

Nov. 19, 1968

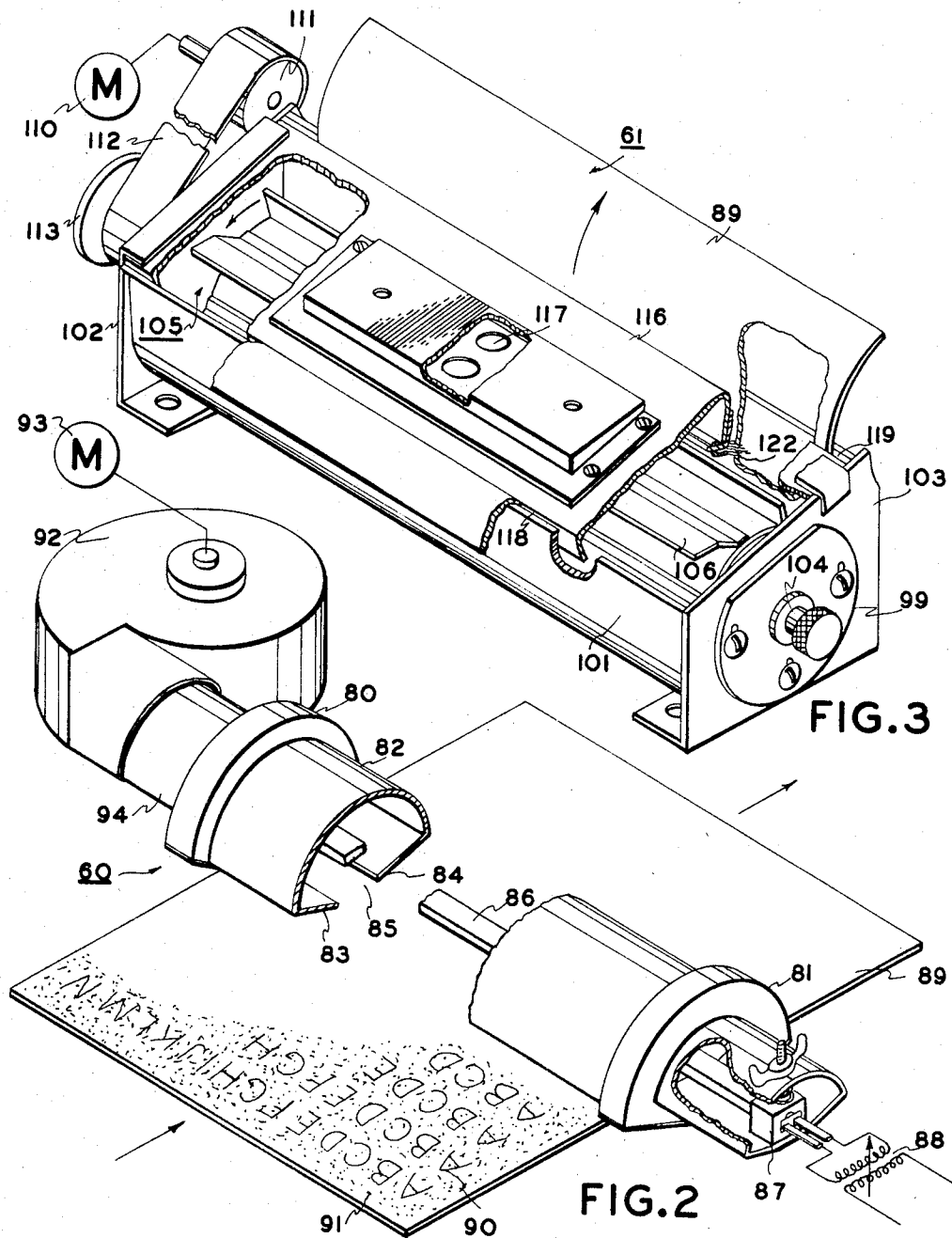
D. L. MALONE ET AL

3,411,932

QUALITY XEROGRAPHIC REPRODUCTIONS

Filed Sept. 23, 1964

4 Sheets-Sheet 2



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QUALITY XEROGRAPHIC REPRODUCTIONS

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4 Sheets-Sheet 3

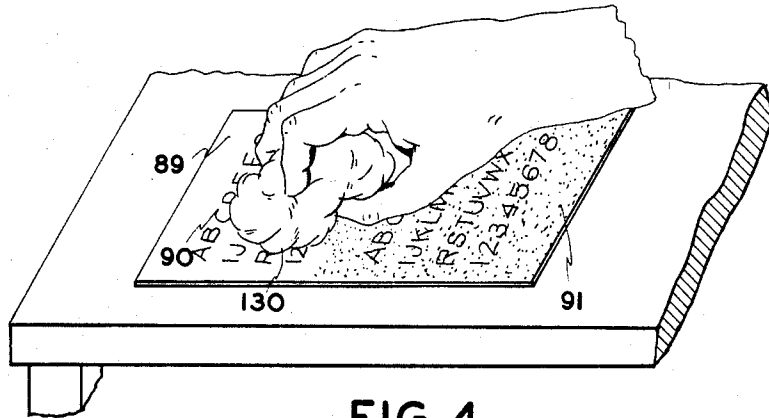


FIG. 4

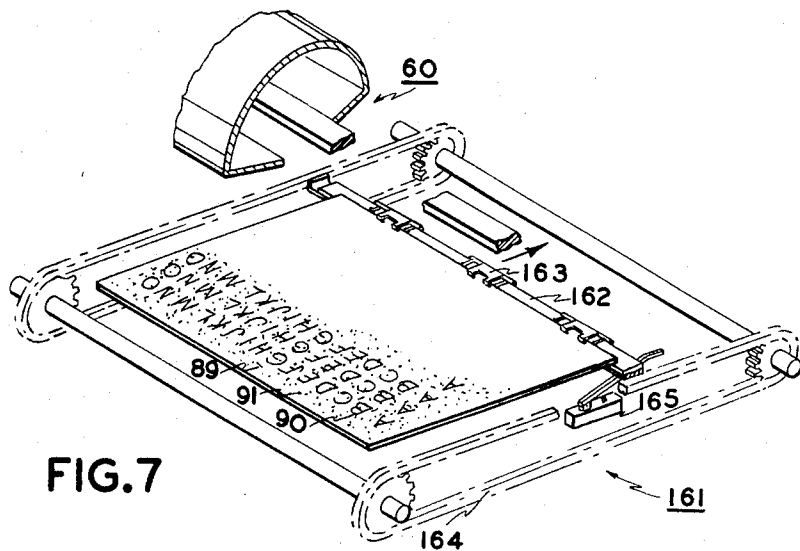


FIG. 7

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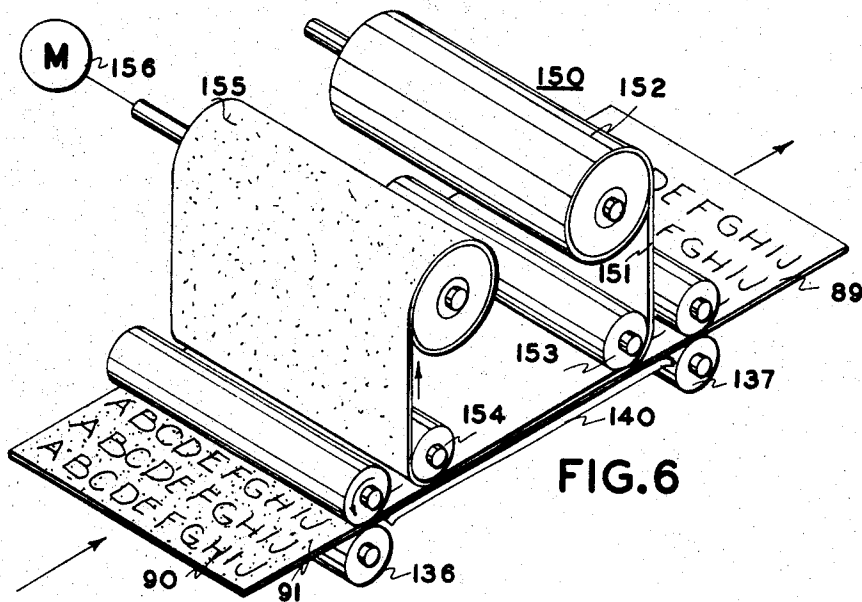
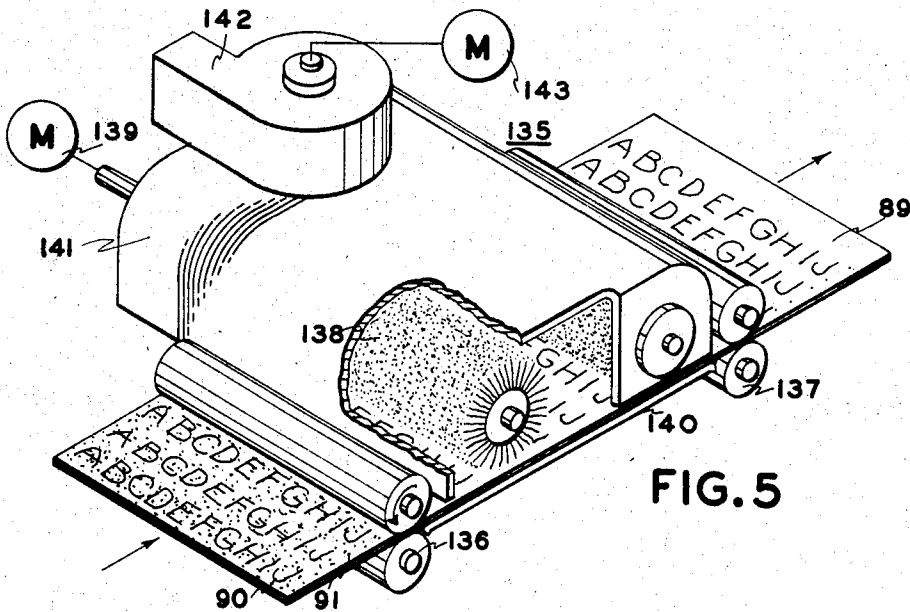
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QUALITY XEROGRAPHIC REPRODUCTIONS

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4 Sheets-Sheet 4



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3,411,932

QUALITY XEROGRAPHIC REPRODUCTIONS
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ABSTRACT OF THE DISCLOSURE

Method and apparatus for producing xerographic reproductions of graphic information on a support, substantially free of undesirable background, from xerographically developed images of high density deposits of powder particles in the image areas and low density unavoidably deposited randomly positioned powder particles in the non-image areas in which the support and powder deposits are exposed to a source of radiation for a predetermined time period at an intensity sufficient to fuse the high density powder deposits to the support but insufficient to fuse the low density background deposits of powder particles to the support and the unfused low density background deposits of powder particles are subsequently removed from the support.

This invention relates to xerography and more particularly to novel method and apparatus for improving the quality of xerographic reproductions characterized by being substantially free of developer powder deposition in unwanted, non-image areas.

In the process of xerography, for example, as disclosed in Carlson Patent U.S. 2,297,691, issued Oct. 6, 1942, a xerographic plate comprising a layer of photoconductive insulating material on a conductive backing is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the plate areas in accordance with the radiation intensity that reaches them, and thereby creates an electrostatic latent image on or in the photoconductive layer. Development of the latent image is effected with an electrostatically charged, finely-divided material such as an electroscopic powder that is brought into surface contact with the photoconductive layer and is held thereon electrostatically in a pattern corresponding to the electrostatic latent image. Thereafter, the developed xerographic image is usually transferred to a support surface to which it may be fixed by any suitable means.

The xerographic process is now widely known and has achieved wide commercial success by incorporation into automatic machines able to produce high quality reproductions at a rapid rate. These machines, producing literally millions of copies each month, utilize a xerographic plate in the form of a rotating cylindrical drum which sequentially passes through the various processing steps for effecting copy reproduction. With each cycle of operation the drum is generally cleaned of residual powders following the transfer step in order to prepare the drum for the next complete cycle of operation. These machines are substantially fully automatic from the time an operator places an original in copying position to the emergence of the final copy which may optionally be one or many from a single original.

A problem which has handicapped optimum quality of these reproductions has been the scattered deposition of unwanted xerographic developer powder in the background or non-image areas of the reproduction. This difficulty is generally attributed to the development sys-

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tem, but may also be attributed to dirty original powder contaminated optics or the like causing the unwanted powder to ultimately appear on the final reproduction. That is, various development systems are known in the art including powder cloud, brush, magnetic brush, cascade or the like each of which are effective to present the developer powder termed "toner" to the charge pattern to effect its development. In the cascade system, the developer comprises a combination of a carrier support in the form of carrier beads and toner, as disclosed for example in Walkup Patent U.S. 2,638,416 and is cascaded over the latent image on the photoconductive layer. Whatever development system is employed, the toner is agitated on its support whereby a triboelectric charge of a desired polarity is produced on the toner and a charge of opposite polarity is produced on the support from which the toner is removed. The triboelectric processes, however, are statistical and it has been known that not all toner particles are charged to the same degree or to the same polarity as that sought to be obtained. As a result of this incomplete triboelectric effect, it has been known that the incompletely charged toner tends to deposit spuriously in non-image areas of the xerographic plate to be later transferred to the final copy sheet and fused thereon. At the same time, it has been known that additional toner particles deposit in the non-image areas by purely mechanical forces when the developer is presented to the photoconductive layer.

It should be appreciated, therefore, that prior to fusing, all the developer, including that comprising the wanted image as well as the unwanted background, is loosely held posing a problem of difficult selective removal. At the same time, following fusing all the powder has heretofore been too permanently affixed as to render the problem of selective removal even more difficult. Efforts to remove this background deposition have therefore been unsuccessful and accordingly, the need to effect its elimination has long been recognized.

In addition to the background problem described above, it has long been desired to enable selective elimination of unwanted image areas reproduced onto the copy sheet as from the original, the transport mechanism or the like. As for example, business considerations such as statements of account, frequently require the updating of information from the original to the copy in order to supply the customer with the most current of information. This likewise has been a problem in that it has not been possible to effect this elimination of unwanted image areas without manual intervention prior to fusing as by intercepting the copy sheet and wiping away loosely held toner in the undesired areas.

Now in accordance with the instant invention, there is provided novel method and apparatus adapted to provide improved xerographic copy by the consistent elimination of scattered background deposition and at the same time possessing the ability to automatically eliminate unwanted image areas from the final copy.

Accordingly, it is an object of the invention to provide novel method and apparatus for effecting improved quality xerographic reproductions.

It is a further object of the invention to provide novel method and apparatus whereby improved xerographic reproductions are formed on a copy sheet substantially devoid of scattered developer powder in the background non-image areas.

It is a further object of the invention to provide novel method and apparatus for improving the quality of xerographic reproductions by eliminating the reproduction of unwanted image areas while also eliminating scattered developer toner from the background non-image areas of the reproduction.

It is a still further object of the invention to provide novel method and apparatus which when incorporated into an automatic xerographic machine effects an economical improvement for producing high quality xerographic reproductions whereby the commercial success thereof is substantially enhanced.

These and other objects are achieved in accordance with the invention by employing a combination of fusing and cleaning in which the fusing member is operatively effective selectively for fusing to the support sheet the electroscopic toner material in mass densities corresponding to an image while at the same time is substantially ineffective for fusing scattered relatively smaller mass densities corresponding to scattered background deposition. Since fusing is selective as aforesaid, background deposition can subsequently be removed in the cleaning phase as by wiping without deleteriously affecting the image areas of the reproduction. In addition to the inherent property of selective fusing, the fusing element employed in the invention is further characterized by having substantially zero warm-up time as compared to approximately 20 seconds to 15 minutes for prior units for which continuous operation is required and substantially zero residual heat which enables substantially immediate discontinuance of the fusing operation. This latter feature permits de-energizing the unit in timed relation to the passing of reproduced unwanted image areas as to effect their elimination in the subsequent cleaning step.

Further objects and features of the invention will become apparent while reading the following description in connection with the following drawings wherein:

FIG. 1 is a schematic sectional elevation of an automatic apparatus which includes fusing and cleaning the final reproduction in accordance with the invention:

FIG. 2 is an isometric view of the fuser illustrated schematically in FIG. 1;

FIG. 3 is an isometric view of the cleaner assembly illustrated schematically in FIG. 1;

FIG. 4 is an isometric view of a hand process step for cleaning the final reproduction following fusing alternatively to the cleaning apparatus in FIG. 1;

FIGS. 5 and 6 are alternative forms of apparatus as may be utilized for cleaning the reproduction following fusing in accordance with the invention; and,

FIG. 7 is a fragmentary isometric view of apparatus illustrating a temporary de-energizing of the fuser permitting unwanted image areas on the reproduction sheet to pass the fuser unfused.

For a general understanding of the xerographic processing system in which the invention is incorporated, reference is made to FIG. 1 in which the various system components are schematically illustrated. The xerographic apparatus described herein may be an adaptation of the type disclosed in Eichler et al. Patent U.S. 2,945,434. As in all xerographic systems based on the concept disclosed in the above cited Carlson patent, a radiation image of copy to be reproduced is projected onto the sensitized surface of a xerographic plate forming an electrostatic latent image thereon. Thereafter, the latent image is usually developed with an electrospectically charged developing material to form a xerographic powder image, corresponding to the latent image on the plate surface. The developed image is then transferred to a support surface to which the image is permanently affixed by means of a fuser apparatus.

As shown in FIG. 1 there is illustrated a light-tight cabinet 10 for enclosure and containment of all the operative components. Copy to be reproduced, such as a book, sheet or the like, here designated 11, is supported at a copy station 12. The copy station includes a horizontally arranged transparent platen support 13, such as glass, on which the copy rests in position to be optically scanned. Projection of the copy image is achieved by means of a scanning mechanism that includes a pair of transversely

extending fluorescent lights 22 and 23 that are adapted to move horizontally from the position shown solid to the position shown dashed as more fully described in the above-cited Eichler patent. Light shields 24 and 25 prevent stray light from being transmitted from the lamps other than that which is utilized for illuminating the copy above. An image of the illuminated copy is reflected through objective lens 26, which moves horizontally in conjunction with the lamp, for projecting an image downwardly through an aperture slit 28 and onto the surface of a xerographic plate in the form of rotating drum 29.

Xerographic drum 29 includes a cylindrical member mounted in suitable bearings in the frame of the machine and is driven in a counterclockwise direction by a motor 30 at a constant rate that is proportional to the scanning rate of the copy, whereby the peripheral rate of the drum surface is identical to the scan rate of the reflected light image. The drum surface comprises a layer of photoconductive insulating material 31, which may for example, be vitreous selenium, supported on a conductive backing 32, such as aluminum. Prior to exposure, the drum surface is sensitized by means of a corona generating device 33, which may be an adaptation of the type disclosed in Vyverberg Patent U.S. 2,965,756 and which is energized from a suitable high potential source (not shown).

The exposure of the drum to the light image discharges the photoconductive layer in the areas struck by light, whereby there remains on the drum a latent electrostatic image in image configuration corresponding to the light image projected from the copy. As the drum surface continues its movement the electrostatic latent image passes through a developing station 40 in which a two-component developing material 41, which may be the type disclosed in Walkup patent supra is cascaded over the drum surface by means of a developing apparatus 42.

In the developing apparatus, the two-component developing material 41 is carried upwardly by conveyor 43 driven by suitable drive means and released onto chute 44 wherefrom it cascades down over the drum surface effecting development of the latent image thereon. Toner component 45 of the developer that is consumed in developing is stored in dispenser 46 and is released in amounts as controlled by the dispensing mechanism.

After developing, the powder image passes through an image transfer station 50 at which the powder image is transferred by means of a second corona generating device 52, similar to corona generating device 33 mentioned above, to a sheet of copy paper 53. The copy sheets are arranged in stack form on a supply tray 54 and are fed therefrom individually by means of a mechanical feeder 55 adapted to feed the top sheet of the stack through driven feed rollers 56 which direct the sheet material into contact with the rotating drum in coordinated registration with the arrival of the developed image at the transfer station.

Following transfer, a pick-off mechanism 57 ensures removal of the copy sheet from the drum surface wherefrom the copy sheet is directed onto an endless conveyor 58 whereby the copy sheet is carried past the fusing and cleaning devices of the invention respectively and designated as 60 and 61. As will be more fully described below, the image is permanently affixed thereat by the fuser onto the copy sheet while unwanted scattered powder deposition in the background areas is removed by the cleaning device. Thereafter, the finished copy passes through further feed rolls into a vertical conveying system 65 by means of which the copy is delivered to a copyholder 66 supported along the top portion of cabinet 10 from where it may conveniently be removed by an operator.

After transfer, the xerographic drum surface passes through a cleaning station 70 at which the surface is brushed by cleaning brush assembly 71, whereby residual developing material remaining on the drum surface is removed. The powder removed from the drum surface

is exhausted through port 72 by means of a suction provided from fan 73 and becomes lodged in a removable filter bag 74. The drum surface then passes through a discharge station 75 at which it is illuminated by a fluorescent lamp 76 whereby the drum surface in this region is completely flooded with light to remove any electrostatic charge that may remain thereon. Suitable light traps are provided in the system to prevent any light rays from reaching the drum surface other than the projected image, during the period of drum travel immediately prior to sensitization by corona generating device 33 until after the drum surface is completely passed through the developing station 40.

Refer now also to FIG. 2 in which the fusing apparatus of FIG. 1 is more completely illustrated. As there shown, the fuser includes two semi-annular machined rings 80 and 81 adapted for mounting within the apparatus of FIG. 1. Each of the rings are pierced to receive an interior polished reflector housing 82 which is semicircular, terminating along its lower portion in a pair of oppositely arranged flange members 83 and 84 extending toward each other obliquely to the horizontal and forming a continuous exposure slit 85 therebetween. Axially supported in the housing and extending aligned parallel above slot 85 is a tubular type enveloped lamp 86 connected to a terminal block 87 to which is connected an adjustable transformer 88. The lamp is characterized by the capability of emitting a predominance of near infrared radiation of wave length generally shorter than $2\frac{1}{2}$ microns and corresponding to a filament temperature of approximately 2500° K. With the arrangement shown, the lamp is positioned such that the polished inner surface of the housing 82 reflects an image of the lamp filament onto a copy sheet 89 passing therebelow to fuse images 90 without significantly affecting loosely scattered toner particles 91 on or about the background areas. Other reflector configurations such as elliptical, double parabolic, etc. can likewise be used to image the filament of the fuser source onto the copy sheet.

The exact conditions under which the lamp is operated is controlled by the voltage supplied by means of variable transformer 88 in order to maintain the desired filament temperature. It has been found that paper conventionally employed for xerography is highly reflective in the named wavelength range such that the lamp when adjusted to optimum settings emits energy that is selectively effective in only heating the large density mass of developer toner particles representing the image. This can be explained on the theory that the portion of radiant energy, such as near infrared radiation directed against the toner images is absorbed and the images become heated. At the same time the support surface being highly reflective to the wave length of emission, reflects rather than absorbs, the received radiation. Accordingly, the radiant energy striking the usually glazed paper surface, lighter in color than the developer, is not converted into heat energy while the developers being pigmented, generally black, are highly heat absorbent to convert the radiation into heat energy to become fused to the paper surface. At the same time, the scattered toner in and about the background areas have such insignificant mass density that they absorb insufficient quantities of radiation to effect their fusing and the area responds reflectively as if in their absence. Typically, image reproductions of typewritten copy have image densities greater than 0.6 while most of the scattered background toner have densities of less than 0.1.

More specifically with the lamp at the desired filament temperature, approximately 75% of the energy emitted by the source lies below $2\frac{1}{2}$ microns. At this range of wave length, the paper is highly reflective while the developer toner absorbs the predominance of incident energy. In the areas of image size toner deposits fusing results since the radiant energy is absorbed raising the toner temperature which in turn heats the paper by conduction. At the same time, smaller particles, representative

of spurious background deposits having higher surface-to-volume ratios, are removable since they lose much of their absorbed energy through reradiation and convection and heat the paper insufficiently to effect bonding. The incident energy by which fusing is accomplished consists generally of direct radiation from the lamp as defined by exit slot 85, as well as the focused radiation emitted therethrough comprising the image of the lamp source formed by the housing reflector system. The efficiency of the selective fusing can be modified by the relationship between the direct radiation and the energy density emitted by the focused radiation.

To effect fusing selectively in accordance with the invention a 1350 watt lamp, marketed commercially by the General Electric Company as a type T2½ tungsten lamp with quartz envelope, was employed. Paper speeds of about 1.4 inches per second produced the necessary fusing with a transformer setting corresponding to approximately 700 watts dissipated by the lamp. Paper speeds of about 0.8 to 1.7 inches per second were likewise suitable at this transformer setting. Since it is desired to limit the longer wave lengths emitted from the lamp, a blower 92 operated by motor 93 is used to force large volumes of ambient air in excess of 10 cubic feet per minute into the housing past the lamp emerging through slot 85. This maintains the lamp envelope temperature low so that very little energy is radiated by the envelope to prevent its becoming a secondary emitter which would otherwise itself partially effect fusing.

Accordingly, after passing the fuser, the image areas 90 on sheet 89 are permanently affixed thereto while the background scattered particles are loosely retained thereon as to be capable of being wiped off or otherwise removed. Several methods have been found convenient for effecting this removal. A first method is incorporated in an apparatus shown in FIGS. 1 and 3 for removing the background deposition automatically. The unit 61 therefore effects cascade cleaning of the copy sheet which is directed toward the unit through a guide slot defined between parallel guide members 95 and 96. The sheet is then gripped by the bite of a pair of driven pinch rollers 97 and 98 which force the sheet into an entrance slot 118 defined in the forward part of the unit.

The cleaning unit 61 comprises a moderately deep disk tank 101 generally semi-cylindrical along its bottom surface and enclosed at its ends by end walls 102 and 103 for containing a predetermined quantity of electroscopic carrier beads 115 adapted to attract and remove unfused toner from the copy sheet. The electroscopic carrier beads 115 are of a type normally employed in combination with developer toner, as described for example, in the Walkup patent supra, but which is employed herein initially toner-free. Secured to the end walls are journal plates 99 between which is journaled shaft 104 having mounted thereon a paddle wheel 105 adapted to convey the carrier beads into a cascading relation with the image side of the moving copy sheet. The paddle wheel is formed of blades 106 secured about shaft 104 and curved generally forwardly in the direction of rotation whereby to convey the carrier beads about the tank and centrifugally release them moving relatively against the surface of the copy sheet. Rotation of the paddle wheel is effected from a motor 110 connected via a pulley 111 and timing belt 112 to a sheave 113 secured on shaft 104. The paddle wheel is rotated at a rapid rate on the order of approximately 200 r.p.m.

A cover 116 fits over the top of tank to generally prevent the escape of the moving carrier and includes a plurality of vent holes 117 by which ambient pressures are maintained within the tank. Cover 116 is physically dimensioned less than the full width dimension of the tank and is situated as shown in the drawings to define an entrance slot 118 whereby copy sheet 89 enters the tank and an exit 119 whereby the copy sheet emerges therefrom. The carrier particles contained in the tank pass over the moving copy with a cascading action and by virtue of

the inherent triboelectric properties generated in its continuous movement, attracts all loosely held powder from the copy sheet 89 passing thereunder. As a result, the copy sheet emerges through exit 119 substantially free of all toner particles except in those image areas in which the powder has been previously affixed thereto. A flexible felt wiper 122, attached to the exit portion of the cover, effects a wiping action against the passing copy to prevent the escape of carrier particles which attach themselves to the copy surface. After repeated use, the carrier beads become contaminated with toner and are replaced with a fresh quantity. The emerging copy is engaged by the bite of a pair of driven feed rolls 123 and 124 which force the copy through a guide slot formed by guide members 125 and 126 after which the copy continues its movement into conveyor 65 described above.

Automatic cleaning units other than that illustrated in FIG. 1 can be substituted therefor. Referring first to FIG. 5, there is illustrated a brush cleaning unit designated 135 past which the copy sheet 89 is fed by means of two pair of driven feed rolls 136 and 137, to pass over a stationary platen 140. The cleaning unit includes one or more rotating brushes 138 which are driven by a motor 139 whereby the brush bristles are rotated continuously in contact with the image surface of the copy moving therepast. The brushes are contained in a generally enclosed housing unit 141 that is continuously evacuated by a blower unit 142 operative by motor 143. The brushes, rotating continuously in contact with the surface of the copy sheet, obtain a cleaning effect analogous to that obtained with the cascade unit described above. Preferably, the bristles are characterized as to triboelectrically attract the loose powder particles and may, for example, comprise natural or synthetic fibers as are known in the art. The vacuum generated by means of blower 142 withdraws the removed toner powder from the brush bristles for discharge to a suitable filter means as to maintain the brush relatively clean for long periods of time.

Still another unit for effecting cleaning is illustrated in FIG. 6 and designated 150. This latter unit comprises an automatic continuous feed of a soft disposable type cloth, such as cotton, in the form of a continuous web 151. The web is supplied from a supply roll 152 wherefrom it passes over a pair of soft resilient guide rolls 153 and 154 that urge the web against the surface of the moving copy sheet and then passes onto a takeup roll 155 being driven by motor 156. The web moves at a relatively slow rate, as compared to the movement of copy, and preferably travels in a direction counter to that of the copy such that the cleanest portion of the web encounters the lowest concentration of scattered toner 91. With a disposable web material, the soiled consumed material on the take-up roll can be discarded or cleaned for subsequent reuse.

As an alternative to cleaning the copy sheet within the apparatus in the manner described above, it can instead be permitted to emerge therefrom with the scattered background toner 91 still contained thereon. As shown in FIG. 4, the background deposition can be removed by means of a soft cotton or the like 130 which is hand-wiped across the copy surface. It is to be noted in the figure that the top portion of the copy sheet over which the cotton has passed is substantially or entirely free of scattered background deposition 91 while that in the lower portion yet to be wiped still contains these particles.

As previously described above, a selected lamp 86 is preferably characterized in its ability to achieve radiant fusing operating conditions substantially instantaneously when energized. At the same time, it has extremely low heat residual as to discontinue significant emission of fusing energy within approximately 100 milliseconds after being de-energized. This inherent property of the preferred lamp structure enables controlled energizing and de-energizing in a manner whereby selected linearly lateral portions of the copy sheet are able to move past the fuser without fusing relatively dense image masses of toner ma-

terial which otherwise would be fused. Particularly, as stated above, it has long been desired to eliminate unwanted image areas for updating information as described above. Various cams, gears, timers or the like can be suitably adapted for switching the fusing circuit in timed relation to the movement of the copy sheet past the fuser mechanism. As shown in FIG. 7 there is illustrated a paper transport 161 which may be of a type described in Eichorn et al. Patent 3,099,943. The transport employs a gripper bar 162 connected to a pair of oppositely arranged endless driven chains 164 having a plurality of individual paper grippers 163 for advancing copy sheet 89 past the fusing unit.

In order, by way of example, to de-energize the fusing lamp at the appropriate transport position of sheet travel as to prevent fusing along the leading edge of copy, there is provided a microswitch 165 supported adjacent to one of the chains intermediate the chain and the side edge of the copy sheet. The microswitch is connected in the fuser circuit and has a long contact arm 166 extending vertically inclined from the switch in the path of the moving gripper bar for engagement thereby. When engaged by the gripper bar the switch de-energizes the fuser for a controlled time period until the gripper bar has completely traversed the contact arm 166. The length of contact is commensurate with the dimension of the copy material to be deleted such that with the copy sheet traveling at 1.4 inches per second, the fuser is de-energized for a period of approximately 0.35 second coincident with the time at which the portion to be deleted arrives and passes the fusing position. Subsequent cleaning of the copy sheet as described above effects removal of the unfused deletable portion. Obviously suitable time delays can be provided to adapt the controlled de-energizing of the fuser to any desired portion of the copy sheet.

By the above description, there is disclosed novel method and apparatus whereby the finished quality of xerographic reproduction is improved in the elimination of unwanted scattered toner in the background areas. At the same time, there is disclosed novel method and apparatus whereby laterally arranged deletable unwanted image portions of the reproduction formed on the copy sheet can be eliminated. The methods and apparatus described form a highly expedient method of improving the overall quality without expensive or elaborate apparatus or controls as have been attempted heretofore. Thus, in accordance with the invention, a simple, yet highly effective means has been disclosed in resolving a difficulty that has long awaited a solution.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A method of producing a xerographic reproduction of graphic information on a support, substantially free of undesirable background, from a xerographically developed image of high density deposits of powder particles in the image areas and low density unavoidably deposited randomly positioned powder particles in the non-image areas comprising,

exposing said support and powder deposits to a source of radiation for a predetermined time period at an intensity sufficient to fuse said high density powder deposits to said support but insufficient to fuse said low density background deposits of powder particles to said support, and

removing the unfused low density background deposits of powder particles from the support.

2. A method of producing a xerographic reproduction of graphic information on a support, substantially free of undesirable background, from a xerographically developed image of high density deposits of powder particles in the

image areas and low density unavoidably deposited randomly positioned powder particles in the non-image areas comprising,

exposing said support and powder deposits to a source of radiation over a predetermined time period at a controlled intensity which produces heating of said high density powder deposits to a temperature sufficient to effect fusion to said support and which produces heating of said low density powder deposits to a temperature insufficient to effect fusion to said support, and

cleaning the image surface of said support to selectively remove the unfused low density powder deposits therefrom.

3. The method according to claim 2 in which the predominance of radiation emitted by said source is in the wavelength range of not greater than 2.5 microns.

4. The method according to claim 2 in which said cleaning step comprises cascading a quantity of electroscopic carrier particles over the image surface of said support to electrostatically remove loosely retained developer powder particles therefrom.

5. The method according to claim 2 in which said cleaning step comprises wiping the image surface of said support with a generally soft fibrous material.

6. The method according to claim 2 in which said cleaning step comprises brushing the image surface of said support with a brush having bristles relatively free of developer powder particles thereon.

7. Apparatus for producing a xerographic reproduction of graphic information on a support, substantially free of undesirable background, from a xerographically developed image of high density deposits of powder particles in the image areas and low density unavoidably deposited randomly positioned powder particles in the non-image areas comprising,

a source of radiation,

means for subjecting said support and powder deposits thereon to exposure by said source of radiation for a predetermined time period at an intensity sufficient to fuse said high density powder deposits to said support but insufficient to fuse said low density background deposits of powder particles to said support, means for removing the unfused low density background deposits of powder particles from the support, and

means for removing said support from exposure by said radiation source and for subjecting the image bearing surface thereof into operative relationship with said powder removing means.

8. Apparatus according to claim 7, said radiation source comprising a lamp which when energized emits a predominance of radiation in the wavelength range of not greater than 2.5 microns.

9. Apparatus according to claim 8, further including a housing for supporting said lamp, said housing including a wall portion having a slot defined therein to permit emission of radiation on exposed portions of said support.

10. Apparatus according to claim 9, said lamp housing including a radiation reflective surface positioned about said lamp to reflectively focus radiation toward said slot.

11. Apparatus according to claim 7, said powder removing means comprising,

bearing surface of said support, and

rotatable brush means positioned to contact the image means for continuously rotating said brush means about the axis thereof.

12. Apparatus according to claim 7, said powder removing means comprising,

a continuous web of soft absorbent material positioned to contact the image bearing surface of said support, and

means for continuously advancing said web across the surface of said support.

13. Apparatus according to claim 7, said powder removing means comprising,

a receptacle containing a quantity of electroscopic carrier particles,

means defining a path of travel within said receptacle along which said support is advanced, and

means for agitating said carrier particles within said receptacle to contact the image bearing surface of said support to remove unfused powder particles therefrom.

14. Apparatus for producing a xerographic reproduction of graphic information on a support, substantially free of undesirable background, from a xerographically developed image of high density deposits of powder particles in the image areas and low density unavoidably deposited randomly positioned powder particles in the non-image areas comprising,

a source of radiant energy,

means for energizing said source of radiant energy to emit radiations at a predetermined energy level,

means for subjecting said support and powder deposits thereon to radiations emitted by said source for a predetermined time period,

said predetermined energy level and said predetermined time period being of respective intensity and duration magnitudes to produce heating of said high density deposits of powder particles in the image areas to a temperature sufficient to fuse to said support and to produce heating of said low density deposits of powder particles in the non-image areas to a temperature insufficient to fuse to said support,

cleaning means for removing the unfused low density powder particles from said support without substantially affecting the fused high density powder deposits thereon, and

means for withdrawing said support from an operative relationship with said source of radiant energy and for subjecting the image bearing surface thereof into operative relationship with said cleaning means.

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E. J. CABIC, *Assistant Examiner*.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,411,932

November 19, 1968

David L. Malone et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 18, "FIG. 1" should read -- FIG. 1. --. Column 9, line 62, beginning with "11. Apparatus" cancel all to and including "thereof." in line 67, same column 9, and insert

11. Apparatus according to claim 7, said powder removing means comprising,
rotatable brush means positioned to contact the image bearing surface of said support, and
means for continuously rotating said brush means about the axis thereof.

Column 10, lines 21 and 22, "particels" should read -- particles --.

Signed and sealed this 10th day of March 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents