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ELECTROPHOTOGRAPHIC PRINTING APPARATUS

Original Filed Nov. 17, 1965

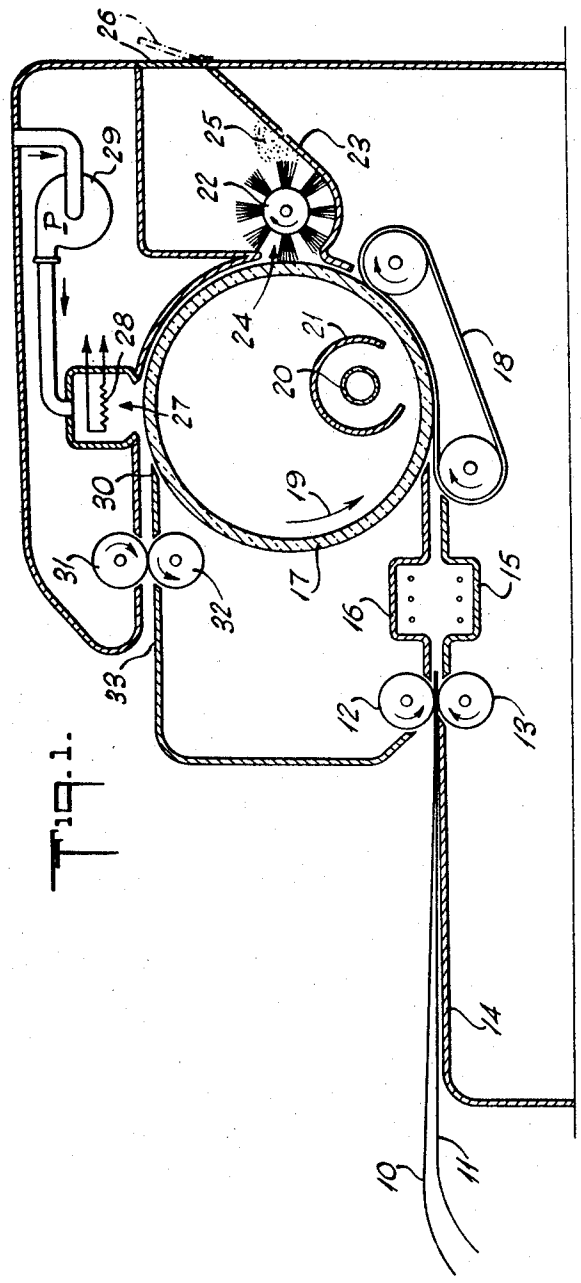


FIG. 1.

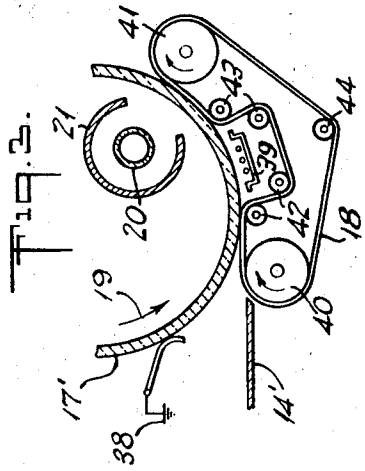


FIG. 2.

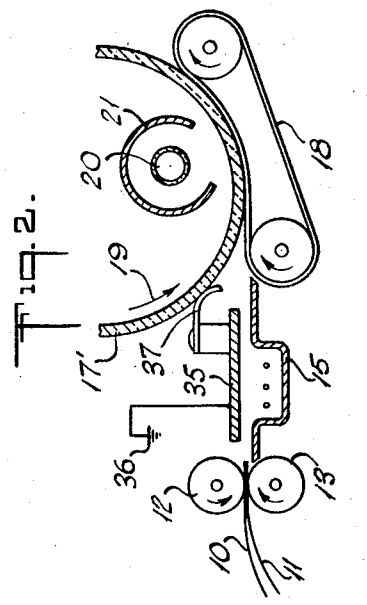


FIG. 2.

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ELECTROPHOTOGRAPHIC PRINTING APPARATUS

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Original application Nov. 17, 1965, Ser. No. 508,659, now Patent No. 3,288,605. Divided and this application Sept. 2, 1966, Ser. No. 576,946
10 Claims. (Cl. 95—1.7)

This application is a division of copending application, Ser. No. 508,659, filed Nov. 17, 1965, which is a continuation of the application, Ser. No. 585,717, filed May 18, 1956.

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 fluorescent lamp, and shield **21** provides the desired directionality.

While in the form shown the exposed and 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 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. Photoreproduction apparatus comprising:

light exposure means providing a supporting surface for a master to be reproduced, roller means for feeding said master into said apparatus in superposed relation with a photoelectric member having a photoelectrically responsive coating on one side thereof,

means for supporting said master and said member so that the photoelectrically responsive coating faces away from said surface when acted upon by said exposure means,

an electrostatic charge region located between said feed rolls and said exposure means for impressing an electrical potential on opposite sides of said master and member while in contact with each other,

and means for electrostatically developing an image on said coating.

2. The apparatus as claimed in claim **1** wherein there is provided means including a heater element for fixing the electrostatically developed image.

3. The photoreproduction apparatus as claimed in claim **1** in which the support for the master consists of electrically conductive translucent material.

4. Photoreproduction apparatus, comprising roller means forming an infeed station to receive a master sheet and copy sheet in superposed relation with one another,

a cylinder of glass mounted for rotation about its axis,

an elongated light source fixed within said cylinder and directing light at essentially one angular location over an elongated area at said angular location,

means for supporting said master sheet and said copy sheet in adjacent relation prior to application to said cylinder and for holding said master sheet and said copy sheet against said cylinder for movement with said cylinder past said light source, said master sheet being adjacent said cylinder and said copy sheet being of the electrically chargeable variety having a photoelectrically responsive coating on one side thereof facing away from said cylinder,

means for impressing an electrical potential on opposite sides of said master sheet and copy sheet while in contact with each other and located between said infeed station and said means for supporting said master sheet and said copy sheet,

and means for electrostatically developing the exposed coated surface of said copy sheet.

5. Apparatus as claimed in claim **4** in which said charging means comprises a corona-discharge element adjacent one side of said master and copy sheet set and a ground plate adjacent the opposite side of said set at the location of said corona-discharge element.

6. Apparatus as claimed in claim **4** in which said charging means comprises two opposed corona-discharge elements of opposite polarity and on opposite sides of said master sheet and copy sheet while held together prior to introduction to said cylinder.

7. In combination, a table for receiving a master sheet and a copy sheet in register, said copy sheet being of the electrically chargeable variety and having a photoelectrically-responsive coating on the side thereof facing downwardly on said table, said master sheet being applied on top of said copy sheet and against the uncoated side thereof, feed rolls for receiving the registerd master sheet and copy sheet and for continuously advancing the same, a cylinder of translucent material mounted for continuous rotation about its axis and oriented to tangentially receive from said feed rolls the registered master and copy sheets with said master sheet adjacent said cylinder so that the coated surface of said copy sheet faces outwardly of said cylinder, a fixed light source within said cylinder and directed to illuminate essentially an elongated area of the inner wall of said cylinder at essentially a first angular location, means advancing with movement of said cylinder for continuously holding said copy sheet and master sheet against the outer surface of said cylinder during movement past said light source, means for electrostatically charging said copy sheet and located between said feed rolls and said last-defined means, and electrostatic-dusting means at a second fixed angular location about the axis of said cylinder and in dusting relation with the exposed coated surface of said copy sheet while continuously advanced by and with movement of said cylinder.

8. The combination as claimed in claim **7** wherein there is included heating means at a third fixed angular location about the axis of said cylinder and disposed to continuously heat the exposed developed coated surface of said copy sheet while continuously advanced with movement of said cylinder.

9. A photoreproduction apparatus comprising:

exposure means including illuminating means associated therewith for exposing a master sheet element and a photoelectrically responsive paper element having a photoelectrically responsive coating thereon, roller means for advancing the elements in superposed relation with the master sheet against the uncoated side of said copy sheet to a charging station, charging means for imparting an electrostatic charge to said photoelectric coating,

delivery means for removing said elements from said charging station and delivering said elements in said

superposed relation with the master along a predetermined path against said exposure means with said photoelectrostatic coating facing away from said exposure means for illuminating said coating through said master,

said means for imparting said electrostatic charge being located between said roller advancing means and said delivery means,

and means for developing the charge image which results on exposure.

10. In combination, a table for receiving a master sheet and a copy sheet in register, said copy sheet being of the electrically chargeable variety and having a photoelectrically responsive coating on the side thereof facing downwardly on said table,

said master sheet being applied on top of said copy sheet and against the uncoated side thereof,

feed rolls for receiving the registered master sheet and copy sheet and for continuously advancing the same,

exposure means comprising a cylindrically shaped illuminated surface to tangentially receive from said feed rolls the registered master and copy sheets with said master in surface contact with said exposure

means so that the coated surface of said copy sheet faces outwardly thereof,

means mounted for continuous rotation contacting a portion of said surface for continuously holding said copy sheet and master sheet against the outer surface of said exposure means during movement past said exposure means,

means for electrostatically charging said copy sheet and located between said feed rolls and said last defined means, and

means for electrostatically developing the exposed coated surface of said copy sheet after exposure.

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