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METHOD OF PREPARING A LITHOGRAPHIC PRINTING PLATE

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9 Claims. (Cl. 96—1)

This invention relates to xerography and in particular to a xerographic method for preparing lithographic printing plates.

Lithographic printing, which is a type of planographic printing is a well-known and established art. In general, the process involves printing from a flat (hence the term "planographic") plate depending upon different properties of the image and non-image areas for printability. In lithography the non-image areas are hydrophilic while the image areas are hydrophobic. In the lithographic printing process, a fountain solution is applied to the plate surface which wets all portions of the surface not covered by the hydrophobic image. This solution keeps the plate moist and prevents it from scumming up. An ink roll coated with a grease-based printing ink contacts the image surface depositing the lithographic ink only on the image area—the hydrophilic non-image areas repelling the ink. The ink image may then be transferred directly to a paper sheet or other receptive surface but generally is transferred to a rubber offset blanket which in turn transfers the print to a final paper sheet. Hence, for each print made during a run, the planographic plate is first dampened with the aqueous fountain solution and then inked with a lithographic ink and finally printed.

The quality obtainable from planographic printing is quite high, approaching that of letter press printing. In addition, planographic plates may be used to obtain runs as long as one hundred thousand prints. However, the methods of placing images on planographic plates is generally a cumbersome and expensive procedure.

A planographic plate comprises either a zinc or aluminum sheet specially treated to make it water-receptive or, for shorter plate runs, comprises a paper base having high wet strength coated with a hydrophilic coating comprising a finely-divided pigment dispersed in a hydrophilic adhesive such as casein. Methods of placing images on such plates comprise typing using a special ribbon, writing on the plate with a grease pencil or utilizing a special photographically sensitized master whereby the image may be formed photographically.

More recently, a novel method known as xerography has come to the fore as a means of applying an image to a lithographic printing plate. The general xerographic process is described in U.S. 2,297,691 to Chester F. Carlson. As there described, the process, in general, comprises placing an electrostatic charge on a xerographic plate, exposing the plate to an image of light and shadow to be reproduced whereby the electrostatic charge is removed in those areas of the plate receiving light, thus producing an electrostatic charge pattern on the plate surface exactly corresponding to the original to be reproduced, contacting the plate bearing the electrostatic image with a finely-divided electroscopic marking material whereby the electrostatically charged marking particles deposit on the plate in image configuration. The powder image may then be transferred to any desirable image support base such as paper or, in the application described herein, to a lithographic plate.

The most generally used method of development in xerography is the cascade development method as described in U.S. 2,618,552 to E. N. Wise. However, other methods of development may be used such as powder cloud development, as described in U.S. 2,725,-304 to Landrigan et al., or magnetic brush development wherein the finely-divided powder particles, called toner, are carried by iron filings (due to electrostatic attraction) which in turn are attracted magnetically by a permanent magnet. By merely brushing the surface of the plate with the clump of filings clinging to the end of the magnet, toner is removed by the electrostatic image which is thus developed or made visible.

The xerographic plate is desirably sensitized by a corona discharge as described in U.S. 2,588,699 to C. F. Carlson. The xerographic plate generally used comprises a film of amorphous selenium on a conductive backing, generally aluminum. Such a plate is relatively expensive but may be used thousands of times without damage. Accordingly, the per-copy cost of the xerographic print is relatively low. However, the extra handling cost involved in, first, developing the powder image on the xerographic plate and then transferring and fixing the image on a suitable lithographic plate and then cleaning the xerographic plate for reuse represents time and therefore cost consuming operations. In addition, the resolution lost in the transfer step inherent in the process together with the necessity of storing and paying for both lithographic and xerographic plates are objectionable. Accordingly, it has long been desired to use the xerographic plate itself as the lithographic plate.

The lithographic plate, as described, consists primarily of a finely-divided pigment dispersed in a hydrophilic adhesive. One type of xerographic plate long known to the art has the same physical structure. Such a plate is described in U.S. 2,663,636 to A. E. Middleton and comprises a photoconductive pigment dispersed in an insulating binder. A well known photoconductive material readily available at low cost is zinc oxide and is described in U.S. 2,169,840 to Lewis et al. Moreover, zinc oxide is a widely used paper coating pigment. Unfortunately, the requirements placed on the adhesives in xerography are diametrically opposed to the needs of the lithographic art.

Most pigments useful in forming binder plates, such as zinc oxide, zinc sulfide, lead oxide, etc., have resistivities which are too low to hold an electrostatic charge in the dark. Accordingly, the insulating properties of the resin used in preparing binder plates are highly critical, particularly when the binder-pigment composition is coated on a paper backing. In general, it has been found that using a hydrophilic resin as the binder in a xerographic plate apparently is sufficient to form a thin surface film of water and consequently lower the surface resistance so that there is considerable lateral leakage of the electrostatic charge. Such a plate is unable to hold an electrostatic image. Although xerographic binder plates have been available for many years, the only resins yet used commercially are silicone resins which are highly hydrophobic. Hence, before a xerographic binder plate can be utilized as a lithographic master, it is essential that the non-image areas of the plate be rendered hydrophilic.

A variety of means of accomplishing this have been investigated. One such method includes treating the non-image areas with a mixture of zinc acetate, water and ethyl alcohol. The throught was that in such a treatment the alcohol would soften or remove the surface film of silicone resin while the hydrophilic zinc acetate would deposit on the exposed zinc oxide to render the surface hydrophilic in a manner analogous to the action of fountain solutions. Attempts to print with a plate so treated have uniformly been unsuccessful, it being seldom possible to obtain printing runs of more than a dozen copies

without the non-image areas inking up. Other methods were investigated, but were also unsuccessful.

As described in my copending application S.N. 646,542, filed on March 18, 1957, of which this application is a continuation-in-part, I have recently discovered processes whereby excellent quality lithographic printing plates suitable for long runs may be prepared directly from a xerographic binder plate.

As described in my copending application, the invention comprises forming a binder plate of a photoconductive insulating oxide or sulfide and in particular of zinc oxide, zinc sulfide, cadmium sulfide, lead oxide, or mixtures or combinations containing these photoconductive pigments either with each other or with other photoconductive pigments such as mercuric sulfide, etc. in any resin having the requisite electrical properties for use in the xerographic process. The resulting pigment-resin mixture is coated on any suitable electrically conductive backing such as paper, aluminum, brass, zinc, etc. A plate so prepared is utilized in the regular xerographic process to form thereon a powder image which is permanently affixed thereto as by heating. The image-bearing xerographic plate is then immersed in a special treating solution for about 30 to 60 seconds, the treating solution comprising an aqueous solution of an acid at least as strong as acetic and hydrophilic anions forming insoluble compounds with ions of the photoconductive pigment. The hydrophilic anions may be added to the solution as a separate water soluble salt or may be provided by the acid itself. Water soluble dichromate or chromate may be added if desired. Plates so prepared have been utilized in printing runs of over 25,000 copies without appreciable deterioration of image quality in any respect.

In the process as described in my copending application, it is believed that the acid in the novel treating solution reacts with the metallic oxide or sulfide of the photoconductive material to liberate ions therefrom. These ions then react with the hydrophilic anions contained in the treating solution to form an insoluble but hydrophilic compound on all exposed surfaces of the photoconductive pigment.

The separate immersion treatment of the xerographic binder plate necessary to render the non-image areas of the plate hydrophilic, results in a limitation on the general commercial utility of the novel process for preparing lithographic plates as described. Thus, the novel treating solutions have a limited shelf life requiring preparation of fresh solution at frequent intervals. I have now discovered a process whereby this limitation has been completely removed from the novel process described in my copending application.

In accordance with the instant invention, the xerographic plate may be treated to render the non-image areas water receptive after the plate has been mounted in the press thus obviating any separate immersion treatment. Further, it has been found possible to carry out the process in such a manner that the treating solution necessary therefor can be stored for an indefinite shelf life. In general, the invention comprises forming an electrostatic image on a xerographic binder plate, developing the electrostatic image with an electroscopic, hydrophobic developer powder and affixing the powder image to the plate as described in my copending application Ser. No. 646,542, then mounting the plate on a lithographic press, immersing an absorbent pad impregnated with a dried organic acid at least as strong as acetic in an aqueous solution of a compound containing hydrophilic anions forming insoluble compounds with ions formed from the photoconductive pigment by the acid, and swabbing the plate with the dampened pad while in place on the press. The pad impregnated with the dried normally solid organic acid has an indefinite shelf life. On saturation with the solution of a water soluble salt having hydrophilic anions forming insoluble compounds with the ions of the photoconductive pigment, the pad is immediately ready for use. The aqueous solutions of the desired water soluble salts also have an indefinite shelf life.

The following examples are presented in illustrations but not in limitation of the invention and it is to be understood that the invention is to be limited only by the appended cliams.

Example 1

A xerographic plate was prepared containing 2.5 parts of zinc oxide to 1 part of a silicone resin obtained from The General Electric Company, under the trade name SR–82. The zinc oxide and silicone, with enough toluene to give suitable grinding viscosity, were ball-milled to obtain uniform dispersion of zinc oxide in the resin solution. Prior to completion of the grinding, an alcoholic solution of rose bengal dye was added to give 0.036 percent dye based on the total weight of the coating. The resin-dye-pigment mixture was then coated on a 0.006-inch thick aluminum sheet and dried for three days. The plate was sensitized using a corona charging unit obtained from The Haloid Company, Rochester, New York, under the trade name XeroX Scorona Unit. The plate was then exposed to a line-copy image and developed using a magnetic brush with finely-divided alcoholized iron carrier and a xerographic toner comprising finely-divided gilsonite. The powder image was fixed to the plate by heating for 90 seconds in an oven at 290° F. The plate so prepared was then fastened to the press cylinder of the lithographic press.

A cotton pad was impregnated with 2.5 percent solution of tartaric acid, wrung out and dried. The pad so prepared contained about 0.4% by weight of solid acids. The acid impregnated cotton pad was wetted with a 0.5% aqueous solution of sodium ferrocyanide. The plate was rubbed lightly with the cotton pad while on the press and then rinsed with water. The plate quality and durability of the plate in the lithographic process (using a commercially available fountain solution and lithographic ink) was fully equivalent to that of plates prepared as in copending application Ser. No. 646,542.

Example 2

Example 1 was repeated excepting that the acid used to impregnate the cotton pad was citric acid. The plate quality and durability of the plate in the lithographic process was fully equivalent to the plate prepared in Example 1.

Example 3

A xerographic plate was obtained from The Haloid Company, Rochester, New York, under the trade name LectroX paper. This plate contains 2.5 parts of zinc oxide to 1 part of silicone resin and 0.036 percent rose bengal dye coated on a paper support. A powder image was placed on the LectroX paper as described in Example 1 and the paper mounted on a lithographic press. The plate was then swabbed with a cotton pad prepared as described in Example 1. Several hundred copies were run off. Plate quality was excellent.

The nature of the absorbent pad is not critical. Thus any absorbent material which is non-reactive under the conditions used, such as cotton, wool, paper, etc. may be used. The material has to be sufficiently absorbent to imbibe the treating solution and should be non-abrasive to the surface of the xerographic plate.

The concentration of acid on the pad is not critical. There should merely be sufficient acid to generate ions when contacted with the protoconductive pigment. Any solid organic acid at least as strong as acetic acid may be used, such as oxalic acid, tartaric acid, tannic acid, citric acid, etc.

In general, for immersing the pad containing the dried organic acid, particularly preferred hydrophilic anions for the treating solution are the water-soluble ferro-

cyanides. In general, the aqueous solutions of these materials used to impregnate the absorbent pads should contain from about 0.1% to about 5.0% by weight of the water-soluble ferrocyanide or ferricyanide. The aqueous solution of the ferrocyanide or ferricyanide, in the absence of acid, has a long shelf life. The ferricyanide is somewhat photolytic and must be protected from light while stored. The absorbent pads, as of cotton, impregnated with the organic acid have an indefinite shelf life.

The process of the instant invention permits conversion of the xerographic binder plate to a lithographic master directly on the press completely eliminating immersing the xerographic plate in a treating solution and then handling the wet plate. The resulting lithographic masters are capable of the highest quality reproduction and may be used for long runs without objectionable image deterioration.

While the present invention has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

I claim:

1. A process for preparing a planographic printing plate from a xerographic plate, said xerographic plate comprising an electrically conductive backing coated on at least one side with a photoconductive insulating material comprising an electrically insulating resin binder having suspended therein a finely-divided photoconductive pigment selected from the group consisting of photoconductive insulating metallic oxides and sulfides, said process comprising producing an electrostatic image on said photoconductive material, developing said electrostatic image with a hydrophobic developer powder, fixing said powder image to said coating, saturating an absorbent pad with an aqueous solution providing hydrophilic anions forming insoluble compounds with said pigment, said pad being coated throughout with a solid organic acid at least as strong as acetic and swabbing the surface of said photoconductive material with said pad whereby the photoconductive pigment in the portion of said surface not protected by said hydrophobic developer powder is rendered hydrophilic.

2. A process for preparing a planographic printing plate from a xerographic plate, said xerographic plate comprising an electrically conductive backing sheet coated on at least one side with a photoconductive insulating material comprising an electrically insulating resin binder having suspended therein a finely-divided photoconductive pigment selected from the group consisting of photoconductive insulating metallic oxides and sulfides, said process comprising producing an electrostatic image on said photoconductive material, developing said electrostatic image with a hydrophobic developer powder, fixing said powder image to said coating, saturating an absorbent pad with an aqueous solution consisting essentially of a salt selected from the group consisting of water-soluble ferrocyanides and water-soluble ferrocyanides, said pad having been impregnated with a solid organic acid at least as strong as acetic and swabbing the surface of said photoconductive material with said pad whereby the photoconductive pigment in the portion of said surface not protected by said hydrophobic developer powder is rendered hydrophilic.

3. A process for preparing a planographic printing plate from a xerographic plate, said xerographic plate having a surface comprising an electrically insulating resin binder having suspended therein a finely-divided photoconductive pigment selected from the group consisting of photoconductive metallic oxides and sulfides and having affixed to said surface image areas of hydrophobic developer powder, said process comprising saturating with an aqueous solution of a salt selected from the group consisting of water-soluble ferrocyanides and water-soluble ferricyanides, an absorbent pad impregnated with a solid organic acid at least as strong as acetic and swabbing the photoconductive surface of said xerographic plate with said pad whereby the photoconductive surface is rendered hydrophilic in those areas not protected by said hydrophobic powder.

4. A process according to claim 3 wherein said finely-divided photoconductive pigment is zinc oxide.

5. A process for preparing a planographic printing plate from a xerographic plate, said xerographic plate having a surface comprising an electrically insulating resin binder having suspended therein finely-divided photoconductive zinc oxide and having affixed to said surface image areas of hydrophobic developer powder, said process comprising saturating with an aqueous solution of a water soluble ferrocyanide, an absorbent pad impregnated with a solid organic acid at least as strong as acetic and swabbing the photoconductive surface of said xerographic plate with said pad whereby the photoconductive surface is rendered hydrophilic in those areas not protected by said hydrophobic powder.

6. A process according to claim 5 wherein said electrically insulating resin binder is a silicone resin.

7. A process according to claim 5 wherein said electrically insulating binder is an acrylic resin.

8. A process for preparing a planographic printing plate from a xerographic plate, said xerographic plate having a surface comprising an electrically insulating resin binder having suspended therein a finely-divided photoconductive pigment selected from the group consisting of photoconductive metallic oxides and sulfides and having affixed to said surface image areas of hydrophobic developer powder, said process comprising saturating with an aqueous solution containing from about 0.1 to about 5 percent, by weight, of a water-soluble ferrocyanide, an absorbent pad impregnated with a solid organic acid at least as strong as acetic and swabbing the photoconductive surface of said xerographic plate with said pad whereby the photoconductive surface is rendered hydrophilic in those areas not protected by said hydrophobic powder.

9. A process for preparing a planographic printing plate from a xerographic plate, said xerographic plate comprising an electrically conductive backing sheet coated on at least one side with a photoconductive insulating material comprising an electrically insulating resin binder having suspended therein finely-divided photoconductive zinc oxide, said process comprising producing an electrostatic image on said photoconductive material, developing said electrostatic image with a hydrophobic developer powder, fixing said powder image to said coating, placing said xerographic plate on an offset printing press, saturating an absorbent pad with an aqueous solution consisting essentially of water and a salt selected from the group consisting of water-soluble ferrocyanides and water-soluble ferricyanides, said pad having been impregnated with a solid organic acid at least as strong as acetic and while on said press swabbing the surface of said photoconductive material with said pad whereby the photoconductive pigment in the portion of said surface not protected by said hydrophobic developer powder is rendered hydrophilic.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,952,536 September 13, 1960

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It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 65, for "throught" read -- thought --; column 4, line 69, for "protoconductive" read -- photoconductive --; column 5, line 1, after "cyanides" and before the period insert -- and ferricyanides --; column 5, line 59, for "ferrocyanides", second occurrence, read -- ferricyanides --.

Signed and sealed this 12th day of September 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

USCOMM-DC