United States Patent Office 2,741,959 Patented Apr. 17, 1956

2,741,959

ELECTROPHOTOGRAPHY

John J. Rheinfrank, Worthington, and James M. Chapman, Dayton, Ohio, assignors, by mesne assignments, to The Haloid Company, Rochester, N. Y., a corporation of New York

No Drawing. Application April 10, 1953, Serial No. 348,126

5 Claims. (Cl. 95—1.3)

This invention relates to electrophotography or xerography, and has for its object to improve the xerographic processes as heretofore known or practiced.

A particular purpose of the invention is to improve the functioning and efficiency of the electrophotographic or xerographic plate, particularly when used for repeated operation.

To these and other ends, the invention consists in the procedure that will appear clearly from the following description, the novel features being pointed out in the claims following the specification.

This application is a continuation-in-part of Serial No. 83,104, filed March 23, 1949, now abondoned.

In the electrophotographic or xerographic process, as described in Carlson Patent No. 2,297,691, October 6, 1942, for example, an electrophotographic plate or xeroplate, comprising a coating of photoconductive insulating material, such as selenium, on a conductive backing, is electrically charged so that the coating carries a fairly uniform positive or negative charge over its surface. The plate is then exposed to a light image to discharge the surface in accordance with the light falling on it and leave an electrostatic latent image. The image is then developed by depositing a finely divided, electrostatically attractable material, such as powder, thereon. Finally, the material or powder is transferred to and affixed on another surface, such as a sheet of paper, to produce a print. The plate is thereupon cleaned of residual powder and recharged in preparation for another exposure to the same or different subject matter.

The charging of the plate may be accomplished by frictional rubbing as described in the Carlson patent or by other methods, such as by passing the plate under a corona discharge emanating from a row of needles or a grid of fine wires as described, for example, in copending application, Serial No. 55,526, filed October 20, 1948, now abandoned.

It has been noticed that if a plate is used repeatedly for reproducing several images in a short period of time by charging the plate, exposing to a light image, and cascading developing powder, such as a finely divided, pigmented resin over its surface, then transferring or removing the powder image and repeating the cycle of charging the plate, exposing to the same or a different light image and developing with powder, and so forth through several more cycles of operation, the successive powder images obtained on the plate in successive cycles often exhibit a pronounced decrease in density and legibility.

This decrease in image density and legibility can be attributed to a decrease in the potential acquired by the plate during charging. Table I, for example, illustrates the decay in potential acquired by a selenium-coated plate during successive charging cycles. In each cycle, the plate coating was subjected to a positive corona discharge by passing it under a row of needles charged to 5000 volts and the potential of the plate surface was then measured with an electrometer and probe. The plate

was then discharged by exposure to light and the charging cycle repeated.

Table I

Charging Cycle	Voltage on Corona Needles	Measured Plate Potential (Volts)
1	+5,000	420
2	+5,000	350
3	+5,000	320
4	+5,000	300
5	+5,000	315
6	+5,000	275
7	+5,000	255

It will be noted that the potential acquired by the plate gradually decreased with successive charging cycles. This effect is typical of the phenomenon known as "plate fatigue," and is a serious problem in continuous or repetitive electrophotographic processes. The present invention relates specifically to the regeneration of fatigued plates.

It has now been discovered that plates can be regenerated by introducing an additional charging step between successive copying cycles. This additional charging step imposes upon the plate a charge of polarity opposite to that of the charge used in sensitizing the plate. Thus, if the plate has been used with positive sensitization for the copying cycle, it has been found that the plate becomes regenerated when a negative charge is imposed upon the plate prior to the next copying cycle. Such a negative charge may be imposed by passing the plate under corona discharge wires or needles which are charged negatively. Upon being resensitized by positive corona (as the charging step in the next copying cycle), the plate will be found to have regained its original ability to acquire a substantial initial potential and to produce images having good density and legibility.

Fatigue occurs when the combined operations of charging and exposing an electrophotographic plate are repeated. The present regeneration process comprises charging the plate to a polarity which is the reverse of the polarity of the original sensitizing charge, before repeating the steps of sensitizing (by charging) and exposing the plate. This regeneration step may be performed at any time between the development step or other utilization of the electrostatic image of one copying cycle and the sensitizing step of the succeeding copying cycle. Thus, for example, the regeneration step may be performed either just before or just after the transfer step, or just following the cleaning step in the copying cycle.

The regeneration step may be employed only when the effects of fatigue become noticeable, rather than between each successive copying cycle, if the operator so desires.

Electrometer tests indicate that regenerated plates will acquire substantially their original potential on resensitization. Table II, which is a continuation of Table I, shows the effect on the potential acquired by a positively sensitized plate, when regeneration is effected by imposing a negative corona discharge between successive copying cycles.

Table II

Charging Cycle	Voltage on Corona Needles	Measured Plate Potential (Volts)
8	−5,000	
9	+5,000	420
10	−5,000	
11	+5,000	420

While the present invention, as to objects and advantages, has been described herein as carried out in a

specific embodiment 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.

What is claimed is:

1. In a repetitive electrophotographic process which comprises the steps of sensitizing a photoconducting insulating layer on a conducting backing by charging it with an electrostatic charge of a first polarity, exposing said coating to a light image, developing an image on said coating by depositing a finely divided material thereon, transferring the image so developed, cleaning said coating and repeating the above cycle of operations, the added steps comprising exposing said coating to a source of electrical charge and energizing said source with a potential opposite in polarity to said first polarity, said added steps being performed subsequent to the developing step and prior to the step of sensitizing the coating in repeating the cycle.

2. In a repetitive electrophotographic process which comprises the steps of sensitizing a selenium coating on a conductive backing by electrically charging said coating to a positive polarity, exposing the sensitized coating to a light image, developing an image on said coating with a finely divided material, transferring said image, cleaning said coating, and repeating the above cycle of operations, the added steps comprising exposing said selenium coating to a source of electrical charge and energizing said source to impose an electrostatic charge of negative polarity on said coating, said added steps being performed after the developing step and prior to recharging the selenium coating to a positive polarity in repeating the process.

3. In the method of electrophotography in which a coating of photoconductive insulating material on a conductive backing is electrically charged to a first polarity, exposed to a light image, developed with a finely divided material and then relieved of said developing material by transfer and cleaning, after which said cycle of operations is repeated, the added steps comprising exposing said coating to a source of electrical charge and energizing said source with a potential opposite in polarity to said first potential, said added steps being performed after cleaning the coating and before recharging to said first polarity in repeating said cycle.

4. The method of copying light images which comprises charging a coating of photoconductive insulating material on a conductive backing with an electrostatic charge of a first polarity, exposing said coating to a light image, developing said coating by depositing a finely divided material thereon, transferring said developed image, cleaning said coating, charging said coating with an electrostatic charge opposite in sign to said first polarity, then recharging said coating with an electrostatic charge of said first polarity prior to a second exposure to a light image.

5. In a repetitive electrophotographic process which comprises the steps of sensitizing a photoconducting insulating layer on a conducting backing by charging it with an electrostatic charge of a first polarity, exposing said coating to a light image to provide a latent electrostatic image, utilizing said electrostatic image in a copying cycle to produce a powder image corresponding thereto, exposing to relatively uniform light between copying cycles, and repeating the entire series of operations, the added steps comprising exposing the coating to a source of electrical charge and energizing said source with a potential opposite in polarity to said first polarity, said added steps being performed subsequent to the utilization of the electrostatic image and prior to the step of sensitizing the coating in repeating the cycle.

References Cited in the file of this patent

UNITED STATES PATENTS

2,551,582	Carlson	May 8, 1951
2,576,047	Schaffert	Nov. 20, 1951