United States Patent Office 3,672,982
Patented June 27, 1972

3,672,982

CONDUCTIVE BASE SHEET FOR ELECTROPHOTOGRAPHIC REPRODUCTION SHEET

Frederick W. Travers, Wellesley, Mass., assignor to Dennison Manufacturing Company, Framingham, Mass.

No Drawing. Filed July 29, 1970, Ser. No. 59,035
Int. Cl. G03g 5/00
U.S. Cl. 117—201 15 Claims

ABSTRACT OF THE DISCLOSURE

A conductive base paper sheet for receiving an electrophotographic coating, which sheet has a conductive and/or holdout layer containing a water soluble, conductive, ionizable resin, such as a quaternary ammonium salt polymer, and/or other synthetic resin which is normally tacky, and a water soluble inorganic salt of a strong inorganic mineral acid or a water soluble salt of acetic acid, preferably sodium, potassium and ammonium salts of phosphoric and hydrochloric acid, to detackify the otherwise tacky conductive or other synthetic resin.

THE PROBLEM

The invention relates to a conductive base sheet for receiving an electrophotographic or electrographic coating which comprises a substrate, such as a paper sheet, to which is applied on one or both surfaces, or which is impregnated with, a resinous conductive layer to render the paper conductive.

Conventional base sheets of this type employ in the conductive layer a conductive resin, such as a conductive water-soluble quaternary ammonium salt polymer, by itself, or admixed with a water soluble, non-conductive film forming polymer, such as a protein, starch, casein, a converted or modified starch, polyvinyl alcohol, polyacrylate, polyvinyl pyrrolidone or like polymeric coating material, to better adhere the layer to the base paper, to impart to the conductive layer the properties of a hold-out coating or barrier to prevent the solvent in the electrophotographic composition from bleeding into the paper when such composition is applied, and to form a better and more continuous and cohesive conductive film. Furthermore, this type of sheet in some cases employs a separate non-conductive hold-out layer of a water soluble, polar synthetic resin such as polyvinyl alcohol, polyvinyl pyrrolidone, polyacrylate and polyvinyl ether.

A serious problem with such conductive resins and such synthetic resins is that they are quite tacky, particularly to the touch. Accordingly, this presents a secondary handling problem. It is believed that this tackiness is caused by absorption of moisture, e.g. the moisture on the fingers.

SUMMARY OF INVENTION

This problem is overcome in accordance with the present invention by incorporating in the conductive and/or hold-out layer a water soluble, highly ionizable inorganic salt of a strong mineral acid or a water soluble highly ionizable salt of acetic acid, which is effective to detackify the otherwise tacky conductive resin and/or the otherwise tacky synthetic resin.

Highly preferred salts are the water soluble ammonium, sodium and potassium salts of strong inorganic mineral acids or acetic acid, such salts of inorganic mineral acids being more preferred.

Optimum results are achieved with water soluble ammonium, sodium and potassium salts of a phosphorus-containing acid, preferably a phosphoric acid, and water soluble ammonium, sodium and potassium salts of hydrochloric, sulfuric, nitric and acetic acids. The hydrogen salts of phosphoric acid provide the best results, the dihydrogen salt being preferred. None of these salts are soluble in the solvents used in the electrophotographic coating compositions which are applied to the conductive layer, as, indeed, they should not be.

The ratio of detackifying salt to conductive resin and/or tacky synthetic resin is preferably between 0.4/1 and 4/1, more preferably 0.5/1 and 2.5/1 or 3/1, with optimum results being achieved with a ratio of between 0.75/1 and 2/1.

Preferred ratios of conductive resin to film forming polymers when they are used together to form both a conductive and hold-out coating, are also between 0.5/1 and 3/1.

Most of the conventional conductive polymers are of the amine type such as polyvinyl quaternary ammonium salt, sold by the Dow Chemical Company under the name Dow Resin QX 2611.12 (polyvinyl benzyl trimethyl ammonium chloride) and that sold under the name Calgon 261 by the Calgon Corporation.

It is believed that the inorganic salt detackifies the conductive resin by acting as an ionization suppressant to the conductive resin. Since it is commonly believed that the conductivity of the conductive resin, as well as its tackiness, are due to its ionizability, it is indeed surprising that the addition of inorganic salts in accordance with the invention eliminates the tackiness but not the conductivity of the resin.

The conductive and/or hold-out layers of the invention may contain fillers such as clay, e.g. Buca clay, or silica, or calcium carbonate.

DETAILED DESCRIPTION

Example 1

To one side of a commercial grade of paper suitable for coating, of 0.0022 inch (56 micron) thickness, there is applied, a conductive coating composition made up of 30 parts of a 20% aqueous solution of α-protein, 30 parts of a conductive polymer sold by the Dow Chemical Company under the designation of Dow Conductive Resin QX 2611.12 (polyvinyl benzyl trimethyl ammonium chloride), 30 parts of a 20% aqueous solution of ammonium dihydrogen phosphate ($NH_4H_2PO_4$) and sufficient water to provide a solids (protein plus phosphate plus Dow Resin QX 2611.12) concentration of 22%. The coating composition is applied in an amount equal to two pounds per ream (3000 ft.^{2}) of paper, followed by drying to form a conductive resin-protein-phosphate coating on the paper surface. In making the composition, the protein is dissolved in water with ammonia to solubilize it and the water soluble Dow resin and ammonium dihydrogen phosphate solution are added to the resulting water solution.

To the other side of the paper (having a conventional hold-out coating of protein and polyvinyl acetate applied thereto) is applied a conventional photoconductive layer made up of the following composition: 100 parts zinc oxide (Florence Green Seal No. 8 of the New Jersey Zinc Co.), 37.8 parts of Acryloid B–82 (40%) which is a 40% solution in toluene of an acrylic polymer from Rohm & Haas Company, 1.4 parts poly-alpha methyl styrene sold under the name Resyn 276 V2 by Dow Chemical Company and 1 part of a sensitizing dye solution made up of Eosin O J, Acid Red 87, Calco fluorescin, Acid Yellow 73 and Rom phenol Blue. This coating is applied in an amount equal to twenty-one pounds per ream of paper followed by drying to form a photoconductive coating seven-tenths of a mil thick made up of the zinc oxide particles dispersed in the acrylic-polystyrene resin film.

The exposed conductive coating is not at all tacky

to the touch or otherwise, whereas the same coating applied to the same paper except for omission of the ammonium dihydrogen phosphate is noticeably tacky to the touch.

The electrophotographic sheet provides excellent copies, which are as good in quality as the same sheet except for omission of the ammonium dihydrogen phosphate from the conductive coating.

Example 2

Same as Example 1 except for omission of the α-protein in the conductive coating. The conductive coating is not tacky whereas the same coating without the ammonium dihydrogen phosphate is noticeably tacky.

Example 3

Same as Example 1 except the phosphate is replaced with sodium chloride with the same results.

Example 4

Same as Example 1 except that the Dow Resin is replaced with Calgon 261 and the α-protein is replaced with polyvinyl alcohol. Whereas the conductive coating without the phosphate salt is noticeably tacky the same layer with the phosphate is not at all tacky.

It has been found that clay, talc, calcium carbonate and other mineral pigments, which are sometimes used as fillers in electrophotographic hold-out and conductive coatings, are not effective as detackifiers.

Furthermore, in order to provide significant reduction in tack the ratio of salt to conductive resin should be at least 0.4 to 1.

Any of the conventional film forming resins can be used in the conductive layer of the examples instead of protein and polyvinyl alcohol, such as starch, polyvinyl pyrrolidone, polyvinyl ether and polyacrylate.

Although salts of strong inorganic acids have been dispersed in the interstices of the base paper to render it conductive and have been added to non-conductive film forming protein and the like to provide a conductive coating on the paper, the conductivity being imparted to the coating by the salt, to my knowledge sodium, potassium and ammonium salts of strong inorganic mineral acids or acetic acid have never been used to reduce the tackiness of a conductive resin either by itself, or in a combination with a film forming resin, and have never been used in an amount to eliminate the tack of ionizable and tacky synthetic polymers, such as polyvinyl alcohol, polyvinyl pyrrolidone, polyvinyl ether and polyacrylate used in hold-out coatings. In this respect, good conductivity is achieved with amounts of such salts which are much less than the amounts required to significantly reduce the tack of highly tacky resins.

The detackifying salts of the present invention can be used to provide the same advantage in conductive and hold-out coatings for electrographic reproduction sheets in which, instead of a photoconductive coating, a conventional dielectric resin coating, without photoconductors, is applied to the base sheet to provide a voltage charge image when subjected to a voltage pattern. Electrophotographic and electrographic sheets both fall within the class of reproduction sheets referred to as electrostatic reproduction sheets.

A search of the prior art revealed the following patents:

2,167,711	3,375,121	3,026,281	2,632,742
2,620,316	3,459,593	3,423,342	3,471,625
2,652,345	2,073,666	2,325,302	3,298,831
2,666,718	2,885,306	2,422,423	3,116,147

none of which disclose the use of water soluble sodium, potassium or ammonium salts of strong inorganic mineral acids or acetic acid to reduce the tackiness or otherwise tacky synthetic conductive resins used as coatings in electrophotographic sheets.

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

I claim:

1. A conductive base sheet for receiving an electrostatic coating comprising a substrate to which is applied a conductive resinous layer normally tacky to the touch comprising a normally-tacky-to-the-touch water soluble, ionizable conductive resin and a water soluble inorganic salt of a strong mineral acid or a water soluble salt of acetic acid to reduce the tack of said resinous layer and said resin.

2. A conductive base sheet for receiving an electrophotographic coating comprising a substrate to which is applied a conductive resinous layer normally tacky to the touch comprising a normally-tacky-to-the-touch water soluble, ionizable conductive resin and a water soluble inorganic salt of a strong mineral acid or water soluble salt of acetic acid to reduce the tack of said resinous layer and said resin.

3. A sheet according to claim 2, said salt being selected from the group consisting of ammonium, potassium and sodium salts of strong inorganic mineral acids or acetic acid.

4. A base sheet according to claim 3, said conductive resin comprising a water soluble quaternary ammonium salt polymer and said substrate comprising paper.

5. A base sheet according to claim 4, said inorganic salt being selected from the group consisting of ammonium, sodium and potassium salts of phosphoric acid and hydrochloric acid.

6. A base sheet according to claim 2, said layer also containing a water soluble, non-conductive film forming polymer normally tack to the touch.

7. A conductive base sheet for receiving an electrophotographic coating comprising a substrate to which is applied a conductive layer comprising a conductive resin and a water soluble inorganic salt of a strong mineral acid or a water soluble salt of acetic acid to reduce the tack of said resin, said layer also containing a water soluble, non-conductive film forming polymer, said film forming polymer being selected from the group consisting of protein, starch, polyvinyl alcohol, polyvinyl pyrrolidone, polyvinyl ether and polyacrylate.

8. A base sheet according to claim 3, said salt being ammonium dihydrogen phosphate.

9. A sheet according to claim 3, said salt being sodium chloride.

10. A sheet according to claim 2, the weight ratio of said salt to said conductive resin being at least 0.4 to 1.

11. A sheet according to claim 10, said ratio being between 0.5 to 1 and 3 to 1.

12. A sheet according to claim 10, said layer also containing a film forming polymer normally tacky to the touch, the ratio of said polymer to said conductive resin being between 0.5/1 and 3/1.

13. A conductive base paper for receiving an electrophotographic coating, comprising a paper substrate to which is applied a resinous conductive layer normally tacky to the touch but containing an ammonium salt of phosphoric acid to reduce the tack of said resinous layer.

14. A base paper according to claim 13 also containing a water-soluble, non-conductive, film forming polymer, the amount of said salt being between 40 and 300% by weight of the resin content of said layer.

15. A conductive base paper for receiving an electrophotographic coating, comprising a paper substrate to which is applied a coating containing a water soluble, normally tacky synthetic polymer of the group consisting of polyvinyl alcohol, polyvinyl ether, polyacrylate, polyvinyl pyrrolidone and quaternary ammonium salt polymer, and a salt selected from the group consisting of

sodium, potassium and ammonium salts of phosphoric hydrochloric, sulfuric, nitric and acetic acids, the ratio of salt to tacky polymer being at least 0.4/1.

References Cited

UNITED STATES PATENTS

3,459,593	8/1969	Cole	117—201
3,075,859	1/1963	Relph et al.	117—201
3,385,130	5/1968	Relph	117—201
3,348,970	10/1967	Gess	117—201

RALPH S. KENDALL, Primary Examiner

U.S. Cl. X.R.

96—1 PC; 117—155 R