film-forming material selected from the class consisting of casein, soy protein, starch, oxidized starch, locust bean gum, polyacrylamide, a butadiene-styrene latex, and a polymeric resin containing units of the formula:



wherein R is a lower alkyl group and R' is a lower alkyl group or group having the formula



and wherein the additional exterior coating has a dry

weight of from about 10 pounds to about 45 pounds per ream of 3000 square feet of paper and comprises finely-divided photoconductive zinc oxide dispersed throughout the matrix of the film-forming, electrically insulating material which bonds said photoconductive zinc oxide to the intermediate barrier coating, said film-forming, electrically insulating material being selected from the class consisting of silicone resins, polyvinyl chloride resins, polyethylene, phenolic resins, polyester resins, methacrylate resins, polystyrene resins, styrenated alkyd resins, vinylacetate-vinylchloride copolymer resins and styrene-butadiene copolymer resins, said photoconductive zinc oxide being present in said coating in an amount of from about 2.6 to about 10 parts by weight per 1 part by weight of said film-forming, electrically insulating material.

7. A photosensitive sheet as claimed in claim 6 wherein at least one of the barrier coatings comprises as an additional component at least one pigment selected from the class consisting of barium sulfate calcium carbonate, calcium sulfate, clay and satin white, said pigment being present in an amount of from about 0.1 part by weight per part of a film-forming material in said barrier coating to about 10 parts by weight per part of the film-forming material in said barrier coating.

8. A photosensitive paper sheet as claimed in claim 7 wherein the paper sheet and the barrier coatings thereon are impregnated with an electrically conductive material selected from the class consisting of inorganic salts, conductive organic compounds and conductive pigments.

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