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HEAT DESENSITIZING OF CONVERTIBLE PLATE

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ABSTRACT OF THE DISCLOSURE

A convertible plate adapted for conversion by electrostatic procedures into a lithographic printing plate, comprising a sheet base formed from a paper web, and a dielectric film extending over the sheet base adapted to receive an image-defining electrostatic charge. The film is degradable by the application of heat. In preparing a printing plate from the convertible plate, the image-defining electrostatic charge is developed, and in nonimage areas the film is densitized by degrading the film with heat. This renders such nonimage areas of the film hydrophilic, or wettable with an aqueous fountain solution, in a lithographic printing process.

This invention relates generally to the preparation of a lithographic printing plate using electrostatic procedures. It more particularly concerns the preparation of such a printing plate where proper hydrophilic properties in nonimage areas of the plate, after developer material has been applied to the plate, are obtained by heating the dielectric film in the plate extending over such areas whereby it breaks down to be rendered hydrophilic.

As is well known in the art, in lithographic printing a plate is prepared with image areas on the surface of the plate rendered oleophilic (such generally being hydrophobic), and with nonimage areas hydrophilic. Such a plate may then be wet with an aqueous fountain solution, which functions to wet the hydrophilic nonimage areas to the exclusion of the image areas. When such a plate is then contacted with an ink roll coated with an oil-base ink, the ink deposits on the oleophilic areas where the image appears exclusively of the other areas, with such ink then being transferable to a paper sheet to produce a final print.

Several procedures have been proposed for preparing an image on a plate to be used in lithographic printing, using electrostatic printing principles. In one type of procedure, referred to herein as electrophotographic imaging, because of its resemblance to an electrophotographic printing process, a sheet including a photoconductive layer is first given a uniform charge over its entire face, in the dark. Then an image-defining electrostatic charge may be formed by exposure of the charged photoconductive layer to light, through a positive image, with the charge being removed in those areas receiving light, and remaining where such is not received, much like a photographic process. In another type of electrostatic process, referred to herein as electrographic imaging because of its resemblance to electrographic printing, an image-defining electrostatic charge is laid directly down upon an insulating or dielectric surface in a sheet, using such electronic devices as a cathode ray tube, a pin matrix and pulsing corona discharge, or by means of a direct image transfer from one surface to another. With either of such electrostatic imaging procedures, after the image-defining charge has been formed on the sheet, the image charge area may be developed using a finely divided developer material, which deposits on the sheet where the charge appears. This developer material is fixed by heating, and is oleophilic. The sheet or plate with the image developed thereon may be employed as the offset master in lithographic printing, providing the sheet either after development or after further processing has proper hydrophilic, oleophilic balance, with areas of the developed image being hydrophobic or oleophilic, and nonimage areas being hydrophilic.

In a more particular sense, the invention concerns the preparation of a lithographic printing plate using an electrographic imaging procedure, where the image defining charge is prepared by laying a charge directly down on an insulating or dielectric surface in the plate. With electrographic imaging, the dielectric film must have high dielectric properties, the film ordinarily being somewhat thinner than the photoconductive film found in plates to be used in electrophotographic imaging, and it is with such highly dielectric films that the invention is particularly applicable.

A problem arises in the selection of the resins used to prepare the dielectric film mentioned, since most, if not all, known resins which are highly dielectric in nature are also hydrophobic, and thus not wettable with an aqueous fountain solution. Desensitizing is thus required, whereby the hydrophilic property desired in the nonimage areas is obtained.

Generally, this invention features a convertible plate, adapted for conversion into a printing plate by an electrographic printing process, where the outer dielectric film, normally hydrophobic in nature, is desensitized in nonimage areas into a film having hydrophilic properties by the application of heat. The heat degrades the film in nonimage areas, to produce the result desired.

An important object of the invention also is to provide a novel process for preparing a lithographic offset master, which features the step of heating nonimage areas in the dielectric film in the plate, to change the characteristic of such nonimage areas from one of which is generally hydrophobic in nature to one which is suitably hydrophilic.

Thus, and considering a specific embodiment of the invention, a plate adapted for conversion into an offset master is contemplated that includes an underlying conductive layer (to dissipate stray electrical charges) surfaced by a dielectric film composed of saran and a catalyst promoting heat degradation of the resin. In developing an image on the plate, a developer may be used which is fixed by the application of heat, and such heat used in fixing the developer may also be employed in producing desensitizing in nonimage areas through heat degradation of the dielectric film.

Various other features and novel objects of the invention will become more fully apparent, as the following description is read in conjunction with certain specified examples, included for the purpose of illustration.

As contemplated by this invention, a convertible plate adapted for conversion into a lithographic printing plate or offset master may be prepared from a paper sheet or web which provides support for various coatings applied thereover. There are no particular requirements for such a web, other than it have sufficient strength to withstand the operations to which the plate is subjected in making from it an offset master, and such other requirements as are dictated by economic reasons, etc. Plates, such as metal plates could be used, although such are more expensive, and are not well suited for use in a disposable type of product.

In manufacturing the convertible plate, it is preferred that first a conductive coating of relatively conductive material be prepared over the paper sheet or web, and over such conductive coating a so-called holdout coating be applied to form what is referred to herein as a sheet base. The conductive coating is advantageous, since such accommodates the dissipation of stray electrical charges in the plate, making it possible ultimately to obtain clearer

prints with less background, etc. The holdout coating is advantageous, in that such provides a covering over the conductive coating (the latter ordinarily being quite thinly spread) which inhibits impregnation of the paper sheet or web by any coating material which is applied subsequently over the holdout coating.

Optimumly, the conductive coating or layer should have a resistance (surface resistivity) lying somewhere within the range of about 10^3 to 10^8 ohms per square. With lower resistances in the conductive layer, change retention problems are introduced, and with greater resistances, stray electrical charges are not sufficiently well dissipated to produce optimum image resolution.

Illustrative of a resinous material useful in the preparation of the conductive coating is a vinylbenzyl quaternary ammonium chloride resin. This is a water soluble resin, with a resistance of about 10^5 ohms, a 50% humidity and room temperature (or 70° F.). The resin is a good one to employ, since it is relatively humidity insensitive, meaning that it retains its conductance at low humidity conditions. Another example of a material useful for the conductive coating is a salt-bridge type of solution, prepared from equal parts of lithium chloride and glycerin, and water. The coating materials are distributed in a suitable liquid vehicle, i.e., dissolved in water in the case of the materials indicated, to produce the consistency desired for the coating process. Ordinarily relatively thin coatings suffice for the conductive layer, and normally spreads of from 0.5 to 2.0 pounds per ream, on a solids basis, are utilized (ream as used herein refers to 3,000 square feet of paper).

With respect to the holdout layer or coating, in general the requirement for the holdout coating is that it resist dissolution by the materials, more particularly the solvent, found in the subsequently applied coating which forms the dielectric film in the completed plate. The holdout coating has no greater and usually insignificant conductivity in relation to the conductivity of the conductive coating. The principal function of the holdout layer is to form an impentrable barrier inhibiting impregnation of the paper sheet or web. Illustrative of coating compositions suitable for use as the holdout coating is one prepared from mineral pigment, such as clay, and starch, in approximately 2 to 1 proportions, dispersed in water to obtain a proper consistency for spreading, with such applied at from 1 to 5 pounds per ream, on a solids basis. As another example, such coating may be prepared from approximately the same proportions of clay and polyvinyl alcohol, suitably disposed in water to obtain required spreading characteristics. With the dielectric film which is prepared over the holdout coating prepared from compositions comprising saran dissolved in an organic solvent, such as toluene, methylethyl ketone, etc., when holdout coatings are prepared and dried from the compositions indicated, such form films resistant to dissolution by such organic solvents, whereby their integrity is maintained during the application of the coating composition which forms the dielectric film.

Considering in more detail the dielectric film and its preparation, the film, after being prepared, preferably should have high dielectric properties, i.e., a resistance (surface resistivity) ranging upwardly from about 10^{10} ohms per square. Such is necessary, to enable any image defining charge prepared on the film to remain without dissipation of the charge, which would result in unclear prints. Where electrographic imaging procedures are contemplated, optimum imaging results have been found to be obtained if the dielectric film is prepared as a coating with spreads ranging from about 5 to 9 pounds per ream. With lower coating weights, marginal density is obtained in any image ultimately produced, and with higher coating weights, print resolution is affected.

According to this invention, the dielectric film may be prepared from saran, which may be polyvinylidene chloride, or more usually a copolymer of vinylidene chloride containing minor proportions of vinyl chloride, acrylonitrile, etc. The film also contains a metal element-containing catalyst, such as a zinc or iron compound, which promotes degradation of the saran film upon the application of heat. This enables the film to be degraded sufficiently in a matter of minutes to become wettable with water. Also preferably included in the dielectric coating composition are minor proportions of resins such as a polymethacrylate (included for the purpose of toughening the ultimate film produced), and a plasticizer, such as a silicone resin. Certain inert materials such as silica, and other mineral pigments, may also be included, to impart nonglossiness to the ultimate product, to inhibit blocking, and to increase the surface area of the dielectric film, whereby heat degradation is further promoted.

Describing the preparation of a convertible plate according to the invention, conventional 38-lb. label base paper was used as the sheet over which various coating compositions were applied to obtain the final plate.

A conductive coating was prepared over this sheet using a coating composition comprising 100 parts Dow QX 2611.7 (a 40% solids aqueous solution of vinylbenzyl quaternary ammonium chloride resin), 15 parts borax, and sufficient additional water to lower the percent solids of the coating composition to 27% by weight. The borax was included to form a gel on the inner face of the holdout coating subsequently applied over the conductive coating, with such gel inhibiting impregnation of the paper web by the holdout coating. Direct steam was used to dissolve the borax. The coating composition was spread at 0.75 pound per ream, on a solids basis. The coating formed had a resistance at 50% humidity and 70° F., of about 10^5 ohms per square.

A holdout coating composition was prepared from 100 parts mineral pigment, i.e., filler clay, 50 parts polyvinyl alcohol, and 600 parts of water. This coating composition was applied over the conductive coating, after the former had dried, with an air knife coater, and with a spread of from 2 to 3 pounds per ream, on a solids basis. Preferably a relatively low viscosity polyvinyl alcohol is employed to promote spreading, and the particular polyvinyl alcohol utilized had a viscosity of below 6 centipoise, at 4% solids, at 70° F.

With the conductive and holdout coatings applied, the sheet base formed was supercalendered, to prepare it for the reception of the dielectric film.

A dielectric film coating composition was prepared comprising 60 parts Dow Saran F220 (a vinylidene chloride-acrylonitrile copolymer), 20 parts polymethylmethacrylate resin, 20 parts Dow DC 840 silicone resin, 20 parts silica aerogel (Monsanto Santocel FRC), 25 parts mineral pigment (zinc oxide New Jersey Green Seal 8), and 0.072 part $FeCl_3 \cdot 6H_2O$. The ferric chloride was dissolved in methylethyl ketone solvent before its addition to the coating composition. The components of the coating composition were dispersed in 350 parts of a mixture of 50% toluene and 50% methylethyl ketone.

In preparing the dielectric film, a spread of the above composition of about 8 pounds per ream was utilized. The dielectric film prepared had a resistance of about 10^{15} ohms per square.

A convertible plate prepared as above had an image-defining charge prepared thereon by an electrographic imaging process, i.e., by laying a charge directly down upon the dielectric film in the plate. This was then developed by sprinkling toner or developer powder over the plate with such powder being attracted to the image defining charge on the plate. The developer powder was conventional, and possessed oleophilic properties and was attractive to greasy inks. Positive toners useful in the development of such plates are discussed in U.S. Pat. 3,107,169, to Bornarth, entitled, "The Process of Producing Lithographic Electrostatic Printing Plates."

With the toner distributed, such was then fixed to the dielectric film by placing the plate in an oven and heating the plate to cure the resin. Heating was continued for

about one and one-half minutes, at about 350° F. The heating not only fixed the resin toner to produce areas of developed image, but also was effective to desensitize the dielectric film in nonimage areas, whereby the film in such areas became hydrophilic and easily wet with water. The degradation of the resin produced by heating was further evidenced by a browning of the paper sheet on its coated side.

Prints were prepared from an offset master so produced using conventional lithographic printing techniques, wherein an aqueous fountain solution is first applied over the plate surface which wets the nonimage areas leaving unwetted the oleophilic image areas. After application of the fountain solution, an ink roll coated with an oil-base printing ink was passed over the plate. Ink adhered to the image areas exclusively of the nonimage areas, and this ink was then transferred to a rubber blanket which transferred the ink to the final paper sheet. Two hundred printed copies were obtained in this manner, with good results.

It will be noted that both zinc oxide and ferric chloride were in the dielectric film coating composition set forth. Both materials were effective in catalyzing the degradation of the polymeric vinylidene chloride resin. Reduced amounts of such constituents may be employed, and one may be used exclusively of the other, with desensitizing with heat being still possible. With too great a reduction in the amount of catalyst present, the heating period required for desensitizing becomes somewhat long. In general, to obtain a convenient desensitizing period, and when employing at least one of the catalyst materials set forth exclusively of the other, its concentration preferably should not be reduced more than about 80% from the concentration indicated. Other iron compounds that are usable comprise such salts as ferric sulfate and ferric phosphate. Large amounts of zinc oxide should be avoided, as such tends to reduce the dielectric strength of the dielectric film. In general terms, it is preferable to maintain any zinc oxide concentration in the coating composition at a level not exceeding about the concentration of the polymeric vinylidene chloride resin. With ferric chloride addition greater than about 0.75% of the polymeric vinylidene chloride resin, yellow staining of the paper was noted.

The methacrylate resin, which was added for softening characteristics, and to produce toughness, should not exceed in quantity the amount of polymeric vinylidene resin present. With a greater proportion of methacrylate resin, it becomes more difficult to degrade the dielectric film with heat.

Silicone additions beyond about 40% of the amount of the polymeric vinylidene resin present did not show any additional benefits. With the silicone increased to approximately the proportion of the saran resin, some intolerance of the silicone by the resin was noted. Silicone, of course, may be eliminated, but the inclusion of some silicone is preferred as a plasticizer.

Where silica aerogel is included in the dielectric film coating composition, the amount of such should not exceed about 50% by weight the amount of saran resin. This is because an excessive amount of silica tends to render the ultimate dielectric film produced somewhat crumbly, which is disadvantageous in a sheet product subjected to handling.

It will be noted that this invention contemplates a novel procedure for desensitizing nonimage areas, whereby such areas are rendered hydrophilic and thus wettable with the usual aqueous fountain solution. The process is extremely simple, and requires no solutions or complicated desensitizing procedures utilizing added chemical reactants.

While particular and preferred embodiments of the invention have been described, obviously variations and changes are possible without departing from the invention.

It is desired, therefore, to cover all such modifications as would be apparent to one skilled in the art, and that come within the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A process for preparing a lithographic offset master from a convertible plate comprising a relatively conductive sheet base and a saran resin dielectric film extending over such sheet base with such resin selected from the group consisting of polyvinylidene chloride homopolymers and copolymers, such film including a metal element-containing compound operable to catalyze degradation of the film with the application of heat said compound being selected from the group consisting of zinc oxide, iron salts, and mixtures thereof, the process comprising depositing an image-defining electrostatic charge on the dielectric film, developing said image-defining charge with a hydrophobic developer material which covers and fixes to the dielectric film in areas where the image-defining charge is located to produce areas of developed image interspersed with nonimage areas, and heat degrading nonimage areas of the film as evidenced by discoloring thereof to render said nonimage areas hydrophilic and wettable with an aqueous fountain solution in a lithographic printing process.

2. The method of claim 1 wherein said dielectric film has silica aerogel distributed therein with such increasing the surface area of the film whereby the heat degrading step rendering the film hydrophilic is promoted.

3. In the preparation of a lithographic offset master from a plate which includes a saran resin dielectric film extending over a relatively conductive sheet base, the plate having an image-defining electrostatic charge deposited on such film, the saran resin of the film being selected from the group consisting of polyvinylidene chloride homopolymers and copolymers, the dielectric film containing a metat element-containing compound operable to catalize degradation of the film with the application of heat said compound being selected from the group consisting of zinc oxide, iron salts, and mixtures thereof, the improvement comprising developing the plate by applying a hydrophobic developer material which covers and fixes to the dielectric film in the region of the electrostatic charge to produce areas of developed image interspersed with nonimage areas, and heat degrading nonimage areas of the film as evidenced by discoloring thereof thereby to render said nonimage areas hydrophilic and wettable with an aqueous fountain solution in a lithographic printing process.

4. The process of claim 1, wherein the image charge areas are developed by distributing a heat fixable developer material over the image charge areas which is attracted to said areas exclusively of nonimage areas on the dielectric film, and the plate is heated simultaneously to fix the developer material in said image charge areas and to degrade the dielectric film in said nonimage charge areas.

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