

1

3,595,650

PHOTOCONDUCTIVE COATING COMPOSITIONS, REPRODUCTION MATERIALS MADE THEREWITH, AND REPRODUCTION PROCESSES

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No Drawing. Filed Jan. 13, 1967, Ser. No. 608,992

Int. Cl. G03g 5/08, 13/22

U.S. Cl. 96—1.8

21 Claims

ABSTRACT OF THE DISCLOSURE

Electrophotographic coating compositions and coated substrates comprising a metallic oxide (e.g., zinc oxide) are prepared with an oil modified polycarboxy-polyol binder resin. The binder resin for dry development should have an acid value of 5-50, a hydroxyl value of 33-133 and a cure rate of 50-110 seconds at 200° C., and for liquid development an acid value of 5-50, a maximum hydroxyl value of 66 and a cure rate of 5 to 40 seconds at 200° C.

Electrophotography is a recent development now being used in the office and industrial copying fields. The process makes use of the unique properties of zinc oxide particles, which when coated on paper, can be made sensitive to light. Basically, electrophotographic paper coatings consist of zinc oxide dispersed in a suitable binder.

The electrophotographic copying process involves several steps: the coated paper is made light sensitive by depositing an electrostatic charge on the surface; exposure to light produces a latent image on the paper; the electrostatic charge is removed where illuminated and retained in the dark areas; a pigmented toner is carried across the surface and is attracted to the charged areas, thus forming a visible image; this image is then fixed to form a permanent copy of the original.

The paper coating is a special zinc oxide dispersed in a non-conductive binder. One necessary property of the binder is to have sufficient dielectric strength to allow an electrostatic charge of several hundred volts to be accepted by the paper coating. The binder must not interfere with the electrostatic and photosensitive properties of zinc oxide.

The coated paper is not sensitive to light until charged. After it is charged by placing a uniform electronegative charge on the surface by means of a high voltage corona, the original of a printed sheet to be copied is exposed to white light in the visible range in such a way that the light is projected or reflected onto the surface of the coated paper. The original electrostatic charge on the coating is dissipated in the exposed areas and retained in the shadowed areas, thus forming a latent electrical image on the paper.

The development of the latent electrostatic image is accomplished by applying a pigmented toner that carries a positive charge. This toner is attracted and held by the negatively charged image areas. Currently there are two types of toners—wet and dry. The dry toner consists of, for example, a mixture of iron filings and finely divided, pigmented, low softening-point resin. This mixture is cascaded over the paper and attracted to the charged areas. The liquid toner is made up of a finely divided, pigmented toner suspended in a low kauri butanol value aliphatic solvent. The copy paper is passed through this liquid and picks up toner at the charged areas.

Two methods are utilized to fix the image to the paper permanently. With the dry toner system the image is fixed by heat, which fuses the toner to the coating and the iron

2

filings fall away. Fixing the image in the wet toner system is accomplished by solvent evaporation.

There are currently machines on the market that use both wet and dry toners. Multi-color copying may be conducted by recharging the coating for each new color and utilizing the proper color of toner. A current use of this technique is in map copying.

In the formulation of a satisfactory electrophotographic paper coating there are certain performance characteristics to be considered. The coating must accept a high electrostatic charge and retain this charge in the dark for intervals up to 30 seconds. When exposed to light, the coating should dissipate the charge very rapidly—0.5 to 1.0 second approximately, but dependent on the light intensity. Finally, it must retain little, or none, of this charge after exposure. These characteristics are termed charge acceptance, dark decay, light decay, and residual voltage. They are primarily influenced by the binder system of the paper coating.

Electrophotographic paper coatings are formulated using three main ingredients, namely, zinc oxide, binder, sensitizing dyes. The basic portion of the coating is French Process zinc oxide because of its electrostatic and photoconductive properties. Three kinds of zinc oxide are in current use—AZO ZZZ661 from American Zinc, Green Seal 8 and Photox 801 from New Jersey Zinc.

An ideal binder system, for carrying zinc oxide is one which allows a charge of 300 to 600 volts to be accepted, retains 85% to 90% of this charge for a 30 second interval of darkness, dissipates all, or practically all, of the remaining charge 0.5 to 1.0 second after exposure to light. An acceptable residual voltage would be 25 to 50 volts.

Dyes and sensitizers must be added to electrophotographic paper coatings to increase the spectral response of the zinc oxide. This is necessary because zinc oxide responds only to light in the violet and ultra-violet range of 3400 to 4200 angstroms. Dyes, however, broaden the coverage to the visible range—3800 to 7800 Å. This increase in response enables the coating to reproduce all tones and colors, therefore, matching the response of the human eye. Some of the commonly used dyes for increasing spectral response include Eosin Y, Methylene Blue, Fluoroscein, Acridine Orange, Methyl Green and Bromophenol Blue.

During the formulation of these paper coatings, the ratio of zinc oxide to binder is usually in the range of 5.5 to 7.5 parts zinc oxide to 1 part binder. The total solids can be varied to match the coating method and use. The volatile portion is usually a single aromatic solvent to permit easy recovery after the paper is coated.

Zinc oxide is dispersed in the vehicle system to a grind fineness of approximately 4 to 7 on the Hegman fineness gauge. Care must be taken to avoid over-dispersion since this will destroy the photographic speed of the zinc oxide.

Paper coating weights for electrophotographic systems are in the range of 20 to 30 pounds dry weight of coating per 3,300 square foot ream. The usual coating methods may be utilized. Care must be taken to obtain smooth and uniform coverage. This insures that a uniform electrostatic charge can be applied to the paper before exposing. If the coating is rough the charge will "bleed off," or discharge, from the high spots and give a poor copy.

The paper or other substrate should preferably be electrically conductive. Thus, a paper containing an electroconductive vinylbenzene quaternary ammonium compound as disclosed in U.S. Pat. 3,011,918 can be used.

It will be recognized that the binder makes up a substantial part of the electrophotographic coating and therefore exerts a considerable influence on the results obtained. Before the coating composition is applied, the binder should not precipitate from the solvent, nor gel with the zinc oxide. After application, the coating should

be capable of rapid drying without discoloration. When the image is fixed by heat, the binder should withstand the heat without deterioration. When the image is fixed by a liquid, the binder should not be dissolved by such liquid.

One of the objects of the present invention is to provide new and improved electrophotographic coating compositions and coated substrate, especially electrophotographic paper which is particularly adapted for dry development.

A further object is to provide such compositions and coated substrate particularly adapted for liquid development.

Another object is to provide new and improved processes which utilize coating compositions as herein described. Other objects will appear hereinafter.

In accordance with the invention, new and improved electrophotographic coating compositions are prepared containing a metal oxide, for example, zinc oxide, capable of being electrostatically charged and of being discharged subsequently on exposure to light, and as a binder an oil modified polymeric polycarboxy acid-polyol resin. For dry development the binder resin should have an acid value of 5-50, a hydroxyl value of 33 to 133 and a cure rate in the range of 50-110 seconds at 200° C. For liquid development the binder resin should have an acid value in the range of 5-50, a hydroxyl value not exceeding a maximum of 66, and a cure rate of 5-40 seconds at 200° C.

The compositions should preferably contain sensitizers of the type previously mentioned, i.e., sensitizing dyes such as, for example, Rose Bengal, Methylene Blue, Fluorosecin, Bromophenol Blue, Eosin Y, Methyl Green and Acridine Orange. In order to apply the composition as a liquid coating to a suitable substrate, it should contain a volatilizable solvent for the resin, preferably a liquid hydrocarbon, e.g., toluene, orthoxylene, metaxylene, paraxylene, and mixed xylenes, including petroleum xylenes. In the following discussion reference will be made to zinc oxide because it is currently used but it will be understood that the binder herein described can be employed with other water insoluble finely divided solids having the required electrical, physical, and light sensitive properties. Those skilled in the art will recognize that the binder solution should normally be electrically non-conductive and hence it is desirable to dissolve the binder in solvents which are non-conductive.

The ratio of zinc oxide to resinous binder is preferably within the broad range of 4:1 to 9:1, a more specific range being 5.5:1 to 7.5:1.

The polymeric polyesters of the invention are preferably prepared by reacting an organic polycarboxy acid or anhydride, for example, phthalic anhydride, with an organic polyol and an unsaturated oil to form a polymeric ester. This reaction can be carried out in the presence of an alcoholysis catalyst, e.g., litharge, sodium hydroxide, lithium hydroxide or calcium hydroxide.

As examples of polycarboxy acids which can be employed in preparing the initial polymeric polyesters, the following may be mentioned: o-phthalic or its anhydride, isophthalic, tetrahydrophthalic and its anhydride, hexahydrophthalic and its anhydride, endomethylene tetrahydrophthalic and its anhydride, and mixtures of these acids and/or anhydrides. Obviously, the methyl esters of the polycarboxy acids, e.g., dimethylphthalate or terephthalic acid methyl ester, could be utilized in the practice of this invention by means of reacting by transesterification versus the normal esterification route. The preferred material is phthalic anhydride.

Optionally, the binder resin can also contain a monocarboxylic acid or acids, preferably benzoic acid.

Examples of polyols applicable to the compositions of the invention are: dipentaerythritol; glycerine; 1,2,6-hexanetriol; pentaerythritol; sorbitol; hydrogenated sugars; trimethylol ethane; trimethylol propane and various ethoxylated and propoxylated triols and tetrols. Trimethylolethane and blends of trimethylolethane with other triols

and tetrols are preferred for the preparation of the compositions of the present invention.

Examples of unsaturated oil modifiers employed in making the binder resin are: soybean, tung, oilicica, linseed, and dehydrated castor, the fatty acids of these oils, and mixtures of such oils and/or acids with saturated acids and oils (e.g., coconut oil).

In the preferred method of preparation of the binder resin the unsaturated oil is alcoholized with a portion of the polyol and then reacted with the carboxy acid or acids and the remaining polyol at from 325° to 485° F. while blowing an inert gas (e.g., nitrogen or carbon dioxide) through the reaction mixture until the desired cure rate and acid value have been obtained. The vapors are discharged into a recovery system.

The unsaturated oil constitutes 20% to 60% by weight, preferably 20-40% by weight, of the total binder resin.

The dispersion of zinc oxide in the binder resin solution can be prepared as a concentrate and later diluted with more solvent to coating consistency.

The zinc oxide should be of the agglomerated type and preferably should have a fineness of approximately 4 to 7 on the Hegman fineness gauge.

The viscosity of the coating composition at coating consistency is normally within the range of 25 to 200 centipoises (cps.) at 77° F. and preferably within the range of 50 to 150 cps. A typical concentrate will have the following composition:

Ingredients:	Parts by weight
Zinc oxide	300
Binder resin in solvent (50% solids)	100
Toluene	150

In order to produce a coating consistency, the amount of toluene is increased to 200 parts by weight.

The coating composition should also contain a dye sensitizer of the type previously described in order to increase the spectral range. Thus, for every 100 grams of zinc oxide, 4 cc. of 0.5% solution of Rose Bengal in methanol can be employed as a sensitizer. Other sensitizers can be similarly used. The invention does not reside in the type of sensitizer employed.

As previously indicated, the type of resinous binder employed is subject to variation depending upon whether the coated paper is to be used in a wet process or in a dry process. For paper that is to be employed in a dry process, the resinous binder should have an acid value broadly within the range of 5 to 50 but preferably within range of 20 to 25, a hydroxyl value broadly within the range of 33 to 133 but preferably within the range of 33 to 100 and a cure rate broadly within the range of 50 to 110 seconds on a chrome plated hot plate at 200° C. but more specifically within the range of 80 to 90 seconds.

For a coated paper which is to be employed in a wet process copying machine, the resinous binder should have an acid value within the broad range of 5 to 50 but preferably 15 to 20, the maximum hydroxyl value should not exceed 66 and preferably not more than 33, and the cure rate should be within the broad range of 5 to 40 seconds but preferably within the range of 11 to 15 seconds.

When coating compositions of the present invention are applied to paper, aluminum or other substrate, they are preferably dried at 200° F. for one minute.

In order that the concept of the present invention may be more completely understood, the following examples are set forth. These examples are set forth primarily for the purpose of illustration and any specific enumeration of detail contained therein should not be interpreted as a limitation except as is indicated in the claims. The quantities are stated by weight unless otherwise indicated.

EXAMPLE I

This example illustrates the preparation of a binder resin for use in making coating compositions that are

to be employed for coating paper which is to be used in an electrophotographic system in which the toner is applied in a dry state.

The binder resin is prepared by reacting together the following ingredients in the following proportions:

Ingredients:	Parts by weight
Soybean oil -----	34.75
Pentaerythritol -----	16.625
Phthalic anhydride -----	31.00
Benzoic acid -----	13.375
Trimethylolethane -----	4.25
Litharge -----	0.07

The soybean oil is heated to 350° F. in a kettle equipped with an agitator and having an inert gas blanket of carbon dioxide. 11 parts of the pentaerythritol and all of the litharge are added and heating is continued to 440° F. The reaction mixture is held at this temperature until monoglyceride formation occurs. The phthalic anhydride and benzoic acid are then added and the mixture is heated to 375° F. The balance of the pentaerythritol and all of the trimethylolethane are added. The reaction mixture is heated to 380° F. and held for 1½ hours. It is then heated to 470° F. and held for one hour. It is then blown with 0.01 liter/min./100 grams of resin of carbon dioxide for one hour. Thereafter, it is blown with 0.02 liter/min./100 grams of resin of carbon dioxide until the acid value is 20-25 and the cure rate 80-90 seconds. The resultant product is then thinned to 50% by weight non-volatile solids by adding a mixture of equal parts by weight of xylene and varnish makers' and painters' naphtha.

The final characteristics of the product are acid value of resin 20-25 (non-volatile matter), viscosity U-W (Gardner-Holdt), cure 80-90 seconds at 200° C. on a chrome plated hot plate.

EXAMPLE II

This example illustrates the preparation of a binder resin for use in making coating compositions that are to be employed for coating paper which is to be used in an electrophotographic system in which the toner is employed in a liquid or wet state.

The binder resin is prepared by reacting together the following ingredients in the following proportions:

Ingredients:	Parts by weight
Soybean oil -----	34.75
Pentaerythritol -----	14.25
Phthalic anhydride -----	32.00
Benzoic acid -----	13.50
Trimethylolethane -----	5.50
Litharge -----	0.07

The soybean oil is placed in a kettle equipped with agitator and provided with an inert gas blanket of carbon dioxide and heated to 350° F. All of the litharge and 9.25 parts of the pentaerythritol are added and the resultant mixture heated to 440° F. until the monoglyceride is formed. The phthalic anhydride and the benzoic acid are then added and the mixture heated to 375° F. The balance of the pentaerythritol and the trimethylolethane are added and the mixture heated to 380° F. for 1½ hours—then to 470° F. for one hour. The mixture is blown with 0.01 liter/min./100 grams of resin of carbon dioxide for one hour, then with 0.02 liter/min./100 grams of resin of carbon dioxide for one hour, and finally with 0.03 liter/min./100 grams of resin of carbon dioxide until it attains an acid value of 15-20, a cure rate of 11-15 seconds and a viscosity (Gardner-Holdt) of L-M at 50% non-volatile matter in xylene. The resultant resin is then thinned to 50% non-volatile matter by adding a mixture of 50% by weight xylene and

50% by weight varnish makers' and painters' naphtha. The final characteristics are acid value (non-volatile matter) 15-20, viscosity (Gardner-Holdt) X-Z, cure rate 11-15 seconds on a chrome plated hot plate at 200° C.

Evaluation of the invention

Resins of the type described in Examples I and II are mixed with zinc oxide and sensitizers in the manner previously described to form coating compositions which are then applied to paper to form electrophotographically coated paper. The coated paper is tested on standard copying machines, one using a dry developing system and another a liquid developer.

The measurements used to evaluate the coatings are contrast number, initial charge acceptance and machine setting of the best print. The contrast number is a measurement of the black produced compared to the background color or whiteness of the coating. The higher the number, the more the contrast and the better the print. The initial charge acceptance is a measure of the voltage that the coating will accept. The desired range for the dry developer is 300 to 350 volts and for the liquid developer 450 to 500 volts. The machine setting of the best print is a measure of the speed of the coating—the lower the number, the faster the coating.

It was found that the coated paper made with the resins of Example I satisfied all of the requirements for dry developing electrophotographic processes and the coated paper made with the resins of Example II satisfied all of the requirements for liquid developing electrophotographic processes.

Numerous coating compositions were prepared with resins of the type described in which the acid value, hydroxyl value and cure time were varied. In coated paper for dry development it was found that a moderate amount of excess hydroxyl will lower the contrast number, lower the machine setting and reduce the initial charge acceptance. As cure time is increased, all of these values tend to decrease. However, it is better to have a higher cure time, thereby giving a faster speed (lower machine setting), even at the expense of a sacrifice in contrast and charge acceptance. A higher acid value also helps increase the speed of the coating. Again, this will slightly decrease contrast and charge acceptance but will not affect them as much as the cure time.

In coated paper for liquid development, it has been found that variation of excess hydroxyl in the liquid developer coating has no substantial effect on the best print machine setting. Both the contrast and charge acceptance increase as hydroxyl decreases. For this type of coating it is desirable to have as high values as possible and therefore a very low hydroxyl content, preferably not exceeding 33 actual hydroxyl value, is indicated. The acid value of the resin does not seem to have much effect on the contrast of the coating and in high concentrations has the effect of lowering the machine setting and increasing charge acceptance. At higher concentrations, these values become constant and no further benefits can be derived. As the cure time is increased, the charge acceptance, contrast and machine setting decrease. The effect is least noted in machine setting. Hence, if the cure time is kept on the low side, a greater advantage will be realized in high charge acceptance and high contrast.

The results obtained show that the acid value, hydroxyl value and cure time of the binder resin must be controlled within certain limits in order to provide resins that are satisfactory for use in electrophotographic coating compositions and coated substrate containing such compositions.

While the examples give the best mode contemplated for the practice of the invention, it will be understood that

some variations can be made in the binder resins provided they retain the critical properties previously described. For instance, glycols, e.g., ethylene glycol, propylene glycol, and neopentyl glycol, can be substituted in part for the triols and/or tetrols. When this is done, the benzoic acid is usually eliminated or the amount reduced.

The "hydroxyl value" as used herein is equal to the number of milligrams of potassium hydroxide equivalent to the hydroxyl content of one gram of sample.

This is determined as follows:

- (a) Weigh to nearest 0.0001 gram, duplicate samples into 250 ml. Erlenmeyer flasks with standard taper glass joints. Also have ready two additional flasks for duplicate blank determinations.
- (b) Pipette 10.0 ml. of acetic anhydride-pyridine reagent into each flask. Attach air condensers, place in an oil bath heated to about 135° C. and reflux gently for 30 minutes.
- (c) Add 10 ml. of water through the condenser, swirl to bring water in contact with all of the reagent and continue heating for two minutes.
- (d) Cool in an ice bath.
- (e) Rinse condenser and flask with 10.0 ml. of pyridine, add about 6 drops of indicator and titrate with 1 N methanolic KOH.
- (f) If free acid is present, determine the A.V. (acid value).

The percent hydroxyl is calculated as follows:

$$L = \frac{(A.V.) (wt. of sample)}{N \times 56.1}$$

where

L=ml. of KOH used to titrate free acids

N=normality of KOH

$$\text{Percent OH} = \frac{(B + L - S) (N) (1.7)}{\text{Wt. of Sample}}$$

B=ml. of KOH used to titrate blank

S=ml. of KOH used to titrate sample

N=normality of KOH

L=ml. of KOH used to titrate free acids

The presence of a considerable amount of water in the sample should be avoided, as it destroys the reagent by hydrolyzing it to acetic acid and prevents complete acetylation of the OH.

The reagents used are:

- (a) acetic anhydride-pyridine add 0.3 ml. of water to 90 ml. of reagent grade pyridine. After mixing add 30 ml. of reagent grade acetic anhydride. Reagent should be prepared fresh each day.
- (b) approximately 1.0 N KOH in methyl alcohol which has been accurately standardized against potassium acid phthalate.
- (c) phenolphthalein indicator (1%). Dissolve 1 gm. of phenolphthalein in 50 ml. of pyridine and dilute with 50 ml. of water.

The hydroxyl value is calculated as follows:

$$\text{OH value} = \frac{\text{Percent OH} \times 56,100}{1700}$$

The invention is hereby claimed as follows:

1. An electrophotographic coating composition comprising a photoconductive metal oxide and a binder resin dispersed in an organic solvent, said binder resin consisting essentially of an unsaturated oil modified polymeric polycarboxy acid-polyol resin having an acid value of 5-50, an unsaturated oil content of 20% to 60% by weight and further characterized by properties from the group consisting of (a) a hydroxyl value of 33 to 133 coupled with a cure rate of 50-110 seconds at 200° C. and (b) a hydroxyl value not exceeding 66 coupled with a cure rate of 5-40 seconds at 200° C., said unsaturated oil modifier being from the class consisting of soybean,

tung, oiticica, linseed, and dehydrated castor, the fatty acids of these oils, and mixtures of such oils and/or acids with saturated acids and oils.

2. A composition as claimed in claim 1 for electrophotographic dry development in which said resin has the properties (a).

3. A composition as claimed in claim 2 for electrophotographic dry development in which the acid value of said resin is within the range of 20-25, the hydroxyl value is within the range of 33 to 100 and the cure rate is within the range of 80-90 seconds on a chrome plated hot plate at 200° C.

4. A composition as claimed in claim 1 for electrophotographic liquid development in which said resin has the properties (b).

5. A composition as claimed in claim 4 for electrophotographic liquid development in which the acid value of said resin is within the range of 15 to 20, the maximum hydroxyl value does not exceed 33 and the cure rate is within the range of 11 to 15 seconds.

6. A composition as claimed in claim 1 in which said unsaturated oil constitutes 20-40% by weight of said resin.

7. An electrophotographic coating composition as claimed in claim 1 comprising a sensitizer adapted to increase the spectral response of said metal oxide.

8. A composition as claimed in claim 1 in which said metal oxide is zinc oxide.

9. A composition as claimed in claim 8 in which the ratio of zinc oxide to said resin is within the range of 4:1 to 9:1.

10. A composition as claimed in claim 8 in which the ratio of zinc oxide to said resin is within the range of 5.5:1 to 7.5:1.

11. A coating composition as claimed in claim 1 in which said resin is the reaction product of soybean oil, pentaerythritol, phthalic anhydride, benzoic acid and trimethylolethane.

12. An electrophotographic member comprising a substrate and a coating thereon comprising a photoconductive metal oxide dispersed in a binder, wherein the binder consists essentially of an oil modified polymeric polycarboxy acid-polyol resin as claimed in claim 1.

13. An electrophotographic paper for dry development comprising paper and a coating thereon comprising photoconductive zinc oxide dispersed in a binder wherein the binder consists essentially of a resin as claimed in claim 2.

14. An electrophotographic paper for dry development comprising paper and a coating thereon comprising photoconductive zinc oxide dispersed in a binder wherein the binder consists essentially of a resin as claimed in claim 3.

15. An electrophotographic paper for liquid development comprising paper and a coating thereon comprising photoconductive zinc oxide dispersed in a binder wherein the binder consists essentially of a resin as claimed in claim 4.

16. An electrophotographic paper for liquid development comprising paper and a coating thereon comprising photoconductive zinc oxide dispersed in a binder wherein the binder consists essentially of a resin as claimed in claim 5.

17. In an electrophotographic copying process wherein a photoconductive metal oxide dispersed in a binder is coated on a substrate, an object to be copied is exposed to white light in the visible range in such a way that the light is projected or reflected onto the surface of said coating, thereby dissipating the charge in the exposed areas and retaining it in the shaded areas, a pigmented toner is carried across the surface of said coating so that it is attracted to the charged areas, thereby forming a visible image and said image is fixed, the improvement which comprises using as the binder in the photoconductive coating a binder consisting essentially of a resin as claimed in claim 1.

18. In an electrophotographic copying process wherein a photoconductive zinc oxide dispersed in a binder is

coated on paper, an object to be copied is exposed to white light in the visible range in such a way that the light is projected or reflected onto the surface of said coating, thereby dissipating the charge in the exposed areas and retaining it in the shaded areas, a pigmented toner is carried across the surface of said coating so that it is attracted to the charged areas, thereby forming a visible image and said image is fixed by dry development, the improvement which comprises using as the binder in the photoconductive coating a binder consisting essentially of a resin as claimed in claim 2.

19. A process as claimed in claim 18 in which said resin is the resin claimed in claim 3.

20. In an electrophotographic copying process wherein a photoconductive zinc oxide dispersed in a binder is coated on paper, an object to be copied is exposed to white light in the visible range in such a way that the light is projected or reflected onto the surface of said coating, thereby dissipating the charge in the exposed areas and retaining it in the shaded areas, a pigmented toner is carried across the surface of said coating so that it is attracted to the charged areas, thereby forming a visible image and said image is fixed by liquid development, the improvement which comprises using as the binder in the photoconductive coating a binder consisting essentially of a resin as claimed in claim 3.

21. A process as claimed in claim 20 in which said resin is the resin claimed in claim 5.

References Cited

UNITED STATES PATENTS

2,915,488	12/1959	Kraft et al.	260—22
3,152,895	10/1964	Tinker et al.	96—1.8
3,240,597	3/1966	Fox	96—1.5
3,329,634	7/1967	McWhorter et al.	260—22
3,331,687	7/1967	Kosche	96—1.5
3,345,162	10/1967	McFarlane et al.	96—1.8
3,437,481	4/1969	Graver et al.	96—1.8
3,442,835	5/1969	Curtice et al.	260—22
3,447,957	6/1969	Behringer et al.	96—1.8X
3,102,026	8/1963	Metcalfe et al.	96—1
3,121,006	2/1964	Middleton et al.	96—1.5
3,165,405	1/1965	Hoesterey	96—1
3,192,043	6/1965	Metcalfe et al.	96—1
3,197,307	7/1965	Blake et al.	96—1.8
3,337,340	8/1967	Matkan	96—1

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U.S. Cl. X.R.

96—1, 1.5; 117—17.5, 37, 118; 260—22