Nov. 29, 1966 F. S. MACKLEM 3,288,605

ELECTROPHOTOGRAPHIC PRINTING METHOD

Original Filed May 18, 1956

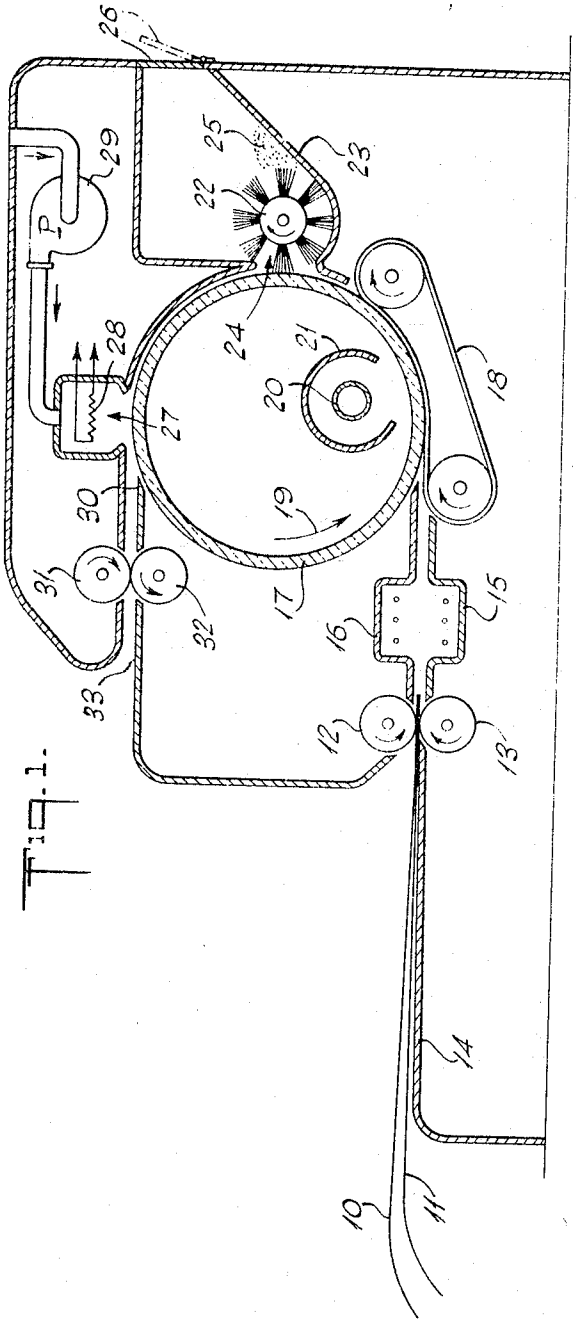


FIG. 1.

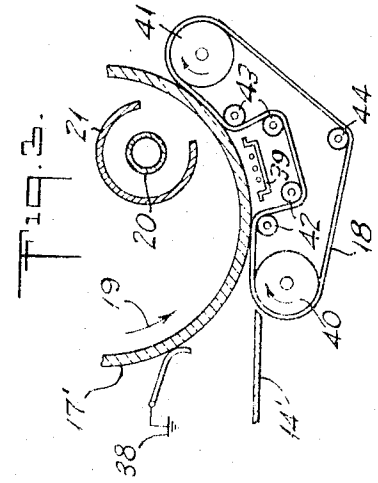


FIG. 3.

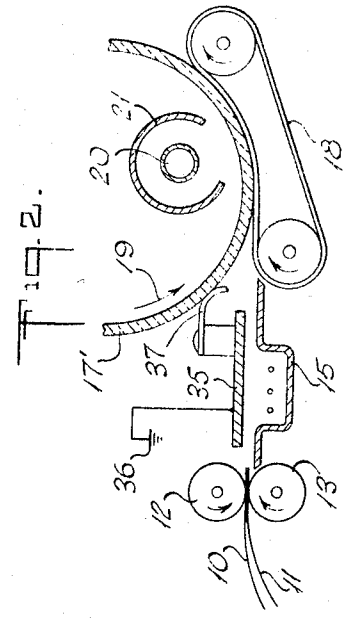


FIG. 2.

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ELECTROPHOTOGRAPHIC PRINTING METHOD

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Continuation of abandoned application Ser. No. 585,717, May 18, 1956. This application Nov. 19, 1965, Ser. No. 508,659

5 Claims. (Cl. 96—1)

This application is a continuation of my copending application, Ser. No. 585,717, filed May 18, 1956, now abandoned.

My invention relates to photoreproduction apparatus particularly adapted to the employment of electrophotographic paper, film, or the like. This invention incorporates certain improvements over that disclosed in my copending application, Ser. No. 538,619, filed Oct. 5, 1955, now abandoned.

It is an object of the invention to provide improved apparatus of the character indicated and to provide an improved method for utilizing electrophotographic paper, film, or the like.

It is another object to provide improved photoreproduction apparatus of the character indicated, whereby developed copies may be more quickly and easily made.

It is a specific object to meet the above objects with a structure particularly adapted to the efficient reproduction of translucent masters.

It is another specific object to meet the above objects with an improved method and apparatus which permit full development and fixation of a print while the master and print are held together, that is, before removal of the master from the print.

Other objects and various further features of novelty and invention will be pointed out or will occur to those skilled in the art from a reading of the following specification in conjunction with the accompanying drawings. In said drawings, which show, for illustrative purposes only, preferred forms of the invention:

FIG. 1 is a simplified sectional view illustrating important steps in my method and parts of my apparatus; and

FIGS. 2 and 3 are fragmentary diagrams representing alternatives for parts of the method and apparatus illustrated in FIG. 1.

Briefly stated, my invention contemplates photoreproduction apparatus adapted particularly to paper, film, or the like, having a coating which is photosensitive when electrically charged. In the present invention, I am specifically concerned with the improved use of such paper, film, or the like, for reproduction of translucent masters, such as those prepared on tracing paper or vellum in ordinary drafting-shop procedures. My invention features the development of the exposed copy sheet while still held against the master through which exposure is made. In this way, I best assure retention of all charge developments up to and including the time of development (as by electrostatic dusting techniques), and no separate handling is required of the copy sheet. My machine delivers the fully developed and fixed copy sheet without ever having separated the copy sheet from the master.

The process of photoreproduction is improved by feeding the photocopy sheet and master into the machine and impressing a charge on opposite sides of both pieces of paper while they are together. After photosensitizing by charging, the two sheets, if desired, may be retained together as mentioned above.

Referring to FIG. 1 of the drawing, my invention is shown in application to a photoreproduction apparatus in which a master sheet or tracing **10** is first brought into register with a copy sheet **11**, before introduction to the

machine at feed rolls **12–13**. For convenience, a table **14** is provided to facilitate assembly of the sheets **10–11**. Both sheets **10–11** are translucent, and the sheet **11** is of the electrophotographic variety, meaning that it has on one side thereof a coating which is photosensitive when electrically charged. For convenience, throughout the specification and claims I shall refer to such paper, film, or the like **11** merely as "paper," it being understood that such reference contemplates any vehicle suitable for the intended purpose and having a coating of the class described.

In the form shown in FIG. 1, the registered master sheet **10** and copy sheet **11** are arranged with the coated side of the copy sheet **11** facing downwardly on the table **14**, and the master **10** is oriented for direct (unreversed) printing, that is, with the marked face thereof pressing downwardly against the copy sheet **11**. After passing through the feed rolls **12–13**, the sheets **10–11** are subjected to an electrostatic charge region, which in the form shown comprises spaced corona-discharge elements **15–16** on opposite sides of the sheets **10–11**. The charged sheets are then preferably fed directly to a translucent cylinder **17** and are held against the cylinder **17** by means of a belt **18** running with movement of the cylinder **17** so as to carry the master and copy sheets in the direction indicated by the arrow **19**.

The cylinder **17** is mounted for rotation about its axis and may be of glass or translucent plastic, but for convenience throughout this specification, will be referred to as a "glass cylinder," even though other materials will be understood to be contemplated by reference to the cylinder **17** as a glass cylinder.

Within the cylinder **17** is a fixed light source **20** which is preferably directional and limited to essentially an elongated area substantially coextensive with the width of the copy sheet and located at essentially one angular location about the axis of the cylinder **17**. The light source **20** may be a fluorescent lamp, and shield **21** provides the desired directionality.

While in the form shown the exposed charged master and copy sheets **10–11** are still held against each other and are advanced with movement of the cylinder **17**, I provide means for developing the charge image which results on exposure. In the form shown, an electrostatic dusting brush **22** is employed at a second fixed angular location about the axis of the cylinder **17**. The brush **22** may be of cylindrical configuration and elongated in substantial conformity with elongation of light source **20**. Brush **22** is shown to rotate continuously in a trough **23** having an aperture **24** adjacent the exposed coated surface of the copy sheet **11**. Dusting material **25** is shown filling the trough **23**, and an access door **26** facilitates replenishment. Brush **22** is preferably driven at a velocity to achieve a small relative surface speed of the brush over the exposed coated surface of copy paper **11** as it passes the brush aperture **24**.

At a third fixed angular location about the axis of the cylinder **17**, I show means **27** for fixing the developed image on paper **11**. This operation may be performed by application of heat to the coated surface of paper **11** at an elongated aperture substantially coextensive with the exposed and developed width of the copy sheet **11**. The heating means is shown to include an electrical heating element **28** and a blower **29**. After fixing, the master and copy sheets are tangentially peeled off the roll **17** at **30**, and feed-out rolls **31–32** discharge the original and the finished copy at an upper table **33**, at which time the copy may be removed from the master.

The arrangements of FIGS. 2 and 3 are similar to FIG. 1 in that there is shown a feeding of a master and photocopy paper to a charging chamber wherein

an electrical potential is impressed on opposite sides of the master and photocopy paper.

The arrangement of FIG. 2 represents a slight modification wherein but a single corona-discharge element **15** is employed, preferably adjacent the coated surface of the copy sheet **11**. In order to establish a charge reference for the means **15**, I show a single plate **35** adjacent the upper surface of the master **10**, and this plate may be referenced to ground potential, as suggested at **36**. If desired, the translucent cylinder **17'** may be of the electrically conductive variety, as of electrically conducting glass, and a brush element **37** assures maintenance of the same ground potential both on the plate **35** and on the cylinder **17'**.

In the arrangement shown in FIG. 3, the translucent cylinder **17'** is again of the electrically conductive variety, and reference of the potential thereof to ground potential is suggested at **38**. Electrostatic charging of the sheets is accomplished at a corona-discharge element **39** fixed between the pulleys **40–41** for the belt **18**. Auxiliary pulleys **42–43–44** are shown for routing the belt **18** around the charge element **39**, so that the desired charge development may be effected directly on the outer face of the copy sheet and with respect to the potential (ground) of the cylinder **17'**. It will be noted that the charge element **39** is so located as to complete its charging function prior to exposure of the copy sheet to light from source **20**.

It will be seen that I have described a relatively simple photoreproduction apparatus, particularly applicable to the reproduction of translucent masters, such as engineering drawings on tracing paper, vellum, or the like. I have found that highly satisfactory reproductions can be made even though the coating of the copy sheet faces away from the master sheet, and the fact that in accordance with my preferred form I perform development and fixing of the charged image prior to separating the master from the copy sheet assures maximum retention of electrostatic charge images, so that more reliable results can be accomplished than by the conventional method of facing the coating against the master and separating the copy sheet from the master for development and fixing. Also, my method and apparatus permit direct reproduction without reversal of the image from the master.

While I have described the invention in detail for the preferred forms shown, it will be understood that modifications may be made within the scope of the invention as defined in the claims which follow.

I claim:

1. The photo-reproduction method employing a sheet of translucent paper having a photoconductive insulative coating on one side thereof that is photoelectrically-responsive when subjected to an electrical charge, which comprises positioning a positive translucent master on the uncoated side of said sheet, impressing an electrical potential on opposite sides of said sheet and master while in contact with each other, directing illumination through said master and sheet to the photoconductive side thereof, thereby producing an electrical charge pattern corresponding to the copy on said master, and developing said coating while held in contact with said master by applying solid developer particles to said photoconductive side, the particles adhering to the side in accordance with said charge pattern.

2. The photo-reproduction method employing a sheet of translucent paper having a photoconductive insulative coating on one side thereof that is photoelectrically-responsive when subjected to an electrical charge, which comprises positioning a positive translucent master to the uncoated side of said sheet with the copy on said master lying adjacent said uncoated side, impressing an electrical potential on opposite sides of said sheet and master while in contact with each other, directing illumination through said master and sheet to the photoconductive side thereof, thereby producing an electrical charge pattern corresponding to the copy on said master, electrostatically developing the resulting charge pattern on the exposed coated surface while said sheet is held in contact with said master by applying solid developer particles to said photoconductive side, and heating said developer particles to fix the electrostatic image while said sheet is held in contact with said master.

3. The photo-reproduction method employing a sheet of translucent paper having a photoconductive insulative coating on one side thereof that is photoelectrically-responsive when subjected to an electrical charge, which comprises positioning a positive translucent master on the uncoated side of said sheet, impressing an electrical potential on opposite sides of said master and sheet while in contact with each other, directing illumination through said master to the photoconductive side of said sheet, thereby producing an electrical charge pattern corresponding to the copy on said master, and developing said coating by applying developer to said photoconductive side.

4. The photo-reproduction method employing a sheet of translucent paper having a photoconductive insulative coating on one side thereof that is photoelectrically-responsive when subjected to an electrical charge, which comprises positioning a positive translucent master on said sheet, impressing an electrical potential on opposite sides of said master and sheet while in contact with each other, directing illumination through said master to the photoconductive side of said sheet, thereby producing an electrical charge pattern corresponding to the copy on said master, and developing said coating by applying developer to said photoconductive side.

5. The photo-reproducing method employing a sheet of translucent paper having a photoconductive insulative coating on one side thereof that is photoelectrically-responsive when subjected to an electrical charge which comprises:

positioning a positive translucent master on the uncoated side of said sheet;

impressing an electrical potential on opposite sides of said master and sheet while in contact with each other to charge substantially the entire area of said photoconductive coating of said sheet;

and, directing illumination through said master and sheet to the photoconductive side thereof, thereby producing an electrical charge pattern corresponding to the copy on said master;

and developing said coating by applying solid developer particles to said photoconductive side, the particles adhering to the side in accordance with said charge pattern;

and thereafter fixing said particles to said sheet.

No references cited.

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