

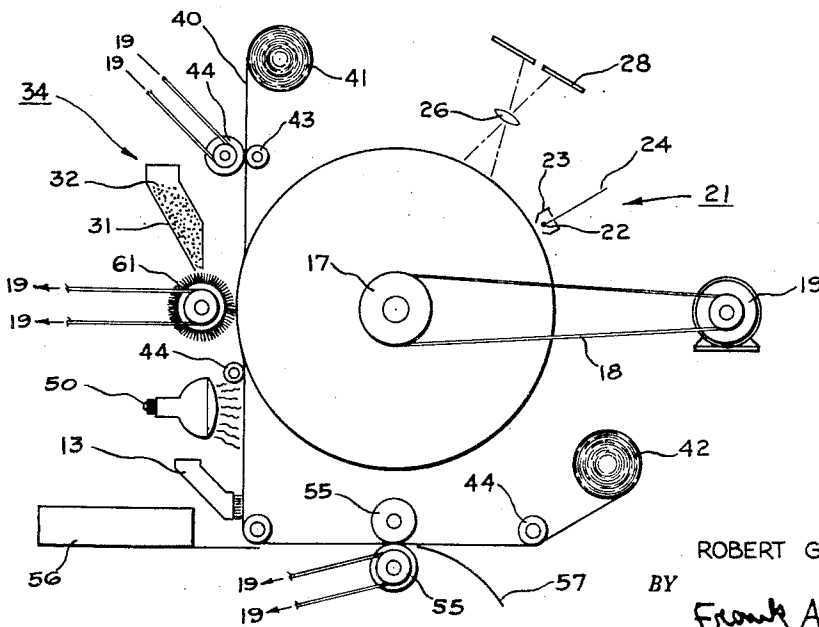
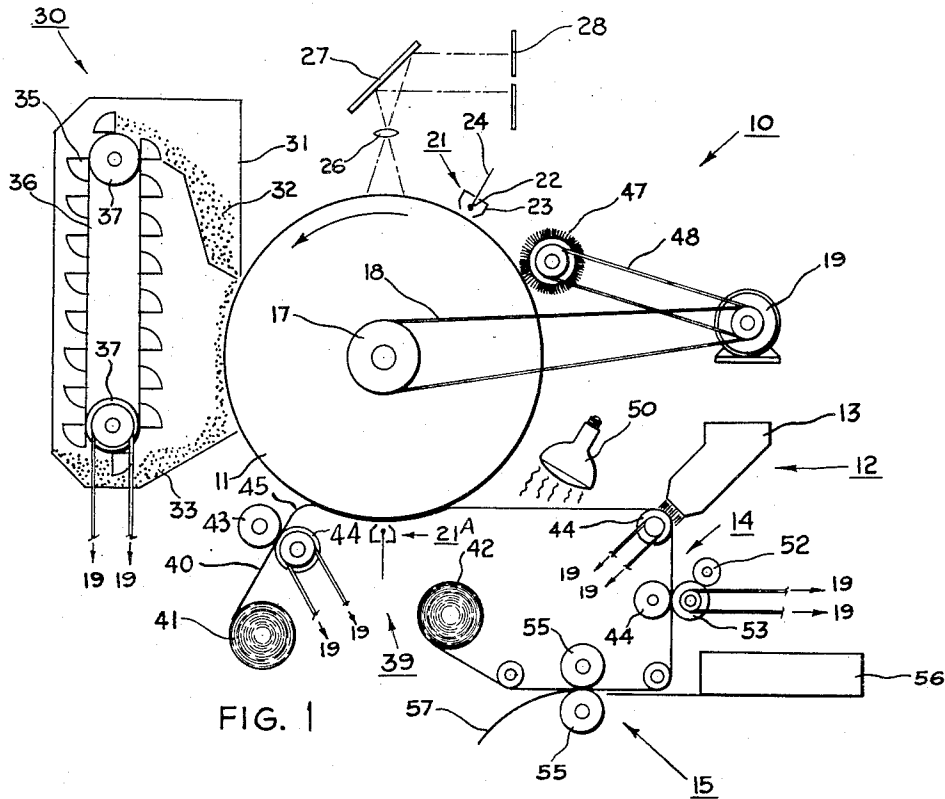
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2,885,955

XEROGRAPHIC MACHINE

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XEROGRAPHIC MACHINE

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2 Claims. (Cl. 101-1)

This invention relates in general to a xerographic machine and in particular to a xerographic printing machine particularly adapted to lithographic production of printed information.

In the art of xerography, as disclosed in Carlson U.S. 2,297,691, an image is recorded and printed by the combined action of electric field and a pattern of light and shadow to form an electrostatic latent image which is then developed and printed on a suitable print receiving surface, such as for example, a sheet or web of paper. In the development and printing of such an image, it is usual to deposit electroscopic powder materials on the xerographic latent image and to transfer and fix the deposited particles onto the paper or like printing surface. The powder image is fixed to this print receiving surface by suitable means, such as for example, heat or vapor fusion or the like.

In the type of operation as thus originally contemplated, a special printing material is deposited in response to the electrostatic image and this printing material is the final image material ultimately transferred and fixed as the xerographic print. The nature of xerography is such as to lend a great deal of flexibility to the choice of printing materials, but at the same time there are limits of flexibility inasmuch as the original print material must be one which is consistent with electrostatic deposition in xerography and frequently must be one which is consistent with deposition on a reusable xerographic plate surface. In addition, because of the operations of electrostatic deposition and transfer to a second surface, the image generally must be one which is not permanently affixed to its surface of first deposition, and thus, is one which normally requires a subsequent fusion or fixing operation. These requirements, therefore, impose a certain limit of flexibility on xerography in general and on the image forming material in particular. In particular, where the final print receiving surface must be of critical dimensions and must be critically free from dimensional instability, operations such as heat or vapor fusing may be found to be either undesirable or unfeasible. Similarly, where duplicate copies are desired, it is necessary to perform duplicate exposure steps or to carry out image multiplication operations to form such duplicate prints from a single exposure. In addition, where the ultimate print receiving material is presented to the originally deposited xerographic image, it must be a material that is completely compatible in operation with the xerographic machine, and thus, is subject to certain limitations of convenience in operation.

Now in accordance with the present invention, a xerographic image is first deposited on and affixed to a lithographic printing surface whereupon there is formed a lithographic printing plate or web corresponding to the xerographic image. The lithographic printing plate or printing web is then carried through a series of lithographic printing stages to form optionally single or multiple printing impressions corresponding to the xerographic image on print-receiving material of a type that is not

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conveniently compatible with conventional xerographic machines in that it may be subject to dimensional change or change in other physical characteristics when subjected to certain xerographic processing techniques. It is, therefore, an object of the present invention to provide means, method and apparatus for lithographic recording by xerography.

It is another object of the present invention to provide means, methods and apparatus for the printing of a xerographic image in single or multiple form on print receiving surfaces of critical dimensional stability.

It is a further and more specific object of the invention to provide improved means, methods and apparatus for xerographic recording of information on business machine cards.

Other objects of the invention will in part be obvious and will in part become apparent from the following specification and drawings, in which:

Fig. 1 is a diagrammatic illustration of a printing machine according to one embodiment of the present invention.

Fig. 2 is a diagrammatic illustration of a printing machine according to a second embodiment of the invention.

In Fig. 1 is illustrated a xerographic lithographic printing machine generally designated 10 comprising a xerographic printing cylinder 11 around which are positioned a series of xerographic processing stations, one of which is a lithographic station generally designated 12 including water application means 13, inking means 14, and a printing station 15.

The xerographic cylinder comprises a cylindrical member rotatably mounted on its axis 17 and adapted to be driven by a belt 18 operably connected to a motor 19 or like drive means. The surface of the cylinder 11 or at least a portion of the surface is xerographically photosensitive and, thus, may comprise a photoconductive insulating layer disposed on a conductive backing surface. Any appropriate photoconductive surface may be employed, such as for example, a photoconductive insulating selenium layer, a layer of anthracene, sulfur, or the like, or a suitable binder layer comprising an insulating film forming binder in combination with photoconductive or photoactive particulate materials, such as crystalline photoconductors including the sulfides, oxides, and selenides of cadmium, zinc, and the like.

Positioned around the circumference of the xerographic cylinder 11 are a plurality of xerographic processing stations. In order of operation, the first of these stations is a charging station 21 comprising, for example, a corona discharge electrode which may include one or more fine corona generating wires 22 mounted within a shield 23 and connected by means of lead 24 to an appropriate high voltage corona generating source. The corona wire 22 is maintained at a corona generating potential with respect to the shield 23, which may, depending on the dimensions of the electrode, be a potential in the order of several thousand volts. A suitable electrode may include one or more strands of conductive wire having a diameter of 3½ mils mounted within an electrode and maintained at a potential in the order of 6,000 to 8,000 volts.

Positioned next in the direction of rotation of the cylinder is an exposure station, which may include contact exposure means or may, as illustrated, include a lens 26 operating in conjunction with a reversing mirror 27 to focus an image from an exposure slit 28 onto the surface of the xerographic cylinder 11. The exposure station as thus defined is adapted to focus an image of documentary material or the like appearing at the exposure slit 28 in direct reading configuration on the xerographic cylinder for double transfer finally to a suitable print receiving material. Obviously, if the original im-

age material is in image reversal configuration or may conveniently be placed in such configuration, the reversal mirror 27 may be omitted.

Positioned next in the direction of rotation of the cylinder 11 is a xerographic development station generally designated 30. This station comprises in general a developer dispensing hopper 31 adapted to cascade a developer material 32 across the surface of the xerographic cylinder into a catching hopper 33. A suitable developer elevator, such as a bucket elevator, including cups or buckets 35 mounted on an endless belt 36 may be driven by a suitable motor or drive means 19 around pulleys 37 at the top and bottom of the elevator to carry the developer from the catching hopper back to the dispensing hopper for recycling. A suitable developing method and apparatus are disclosed, for example, in Wise U.S. 2,618,552.

Positioned next in the direction of rotation of the cylinder is a transfer station generally designated 39. At this station a lithographic transfer web or belt 40 passing from a feed roll 41 to a take-up roll 42 is brought into contiguous contacting relationship with the surface of the xerographic cylinder 11. Suitable guide rollers 44, some of which may be powered by a drive means 19, convey the transfer web in its desired path between the feed roll 41 and the take-up roll 42. Preferably immediately before the web is brought into contact with the xerographic cylinder, it passes between one of the powered guide rolls 44 and a mating roll 43, which pair of rollers are powered at a speed at least equal to and optionally slightly in excess of the speed of rotation of the xerographic cylinder 11. In this manner, a channel or curve 45 is developed in the web feed at the point of contact with the drum surface to smooth out wrinkles, bulges, and the like. Positioned opposite to the point of contact between the web and the cylinder is a transfer member, such as for example, a corona discharge electrode generally designated 21A of like construction and operation as the charging electrode 21. Electrode 21A is adapted operably to deposit on the reverse side of the transfer web a suitable electric charge such as to transfer the developed image from the xerographic plate to the web surface.

The lithographic belt or web is, briefly, a hydrophilic surface of suitable shape and dimensions for the machine. Its purpose is to receive the xerographic image to form a lithographic printing master, and accordingly, it is constructed or surfaced of a suitable water-receptive ink repellent material. This may be, for example, a surface coating of water-receptive cellulosic derivatives or mixed compositions of these or other hydrophilic materials as are conventional in the offset printing art. Thus, planographic printing surfaces or coatings of various types may be employed consistently with the objectives of the invention.

Optionally positioned next in the direction of rotation of the cylinder is a suitable cleaning member, such as for example, a rotating brush 47 of suitable fibrous materials such as hair, fur, synthetic fibers, or the like. This brush likewise is powered by a drive belt 48 operated by a motor or drive means such as motor 19. The brush is positioned so that the fibers are adapted to brush against the surface of the cylinder preferably with a snapping or whipping motion to remove from the cylinder surface any residual powder image which may not have been transferred at the transfer station.

The lithographic web 40 upon leaving the xerographic cylinder 11 then passes through a series of operating stations as follows. First, it is desirably moved to a fusing or fixing station at which the powder image is adapted to be permanently affixed to the belt. This may comprise, for example, a heating element such as an infrared radiating lamp or heating member 50 adapted to project onto the web surface sufficient heat to melt the powder image thereon. Optionally other fixing means may be

used, such as for example, a solvent vapor chamber where the belt is passed through a solvent atmosphere adapted to fuse the powder to the web surface or, alternatively, pressure means or like fixing members. The web then passes around suitable guide rollers, such as a guide roller 44 powered by motor 19, optionally near which a liquid dispensing means 13 is adapted to apply water or an aqueous liquid to the web surface. This, of course, may be by spraying, brushing, or like applying means to moisten the web surface in preparation for the lithographic printing operation. The water-moistened web then passes to inking rollers, such as for example, an ink reservoir 52 adapted to provide a constant supply of ink to an inking roller 53 optionally receiving the web material between its surface and a guide roller 44. At this station, the lithographic web receives a printing material, such as printing ink, on the image areas to transform the lithographic belt into a planographic printing member.

The belt then passes to a pair of printing rollers 55 or the like where it receives an ultimate print receiving surface from a sheet feed member 56 or like device or mechanism adapted to feed paper, cards, envelopes, or other ultimate print receiving members to the printing rolls 55. The print feeding mechanism 56 will be such conventional mechanism as may be appropriate in the printing art for feeding the desired material to the printing rollers, and may include conventional sheet feeding mechanism, conventional card handling and feeding mechanism, or other sheet or web feeding devices adapted to feed the printing surface to the lithographic belt. It is specifically intended that the print feeding mechanism may be feed means for business machine cards or the like.

After leaving the printing rollers, the lithographic web may pass to a take-up roll 42 while the printed sheet 57 or the like may be suitably collected or conveyed to a desired location. Alternatively, the lithographic web may be an endless belt in which case it is cleaned by suitable means and returned to the xerographic cylinder.

In operation, the apparatus disclosed in Fig. 1 is adapted to form directly one or more lithographic printed images corresponding to an optical image projected to the cylinder surface through the exposure lens 26. The xerographic plate is charged at charging station 21 and is exposed to an image of documentary material or like matter passing by exposure slit 28. At the developing station 30 a suitable powder developing material is deposited on the xerographic cylinder and this powder material then in image form is transferred to the lithographic web 40 at transfer station 39. The image is then fused or fixed onto the lithographic web surface at the fixing station 50, after which it is passed through the printing apparatus to form a lithographic print 57. It is apparent that conventional actuating mechanisms may be placed in the printing apparatus for the purpose of printing one or more copies of a suitable lithographic print. Desirably, this may be operated by coded signals in the xerographic image translated into operating impulses by suitable detection and amplifying means such as, for example, photo cell detectors and amplifiers, relays, and the like. Thus by conventional operation, the printing mechanism may be stopped and repeated for a plurality of lithographic prints as may be desired.

Optionally, the lithographic web on take-up roll 42 may be recycled through one or a plurality of subsequent printing operations to form additional printed copies or, if desired, the web may be stored to form a permanent record of the output of the lithographic printer.

In Fig. 2 there is illustrated another embodiment of a machine according to the present invention. According to this embodiment of the machine, the xerographic image is developed directly on the lithographic web in mirror reversal configuration whereby only a single trans-

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fer by lithographic means is required for the production of a finished print. As illustrated in the figure, a xerographic cylinder 11 is rotatable on its axis 17 by means of a belt or similar member 18 powered by drive means 19. Positioned around the cylinder are a plurality of xerographic stations.

A xerographic charging station generally designated 21 similar to that described in Fig. 1 is positioned adjacent to the cylinder surface and may, for example, include one or more fine conductive wires 22 or a row or plurality of rows of conductive points or needles connected to a high voltage source by means of conductive lead 24 and preferably at least partially surrounded by a conductive backing shield 23. This electrode is operable to supply corona discharge ions onto the surface of the xerographic cylinder 11.

Positioned adjacent to the charging member and next in the direction of rotation of the cylinder is an exposure station comprising suitable exposure means such as a lens 26 operable in conjunction with an exposure slit 28 to project onto the cylinder surface in slit exposure progress an image of a suitable documentary or other light image to be recorded. Because of the single printing step in the output of the machine, there is no need for a reversal mirror, and mirrors, if employed, are used in pairs to avoid image reversal in projection onto the cylinder surface.

Next adjacent to the exposure stage is a development stage generally designated 34, whereat a xerographic image is developed directly on a lithographic web 40. At this stage a lithographic web 40 passes from a feed roller 41 through guide and drive rollers 43 and 44 to take-up roll 42 passing between the xerographic cylinder 11 and a development member 61. Illustratively, the development member 61 may be a rotatable brush as for example, a fur brush or the like, adapted to pick up and receive developer material 32 from a developer dispensing hopper 31. The developing brush 61 is adapted to be rotated by suitable power source, such as for example, drive means 19, and is positioned to carry developer from the hopper 31 to and into contact with the reverse side of the lithographic web 40. In this manner, a developer, which may for example be finely divided powder material, is brushed onto the surface of the brush fibers whereby it is electrified by frictional contact and is then carried to the lithographic web where it is electrically deposited in conformity with the electrostatic image on the cylinder surface.

The xerographic cylinder upon leaving the development zone is free from deposited xerographic image by virtue of the image having been deposited directly on the lithographic web rather than first on the cylinder. It, therefore, may be moved directly to the charging zone 21 or may, if desired, be passed through any electrical regeneration stages or the like as may be preferred for operation. Thus, for example, in co-pending application Serial No. 348,126 filed April 10, 1953, there is disclosed and claimed an electrical regeneration system in which a xerographic plate is charged between xerographic cycles to an opposite polarity of charging in order to remove or fill electron or hole traps within the photoconductor or to otherwise improve the performance of the xerographic plate upon repeated recycling. It is understood that this or similar operation may be performed on the xerographic cylinder at a suitable stage in its cycle of rotation.

The lithographic web 40 leaving the xerographic cylinder 11 again bears a xerographic powder image which may, if desired, be passed through suitable fixing or fusing means such as a heat zone responsive to heat lamp 50 and thence to a water dispensing member 13 whereupon the hydrophilic lithographic web 40 is activated for selective ink reception. The web then passes to a suitable ink applicator and thence between printing rollers 55 where it receives a print sheet or the like from a paper feed

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mechanism 56. Thus there is directly produceable one or a plurality of lithographic prints 57 corresponding to an original xerographic image deposited on the web 40.

It is to be understood that the machine and mechanism described herein may be incorporated as a unit in a more complete mechanism including various card and sheet feed mechanisms for the presentation of image or copy material and for the presentation of print receiving surfaces. It is specifically intended that the machine may become a portion of a card feed or card recording system wherein documentary or like information is presented to the exposure slit 28, whether on moving card records or in the form of a cathode ray tube image corresponding to such documentary records. In addition, it is to be understood that the sheet feed mechanism 56 is intended to permit inclusion of means for the presentation of recording cards or business machine cards or the like to receive documentary information recorded thereon, and the machine is particularly valuable for the recording of documentary information on such cards.

In the present means and mechanisms for recording documentary and like information on cards or card-like members, it is presently particularly essential to maintain these cards in almost perfect dimensional stability. Thus, it is conventional for these cards to be punched in coded configuration wherein the dimensional tolerance from end to end of the card is extremely critical, generally being considered critical to a tolerance of about $\frac{1}{32}$ inch along the entire length of about six inches. Furthermore, card handling mechanisms require virtually complete absence of warping or other bending or disfiguration of the cards such as to call for extreme dimensional stability. One of the particular advantages of the present xerographic machine is its ability to print a final image which requires no additional operations for fixing or making permanent, while at the same time permitting development with material consistent with xerographic processing. Thus, the steps of making the image permanent on the print receiving member are obviated whereby operations inherently detrimental to dimensional stability are kept apart from the final print support, such as for example, documentary recording cards or the like.

It is to be understood that other devices and mechanisms for presentation of printing surfaces to the lithographic web may be employed without departing from the scope of the invention, and thus it is to be understood that print receiving members and surfaces of all types may likewise be employed within the scope of the invention. Nevertheless, an inherent advantage of this invention and one which is particularly valuable in potential commercial use is its preferential adaptability to the printing of documentary information on cards and card-like members. Specifically, other modifications may be made in the mechanism and device described herein and engineering details of construction may be added without departing from the scope of the present invention. Illustrated in the figures are typical xerographic procedural operations, and thus it is to be realized that certain modifications of these may be employed. For example, in xerographic development there has been illustrated development by cascade methods and by powder deposition from a moving brush or the like, and it is to be realized that other development methods such as presentation of developer in air or gas suspension or development by finely divided liquid developer may be employed. Similarly, slit projection exposure has been illustrated, and it is to be realized that contact exposure may be employed, as may single frame projection or contact exposure. Likewise, sensitization of the xerographic cylinder is shown by corona discharge electrodes and it is to be understood that other means of ion sensitization such as by means of radioactive materials may be employed, as may electrification by frictional contacting members. Similarly, transfer by electrostatic attraction is illustrated in Fig. 1

for transferring the image material from the xerographic cylinder to the lithographic web and thus it is to be realized that various forms of adhesive or contact transfer may be substituted therefor. In particular, by adhesive or contact transfer means there may be achieved some measure of fleeting or transitory attachment between the image and the lithographic web, whereby the web in belt form can be readily cleaned for reuse. Likewise, the image may be developed on the xerographic cylinder and subsequently transferred, or may, if desired, be formed directly on the lithographic web. Fixation of the image to the lithographic web may be performed by heat, by vapor, or by other means as desired. If desired, offset printing steps and apparatus may be incorporated in the machine and process, and in such case suitable image reversal mirrors, prisms, or other reversal mechanisms should be interposed in the optical system to produce a right-reading final print. It is specifically to be understood that these and other variations are within the scope of the present invention.

What is claimed is:

1. An apparatus for printing on print-receiving material of a type liable to dimensional change or change in other physical characteristics when subjected to xerographic heat or vapor fixing techniques, said apparatus including the combination of a rotatable xerographic cylinder having an image forming surface including a photoconductive layer, means to rotate said cylinder through a predetermined path of movement relative to a plurality of xerographic processing stations including a charging station having charging means for applying an electric charge to the photoconductive layer, an exposure station having projection means for projecting a light image of indicia to be recorded onto the charged photoconductive layer to form an electrostatic latent image corresponding to the light image, and a developing station having developing means for depositing powdered developing material on the photoconductive layer to form a powder image corresponding to the electrostatic latent image; means for supporting a web of water receptive planographic printing material, means for moving said web in surface contact with said photoconductive layer through a portion of its path of movement, transfer means for transferring the powder image from the photoconductive layer to the web surface during the period that the photoconductive layer and web are in surface contact, fixing means for fixing the powder image on the web surface, means for applying an aqueous solution to the surface of the web, means for applying lithographic

ink to the fixed powder image on the web surface, feeding means for feeding said print-receiving material into surface contact with the inked surface of the web, and means for pressing said print-receiving material into intimate surface contact with the inked powder image on the web surface.

2. An apparatus for printing on record cards of the type employed in business machine systems which are of such nature that they are liable to dimensional change or change in other physical characteristics when subjected to xerographic heat or vapor fixing techniques, said apparatus including the combination of a rotatable xerographic cylinder having an image forming surface including a photoconductive layer, means to rotate said cylinder through a predetermined path of movement relative to a plurality of xerographic processing stations including a charging station having charging means for applying an electric charge to the photoconductive layer, an exposure station having projection means for projecting a light image of indicia to be recorded onto the charged photoconductive layer to form an electrostatic latent image corresponding to the light image, and a developing station having developing means for depositing powdered developing material on the photoconductive layer to form a powder image corresponding to the electrostatic latent image; means for supporting a web of water receptive planographic printing material, means for moving said web in surface contact with said photoconductive layer through a portion of its path of movement, transfer means for transferring the powder image from the photoconductive layer to the web surface during the period that the photoconductive layer and web are in surface contact, fixing means for fixing the powder image on the web surface, means for applying an aqueous solution to the surface of the web, means for applying lithographic ink to the fixed powder image on the web surface, feeding means for feeding said record cards into surface contact with the inked surface of the web, and means for pressing said record cards into intimate surface contact with the inked powder image on the web surface.

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