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XEROGRAPHIC CLEANER

Paul G. Andrus, Columbus, Ohio, assignor, by mesne assignments, to Haloid Xerox Inc., Rochester, N. Y., a corporation of New York

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1 Claim. (Cl. 117—17.5)

This invention relates in general to xerography and in particular to the cleaning of reusable, xerographic, photosensitive members.

In the art of xerography it is usual to form a xerographic latent image on a photosensitive member such as, for example, a plate comprising a photoconductive insulating layer overlying a conductive support. The latent image when formed is then developed by the deposition thereon of electroscopic finely divided material such as pigment or a pigmented xerographic powder developer. The developed image is then customarily transferred to a print-receiving surface such as, for example, a sheet of paper or the like to form a finished xerographic print. When this cycle of operations is completed the xerographic plate is then cleaned for reuse in a new cycle of operations.

In the past, the cleaning operation has generally been accomplished by either of two methods. The first of these comprises flowing across the surface a powder or granular material according to the method disclosed by Copley in U. S. Patent 2,484,782. The other method is by brushing or like cleaning action, the precursor of which is shown in Carlson 2,357,809. Other methods have from time to time been proposed and explored; nevertheless, in spite of extensive experimentation the two methods mentioned above and other methods under consideration have been subject to significant disadvantages.

Apart from mechanical and process difficulties which have beset various of the systems of cleaning of the xerographic plate, the prior methods have suffered from a serious fault in that the surface of the xerographic plate becomes impaired by repeated cleaning operations. For example, in the cascade method of cleaning such as is disclosed in Copley, it is the general practice in commercial use to supplement such cascade cleaning with occasional solvent cleaning to remove a film of material that builds up on the plate surface. Similarly, in brush cleaning methods such as disclosed in the Carlson patent it is extremely difficult to obtain the correct balance between the vigorous cleaning required to remove all of the residual image and the delicate handling required in order to avoid abrasion or physical change in the xerographic plate surface, with the result that here, again, it is usual to have a film build up on the surface.

Now in accordance with the present invention there are provided means, methods and materials for the improved cleaning of residual xerographic image from the surface of a reusable xerographic plate. In general terms, the new method comprises pressing into close surface contact with the xerographic plate, a new cleaning member comprising a pellicle support and a film thereon of a soft nontacky material adapted to receive the image powder imbedded into its surface.

When xerography is applied to the production of continuous-tone subjects or photographic type of objects such as portraits, scenes, and other reproduction of high quality, such as, for example, reproductions calling for resolution in excess of 20 lines per millimeter, extremely critical demands are made on the quality of the xerographic plate. The plate and its surface must be free from defects either in visible characteristics or in electrical properties because such defects will be evidenced by lighter or darker or otherwise distorted areas in the xerographic print being produced. One of the necessary results of this is that cleaning methods and materials must be so designed and adapted as to cause literally no adverse effect on the xerographic plate surface when the xerographic plate is being used for high quality, continuous-tone reproductions. Thus, in particular, one of the objects of the present invention is to devise new means and methods and materials for the cleaning of xerographic plates used for continuous-tone reproductions and for similar high quality reproductions having a resolution of at least 20 lines per millimeter.

In a copending application by Paul G. Andrus, Ser. No. 397,917, filed December 14, 1953, there is disclosed the transfer of a xerographic image from a xerographic plate to a special transfer material wherein the xerographic image powder is imbedded into the soft transfer material by pressing the transfer material against the image-bearing xerographic plate. In another copending application by Warren G. Van Dorn, Ser. No. 499,784, filed April 7, 1955, there is disclosed the transfer of a xerographic image by pressure contact between the image-bearing plate and a second type of print-receiving material. In the first of these cases, the transfer material comprises a sheet or pellicle having on its surface a softened hydrophilic material which has been caused to swell by contact with moisture and is when thus moistened particularly adapted to receive the image powder from the xerographic plate. In the second case, there is disclosed a new method and material for xerographic transfer in which a support sheet or pellicle is coated with a layer of polyethylene or like soft thermoplastic resin material and which is pressed against the image surface, again to receive the image imbedded therein. None of the materials disclosed and claimed in these copending applications is characterized by what is generally known as tackiness in that these materials are not themselves sticky or tacky to the touch and do not themselves adhere to the xerographic plate even when pressed into firm contact therewith. It is a specific characteristic of materials suitable for the present invention that they are soft and possess resiliency or "flow" under pressure so as to receive the powder material imbedded therein and to flow around and partially encase the xerographic image powder, without at the same time being sticky or tacky so as to stick to or adhere to the xerographic plate surface. One of the properties generally associated with true tackiness is the property of adhesion between the material and an adjacent surface such that there is the tendency to form a coating or layer on the adjacent surface. This property or result of tackiness is specifically incompatible with repeated cycling in contact with the xerographic plate since one of the principal objects of the present invention is to overcome the tendency of cleaning materials or operations to build up on the plate surface a film or layer of foreign material.

It is, therefore, a principal object of the present invention to provide a new xerographic plate cleaning method and material wherein the xerographic plate may be cycled through successive cleaning operations with substantially complete freedom from a layer or film of foreign material built upon the xerographic plate surface.

The general nature and scope of the present invention having been set forth, the following examples are submitted in illustration but not in limitation of the invention.

Example I.—Kodak dye transfer paper, Type F Glossy (available from Eastman Kodak Company, Rochester, New York), believed to carry the same emulsion as double weight, glossy photographic paper on the usual photographic paper base, except that the silver salts are omitted, was soaked in water at room temperature for 30 seconds and was passed through pressure rollers under a very light pressure to remove the excess water therefrom. After passing through the rollers, the dye transfer paper is a transfer cleaning material adapted for use in the present invention, and is usable for transfer cleaning for a period of several minutes after removal from the rollers and until its surface begins to dry.

A xerographic plate comprising a layer of vitreous-appearing selenium on a conductive metal backing support was used for the formation of a xerographic image in the conventional manner. The plate was charged by passing it under a corona discharge electrode adapted to ionize the air adjacent to the plate surface and to deposit positive polarity charge on the surface, thereby charging the plate to a potential of about 500 volts. The plate was exposed to a pattern of light and shadow to be recorded, forming a xerographic latent image which was then developed by deposition on the plate surface of an electroscopic powder. The image was then transferred to a suitable print-receiving surface, for example, by placing a sheet of paper against the xerographic plate and passing the same corona discharge electrode across the plate and removing the paper with the xerographic image electrostatically adhering thereto. The xerographic plate, after removal of the image-receiving paper continued to hold on its surface a residual image consisting of a portion of the developed image body, and this image required removal before the cycle of xerographic operations could be repeated.

The moistened dye transfer paper placed face down against the xerographic plate bearing the residual powder image was rolled against the plate surface with a force of about 5 to 10 pounds per linear inch. The dye transfer paper was removed and replaced with a second sheet of similarly prepared dye transfer paper which was again rolled against the plate surface. After two cleaning operations the plate appeared to be substantially clean. A moderately heavy deposit of residual image could be observed imbedded in the surface of the first sheet of dye transfer paper and a light deposit of residual image was observed imbedded in the surface of the second paper. A third sheet of similarly prepared dye transfer paper was rolled against the plate surface, and upon removal therefrom appeared to be substantially free from image material imbedded therein. The plate surface likewise appeared clean.

The cycle of operations, namely, the formation, development and transfer of a xerographic image and its cleaning by the three-step process just described was repeated through a plurality of cycles. During the entire course of these operations no detectable or visible film was formed on the xerographic plate surface and at the end of the series of cycles the plate appeared to be in condition at least equal to its condition at the start of the series of cycles. The image quality of the last image seemed identical with the image quality of the first image and the operation of the plate was unimpaired according to the best test techniques available to determine performance of the xerographic plate.

Example II.—A sheet of baryta-coated base stock was coated with a layer of polyethylene according to the procedure generally disclosed in copending application, Ser. No. 499,784, referred to hereinbefore. In general the coating operation comprised flowing onto the surface of the baryta-coated paper a solution of Bakelite DYGT, a polyethylene having a relatively low molecular weight of 7000, a softening temperature of 98° C., and a melt viscosity at 150° C. of 121 poises, and available from the Bakelite Corporation of New York, the polyethylene being dissolved in 20% solution in trichloroethylene. A uniform coating about 1 mil thick was applied in this manner to the paper. The solvent was removed by evaporation to form a substantially nontacky polyethylene-coated sheet of a transfer cleaning member suitable for use in the present invention.

A xerographic plate was used in xerography, according to the procedure of Example I to form a xerographic developed image thereon which was transferred to a sheet of paper by conventional methods. A residual image was left on the plate and this image was cleaned in accordance with the procedures of the present invention.

The polyethylene-coated transfer cleaning material prepared as herein described was placed face down against the xerographic plate bearing the residual image and was rolled into contact therewith with a rubber-covered roller at a pressure of approximately 100 pounds per linear inch. After being rolled into firm contact with the plate surface the cleaning material having the polyethylene layer thereon was removed from the plate carrying the largest proportion of the residual developed image. A second sheet of the same polyethylene-coated paper was placed against the xerographic plate and again rolled into contact therewith at a pressure of about 100 pounds per linear inch. Upon removal from the plate surface, this second sheet of cleaning material carried with it a relatively smaller proportion of the residual image which appeared to be the entire remaining residual image left after the first cleaning operation. A third sheet of polyethylene-coated paper was rolled against the plate surface in the same manner, and upon removal was seen to bear substantially no xerographic powder image. The plate surface appeared spotlessly clean and was ready for reuse in the xerographic process.

The same plate was reused by this same cycle of operations through the production of 50 successive xerographic images with transfer and cleaning between the formation of each of the images, and at the end of 50 such cycles was found to be substantially unimpaired in its operation. The xerographic print formed after the 50th cycle appeared to be identical with the print formed after the first cycle, and the plate surface was clean and shiny and had no detachable powder image or film on its surface.

The xerographic cleaning process as illustrated in Examples I and II comprises essentially rolling into surface contact with the residual image-bearing plate which is to be cleaned a pellicle, sheet, web, or like cleaning member having a surface that is soft and compressible and adapted to receive xerographic powder material imbedded therein. The cleaning material is rolled into firm contact with the xerographic plate surface and the soft surface of the cleaning material is caused to form around the xerographic powder developer left on the xerographic plate surface, and to hold this powder material within its surface configuration and carry it away from the xerographic plate. The cleaning material is essentially nontacky and does not stick to the xerographic plate and, therefore, does not damage nor coat the xerographic plate surface. While it is not desired to limit the invention to any particular theory of operation, it is now thought that the powder material adheres to the cleaning member by electrical forces brought about by the very close contact between the surface of the fine, irregularly shaped particles and its soft surface that has conformed to the shape of the particles. Upon removal from the plate surface the cleaning material leaves the xerographic plate substantially in its original condition so that a xerographic plate of original good quality remains of equal quality throughout many cycles of xerographic reproductions.

In general it is intended that the xerographic cleaning operation of the present operation should be complete with two cleaning steps wherein in each case the cleaning material is pressed into firm contact with the xerographic plate surface and removed therefrom. It should be understood, of course, that fewer or more repetitions of the cleaning process may be needed, depending upon the amount of residual image left in the original xerographic transfer step. Thus, for example, electrostatic transfer of a xerographic image generally leaves a substantial residual image and a residual image in such case my require three or perhaps even more repetitions of the cleaning step. On the other hand, under some conditions, the original transfer may be substantially more complete, in which case cleaning may be more satisfactory with a single cycle of the cleaning process.

It is to be understood that variations and modifications may be made in the present invention without departing from the scope thereof, and accordingly, the scope of the invention is to be limited only by the appended claim.

What is claimed is:

In a method of xerographic reproduction wherein a xerographic plate comprising a photoconductive insulating layer overlying a conductive support is repeatedly subjected to an operational cycle which includes forming a latent image thereon, developing said latent image by the deposition thereon of finely divided powder material to create a developed image, and transferring the devel-

oped image to a print-receiving surface, the improvement comprising cleaning said plate before repeating an operational cycle thereof by rolling into firm non-sliding contact with said plate at a pressure of about 100 pounds per linear inch a thin solid homogeneous layer of low molecular weight polyethylene coated on a flexible support material, said polyethylene having a softening temperature of about 98° C. and a melt viscosity at 150° C. of about 121 poises, removing said layer from said plate and repeating the step of rolling into contact and removing subsequent layers of polyethylene until said plate is clean.

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