MAGNETIC BRUSH CLEANING SYSTEM

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Field of Search 355/3, 10, 14, 15, 17; 118/637; 117/17.5, 37 LE

References Cited

UNITED STATES PATENTS

3,405,682 10/1968 King et al. 355/10
3,572,923 3/1971 Fisher 355/15
3,590,412 7/1971 Gerbasi 355/15

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ABSTRACT

The present case concerns several systems for cleaning a photoconductor of residual toner at a cleaning station and recirculating the toner to a developer station in a copier machine. One embodiment contemplates a fairly continuous accumulation of residual toner in the cleaning unit and a periodic recirculation of the toner to the developer unit. Another embodiment makes use of a cleaning station for performing cleaning of toner from an imaging portion of a photoconductor drum member and concurrent conveyance of residual toner from the cleaning station back to the developer station by another portion of the photoconductor. In still another version, recirculation is performed by augers. In some cases, recirculation is initiated by counter means operative after a predetermined number of cycles.

15 Claims, 5 Drawing Figures
MAGNETIC BRUSH CLEANING SYSTEM

BACKGROUND OF INVENTION, FIELD, AND PRIOR ART

A variety of techniques have been described in the prior art for cleaning of a photoconductor in a copier machine and in some circumstances, recirculation of residual toner. However, none of the prior art to be discussed is considered anticipatory of the present arrangements.

U. S. Pat. No. 2,757,635 and United Kingdom patent 1,059,649 are representative of toner recirculation systems using blowers or air flow. The U. S. Pat. Nos. 3,306,193; 3,333,572; 3,405,682; and 3,438,706 are representative of patents showing the use of separate belt members, or the like, for conveyance of toner in the system in a recirculation mode, or simply for the purpose of cleaning, without recirculation. The U. S. Pat. No. 2,874,063 is an early teaching of the use of a magnetic member for cleaning of a photosensitive surface. The U. S. Pat. No. 3,357,402 describes the use of fur brushes for both developing and cleaning of a photoconductor. The U. S. Pat. No. 3,552,850 describes a cascade developer with a scraper member for cleaning and effects some transportation of residual toner particles on the photoconductor surface.

SUMMARY OF THE INVENTION

The invention, in its various forms, is set in a copier machine making use of a drum photoconductor member. In a first embodiment, various stations are arranged around the periphery of the drum including a charging station, an imaging station, an erasing station, a developing station, a transfer station, and a cleaning station. In one form, the developing and cleaning stations comprise magnetic brush members operable to attract and repel toner particles relative to the drum photoconductor surface. Electrical circuit means is provided that is operable in a first mode to provide appropriate biasing signals to effect charging, imaging, developing, transferring, and cleaning of images with accumulation of residual toner particles at the cleaning station. In another mode, the electrical circuit means is effective to establish appropriate biasing so that residual toner particles are attracted from the cleaning unit onto the surface of the drum, conveyed by the drum to the developing station and deposited therein. A counter controls the timing or institution of the recirculation cycle.

In another form of the invention, inter-image areas are provided on the surface of the drum between each succeeding image area, and cam members are located in operable relation with respect to the drum to effect changes in bias of the various stations to convey toner from the cleaning station to the developing station in the inter-image areas concurrently with imaging and copy making. Thus, recirculation is effected concurrently with the copy making process and a separate recirculation cycle is not required in this version.

In another form of the invention, a magnetic brush member has a first cleaning portion operable to remove residual toner particles from the surface of the photoconductor drum and a second portion insulated from the first portion and operable to convey residual particles from the cleaning station back onto the drum for conveyance back to the developer station. In this version, the recirculation of toner particles also takes place concurrently with the normal copy making processes in the machine. As before, appropriate biasing potentials are provided in the system to effect the removal and transportation of toner particles.

In still another version, cleaning and developing stations are provided adjacent the drum photoconductor member and recirculation of toner particles is effected essentially in a mechanical fashion by the use of auger means arranged in such a fashion that toner particles may be conveyed from the developer station to the cleaning station, or vice versa.

OBJECTS

Accordingly, a primary object of the present invention is to provide a cleaning system for a copier machine with the capability of recirculating residual toner in a highly efficient manner to the developing station in the machine for reuse. Another object of the present invention is to provide a cleaning and recirculating system for a copier machine wherein the system is normally operable to develop and clean a photoconductor member during a copy making mode and is periodically operable in a recirculating mode to transfer residual toner from the cleaning station to the developing station. Still another object of the present invention is to provide a system of this nature in which recirculation of residual toner from a cleaning station to a developing station is effected concurrently with copy making operations, thereby eliminating the requirement for a separate independent recirculation cycle.

A further object of the present invention is to provide a cleaning and recirculating system for a copier machine in which a recirculation cycle is initiated upon occurrence of a predetermined number of developing and cleaning cycles during copy making operations. A still further object of the present invention is to provide a combined cleaning member having a first portion operable to remove residual toner from a photoconductor member during cleaning operations and a second portion operable to return residual toner to said photoconductor member for transportation to the developing station in said system.

An object of the present invention is to provide a cleaning and recirculating system for a copier machine making use of mechanical means to effect the recirculation of residual toner in the system. The foregoing and other objects, features, and advantages of the invention will be apparent from the following more particular description of various embodiments of the invention as illustrated in the accompanying drawings.

DRAWINGS

In the Drawings:

FIG. 1 represents a copier machine incorporating a cleaning and recirculating system in accordance with the present invention in which developing and cleaning cycles are normally effected during copy making operations and having provision for periodically recirculating residual toner from a cleaning station to a developing station with the photoconductor member serving as the transport means in the system. A counter is provided to recognize the occurrence of a predeter-
FIG. 2 represents a cleaning and recirculating system in which a photoconductor member has a plurality of image areas, each separated by an inter-image area and having facilities for imaging, developing, transferring, and cleaning the image areas in a normal copy making mode while concurrently providing appropriate potentials to effect recirculation of toner from the cleaning station to the developing station by deposition in the inter-image areas.

FIGS. 3 and 4 represent another version of the invention in which the cleaning station comprises a magnetic brush member having a first portion for cleaning of residual toner from the photoconductor member and a second portion for transfer of residual toner onto a special area of the photoconductor member for transportation back to the developing station concurrently with copy making operations.

FIG. 5 represents a cleaning and recirculating system having a developing station and a cleaning station and mechanical means in the form of augers for effecting recirculation of toner back and forth between the stations, as required.

**DETAILED DESCRIPTION**

**Cleaning System**

The system includes a separate magnetic brush cleaning station with means for recirculating toner from the cleaning station to the developing unit.

FIG. 1 shows schematically a copying machine having a developer 1 in which magnetic brush 2 rotates as shown and a separate cleaning station 3 in which magnetic brush 4 rotates as shown. The units have bucket systems 5 and 6 which transport mixtures of toner and magnetic carrier upward into reservoirs placed atop the magnetic brush drums. These drums contain stationary magnets in core assemblies (not shown) which attract the magnetic carriers so the mixtures are carried past the photoconductor on drum 7 by the abrasive surfaces of the magnetic brush drums. Developer unit 1 also includes a replenisher unit 8 which adds toner to the system and a mixing auger 9a which mixes carrier and toner. This machine has two modes of operation.

In the development mode, toner is placed on the photoconductor surface and appropriate areas by development magnetic brush 2. Most of this toner is subsequently transferred to paper 9 supplied by paper feed unit 10 at transfer station 11. This paper is subsequently fed through fuser 12 to stack 13. Residual toned images left on the photoconductor after transfer are subsequently removed by cleaner magnetic brush 4.

Operation in this mode can continue until the concentration of toner in the cleaner unit 3 reaches a level which prevents effective cleaning. When this occurs a recirculation cycle is obtained by the operation of relay coil 14, the contacts of which change the electrical bias applied to various components so that toner is deposited on the photoconductor surface by cleaner magnetic brush 4 to be subsequently carried by the revolution of drum 7 to developer magnetic brush 2 which attracts and removes this toner. The following discussion of both modes of operation assumes that the carrier in developer unit 1 is coated with a material such as tetrafluoroethylene which triboelectrically places a positive charge on the toner particles and that the carrier in cleaner unit 3 is coated with a material such as ethyl cellulose which triboelectrically places a negative charge on the toner particles. This combination produces effective cleaning.

In the development mode, the photoconductor surface is first charged negatively by charge corona wires 15 operating in conjunction with grid wires 16. The photoconductor is subsequently discharged in areas corresponding to the light areas of document 17 placed atop a glass plate traveling in the direction shown and illuminated by lamps 18 which expose photoconductor through lens assembly 19 and aperture 20. Erase lamp 21 is not used in this mode. A negative bias is applied through contact 52 associated with coil 14 to provide the conventional development electrode effect which prevents the toning of background areas of the photoconductor. Triboelectrically positively charged toner particles from the mixture being carried by developer magnetic brush 2 are deposited on the areas of the photoconductor which have not been fully discharged. Most of these particles are subsequently transferred to the surface of paper 9 with the aid of an electrostatic field produced by the application of a negative voltage to transfer corona wire 22. The photoconductor is subsequently discharged by a fluorescent erase lamp 23 driven by ballast 24 which is in turn activated by the AC line through contact 25 of the relay. Subsequently toner particles remaining on the photoconductor are triboelectrically charged negatively by contact with the carrier in cleaner unit 3 and are attracted by the electrostatic field produced through the application of a positive electrical bias to the unit through relay contact 25.

In the recirculation mode, the transfer of relay contact 25 shuts off the mechanical drive in paper feed unit 10 and turns off erase lamp 23. The transfer of relay contact 27 applies a positive voltage to corona wire 22 which in turn charges the photoconductor positively. The transfer of relay contact 26 applies a negative bias to cleaner unit 3. The electrostatic field thus produced transfers triboelectrically negatively charged toner particles from the mixture traveling on cleaner magnetic brush 4 to the photoconductor surface. The transfer of contacts 28 and 29 prevent the application of voltage to corona wires 15 and grid wires 16 preventing the deposition of toner on these wires. The transfer of contact 25 applies an AC voltage to ballast 30 which drives fluorescent erase lamp 21 discharging the photoconductor. The transfer of relay contact 52 applies a higher negative bias to developer unit 1 so that toner particles on the photoconductor surface which are triboelectrically charged positively by contact with the carrier transported by developer magnetic brush 2 are removed from the photoconductor surface.

During the operation of the machine in the development mode, each rotation of cam 31 with drum 7 transfers contact 32 applying the AC line voltage to line 33 advancing counter 34, which is designed to close contact 35 when the number of revolutions taken by drum 7 indicates that the toner concentration in cleaning unit 3 may be reaching a level that prevents efficient cleaning. The closure of contact 35 then applies AC line voltage to relay coil 14 and the closure of its associated
contact 36 holds this voltage on the coil through contact 32 when this contact transfers. At this time the transfer of contact 37 also applies the line voltage coming through contact 32 and 36 to line 38 resetting counter 34. When contact 32 transfers again after one revolution of drum 7 the circuit path by which coil 14 is held and through which the voltage is applied to line 38 is broken. Since the counter has been reset by this time, contact 35 has opened so that coil 14 is dropped. Thus, when counter 34 reaches the count for which it was designed relay coil 14 is actuated and held for a single revolution of drum 7 producing the required toner recycling operation.

Alternately and more desirably a means for sensing toner concentration within the cleaner unit 3 may be provided so that a toner recirculation cycle is automatically provided when and only when this concentration reaches a level at which effective cleaning is jeopardized. In any case, the recirculation cycle may be automatically provided when required at the end of copy run rather than during them. Operation intervention can also be used to start a recirculation cycle when cleaning appears to be a problem.

FIG. 2 shows schematically alternate means for providing for the transfer of toner from cleaner unit 3 to developer unit 1. The motion of document 17 and the operation of paper feed unit 19 are synchronized with the rotation of photoconductor drum 7 so that images to be copied are placed on defined areas of the photoconductor surface. Cam surfaces 39, which rotate with the photoconductor drum define the photoconductor areas between these image areas. These surfaces move segments 40, transferring contacts which switch the operation of components as described in reference to FIG. 1 so that toner is deposited on these areas by cleaner magnetic brush 4 and picked up from these areas by developer magnetic brush 2. This configuration has the advantage of not requiring a separate recirculation cycle and of maintaining a low toner concentration in the cleaner by recirculating toner after cleaning residual toner from each image area, but sufficient space for this operation must be provided between image areas on the photoconductor.

FIGS. 3 and 4, which are partial sectional views taken as shown by section lines 3-3 and 4-4 respectively in FIG. 1, show alternate means of providing for toner recirculation in which the circuits for switching the operation of components are eliminated. The cleaner magnetic brush 4 is divided into two sections 4a and 4b turning together but separated by an insulating section 4c. An electrical bias favorable to the removal of toner from the photoconductor is placed on section 4a, which covers the width of the photoconductor on which images are placed as defined by the slot in aperture 20 and the position of paper 9, while an electrical bias favorable to the deposition of toner on the photoconductor from cleaner magnetic brush section 4b is applied to this section. Charging corona wires 15, associated grid wires 16, transfer corona wire 22, and erase lamp 23 extend across the photoconductor width used for imaging. Erase lamp 21a and an additional charging corona wire 41 are placed between the developer and cleaner units, to which a voltage is applied so that the photoconductor is charged in a manner favorable to the transfer of toner from cleaner magnetic brush section 4b to the surface of the photoconductor, extend across the photoconductor width used for toner recirculation. Augers may be included in cleaner unit 3 to aid in the circulation of carrier and toner within the unit. This configuration provides for continuous development and toner recirculation by photoconductor charging and discharging and by toner transfer mechanisms as described in reference to FIG. 1. Alternately another material capable of being charged and discharged by corona units may be used in place of the extra photoconductor width.

FIG. 5 shows alternate means for providing for the circulation of toner. The mixture of carrier and toner from developer unit 39 and cleaner unit 40 is continuously circulated by augers 42 and 43 operating in the reservoirs of the units and by augers 44 and 45 connecting the units. Besides the large quantities of material in the units, a relatively slow rate of material transport between the units is required to maintain approximately the same toner concentration in both units. The photoconductor drum 7 and conventional means for charging and imaging the photoconductor on its surface and conventional means for transferring toner images from its surface to paper (not shown) are provided as described before. Assuming that a magnetic carrier coated with a material such as tetrafluoroethylene which triboelectrically places a positive charge on toner particles is used, a negative electrical bias is placed on the developing unit to provide the development electrode effect which prevents toning background areas. A positive preclean corona wire 45a is used to discharge the photoconductor before it passes by the cleaning station. The use of this wire may be considered an alternative to the use of an erase lamp as previously described in reference to FIG. 1. A negative bias which may be higher than that applied to developer unit 39 is applied to cleaner unit 40. Since the photoconductor has been discharged this bias produces an electrostatic field which effects the removal of triboelectrically positively charged toner particles from the photoconductor to the carrier mixture in the cleaner unit.

The systems described in this disclosure have advantages over conventional cleaning methods of eliminating the air system with its filter replacement and noise problems and of recirculating the toner picked up by the cleaning station reducing the rate of toner usage. The configuration shown in FIGS. 1 through 4 have the advantage over that shown in FIG. 5 of allowing a wide choice of carrier coatings for use in the cleaner unit, which appears desirable. The configurations shown in FIGS. 2 through 5 have the advantage over that shown in FIG. 1 of allowing continuous operation without separate recirculation cycles. The configurations shown in FIGS. 3 and 4 require additional areas on the photoconductor or other material for toner recirculation.

What is claimed is:

1. A cleaning and recirculation system for a copier machine having a photoconductor member and charging, imaging and transfer stations, arranged for processing of images on said photoconductor member, comprising:
a developer station positioned adjacent said photoconductor member and having a magnetic brush normally operable to develop images on said photoconductor by deposition of toner on said photoconductor member following imaging thereof at said imaging station;

cleaning station positioned adjacent said photoconductor member and having a magnetic brush normally operable to clean residual toner from said photoconductor member following transfer of an image from said photoconductor member to a receiving surface at said transfer station; and

circuit means operable in a first mode to supply first predetermined bias potentials to the various stations in said system to effect developing and cleaning by said brushes as set forth and said circuit means being operable in a second mode to supply second predetermined bias potentials to the various stations in said system to effect transfer of residual toner from said cleaning station to said photoconductor member, and conveyance of said residual toner by said photoconductor member back to said developer station for re-use.

2. The system of claim 1 further comprising:
recirculation control means for monitoring developing and cleaning cycles of said system and operable upon occurrence of a predetermined number of cycles to initiate said second mode of operation of said circuit means.

3. The system of claim 2 further comprising:
counter means operable to count said predetermined number of cycles.

4. A cleaning and recirculation system for a copier machine having a photoconductor member, and various stations, arranged for processing of images on said photoconductor member, comprising:
a charging station operable to uniformly charge said photoconductor member;
an imaging station to discharge said photoconductor member in accordance with light patterns derived from an original document;
a first erase station;
a developer station positioned adjacent said photoconductor member and having a magnetic brush normally operable to develop images on said photoconductor by deposition of toner on said photoconductor member following imaging thereof at said imaging station;
a transfer station operable to effect transfer of an image developed on said photoconductor to a receiving surface;
a second erase station;
a cleaning station positioned adjacent said photoconductor member and having a magnetic brush normally operable to clean residual toner from said photoconductor member following transfer of an image from said photoconductor to a receiving surface at said transfer station; and

circuit means operable in a first mode to supply first predetermined bias potentials to the various stations in said system to effect developing and cleaning by said brushes as set forth and said circuit means being operable in a second mode to supply second predetermined bias potentials to the various stations in said system to effect transfer of residual toner from said cleaning station to said photoconductor member, and conveyance of said residual toner by said photoconductor member back to said developer station for re-use.

5. A cleaning and recirculation system for a copier machine having a photoconductor member, and various stations arranged for processing of images on said photoconductor member, comprising:
a charging station operable to uniformly charge said photoconductor member;
an imaging station to discharge said photoconductor member in accordance with light patterns derived from an original document;
a first erase station;
a developer station positioned adjacent said photoconductor member and having a magnetic brush normally operable to develop images on said photoconductor by deposition of toner on said photoconductor member following imaging thereof at said imaging station;
a transfer station operable to effect transfer of an image developed on said photoconductor to a receiving surface;
a second erase station;
a cleaning station positioned adjacent said photoconductor member and having a magnetic brush normally operable to develop images on said photoconductor by deposition of toner on said photoconductor member following imaging thereof at said imaging station;
a transfer station operable to effect transfer of an image developed on said photoconductor to a receiving surface; and

circuit means operable in a first mode to supply first predetermined bias potentials and gating signals to the various stations in said system to effect developing and cleaning by said brushes as set forth comprising:
supplying positive potentials to said charging station and said cleaning stations and minus potentials to said developing and transfer stations, an a-c potential to said second erase station and concurrently gating off said first erase station; and said circuit means being operable in a second mode to supply second predetermined bias potentials and gating signals to the various stations in said system to effect transfer of residual toner from said cleaning station to said photoconductor member, and conveyance of said residual toner by said photoconductor member back to said developer station for re-use comprising:
supplying a positive potential to said transfer station, a negative potential to said cleaning station and a higher negative potential to said developing station, an a-c potential to said first erase station, and concurrently gating off said charging station, said imaging station, and said second erase station.

6. A cleaning and recirculation system for a copier machine having various stations arranged for processing of images member, comprising:
a photoconductor member, said photoconductor member having at least one image area and at least one inter-image area;
a charging station operable to uniformly charge said photoconductor member;
an imaging station to discharge said photoconductor member in accordance with light patterns derived from an original document;
a developer station positioned adjacent said photoconductor member and normally operable to develop images in the image area on said photoconductor by deposit of toner on said photoconductor member following imaging thereof at said imaging station;

a transfer station operable to effect transfer of an image developer on said photoconductor to a receiving surface;

a cleaning station positioned adjacent said photoconductor member and normally operable to clean residual toner from the image area on said photoconductor member following transfer of an image from said photoconductor member to a receiving surface at said transfer station; and

circuit means operable in a copy-making mode to supply first predetermined bias potentials to the various stations in said system to effect developing and cleaning of said image area by said brushes as set forth and said circuit means being further operable in a recirculate mode to supply second predetermined bias potentials to the various stations in said system to effect transfer of residual toner from said cleaning station to said inter-image area on said photoconductor member in an alternating fashion with said copy-making mode, and convanee of said residual toner by said photoconductor member back to said developer station for re-use.

8. The system of claim 7 further comprising:

means mounting said photoconductor member for relative movement with respect to said stations; and

means mounting said circuit means for operation in timed relation with relative movement of said photoconductor member and said stations to effect copy-making and recirculate modes in proper synchronism with respect to said image and inter-image areas on said photoconductor member.

9. The system of claim 8 wherein said photoconductor comprises a drum member and said circuit means comprises a cam member and a switch member and further comprising:

a common shaft means mounting said drum member and said cam member for synchronized rotation.

10. A cleaning and recirculation system for a copier machine having various stations arranged for processing of images, comprising:

a photoconductor member, said photoconductor member having a plurality of image areas and inter-image areas interspersed between said image areas;

a charging station operable to uniformly charge said photoconductor member;

an imaging station to discharge said photoconductor member in accordance with light patterns derived from an original document;

a developer station positioned adjacent said photoconductor member and having a magnetic brush normally operable to develop images in the image area on said photoconductor by deposition of toner on said photoconductor member following imaging thereof at said imaging station;

a transfer station operable to effect transfer of an image developed on said photoconductor to a receiving surface;

a cleaning station positioned adjacent said photoconductor member and having a magnetic brush normally operable to clean residual toner from the image area on said photoconductor by following transfer of an image from said photoconductor to a receiving surface at said transfer station; and

circuit means operable in a copy-making mode to supply first predetermined bias potentials to the various stations in said system to effect developing and cleaning of said image area by said brushes as set forth and said circuit means being further operable to supply second predetermined bias potentials to the various stations in said system to effect transfer of residual toner from said cleaning station to said inter-image areas on said photoconductor member in an alternating fashion with said copy-making mode, and

convanee of said residual toner by said photoconductor member back to said developer station for re-use.

11. A cleaning and recirculation system for a copier machine having a photoconductor member with first and second portions and charging, imaging and transfer stations arranged for processing of images on said photoconductor member, comprising:
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a developer station positioned adjacent said photoconductor member and normally operable to develop images on said photoconductor member by deposition of toner on said photoconductor member following imaging thereof at said imaging station;
a cleaning station incorporating a magnetic brush member, said magnetic brush member having a first portion positioned adjacent the first portion of said photoconductor member, and normally operable to clean residual toner from said photoconductor member following transfer of an image from said photoconductor to a receiving surface at said transfer station and said magnetic brush member having a second portion positioned adjacent the second portion of said photoconductor member operable to convey residual toner onto the second portion of said photoconductor member; and
circuit means operable in a copy-making mode to supply first predetermined bias potentials to the various stations in said system to effect developing, and cleaning by said first magnetic brush portion and said circuit means further being operable to supply second predetermined bias potentials to the various stations in said system to effect transfer of residual toner from said cleaning station by said second magnetic brush portion to said photoconductor member, and conveyance of said residual toner by said photoconductor member back to said developer station for re-use concurrently with said copy-making mode.

12. A cleaning and recirculation system for a copier machine having a photoconductor member with first and second portions and charging, imaging and transfer stations, arranged for processing of images on said photoconductor member, comprising:
a magnetic brush developer station positioned adjacent said photoconductor member and normally operable to develop images on said photoconductor member by deposition of toner on said photoconductor member following imaging thereof at said imaging station;
a cleaning station incorporating a magnetic brush member said magnetic brush member having a first portion positioned adjacent the first portion of said photoconductor member, and normally operable to clean residual toner from said photoconductor member following transfer of an image from said photoconductor member to a receiving surface at said transfer station and said magnetic brush member having a second portion positioned adjacent the second portion of said photoconductor member and operable to convey residual toner onto the second portion of said photoconductor member; and
circuit means operable in a copy-making mode to supply first predetermined bias potentials to the various stations in said system to effect developing, and cleaning by said first magnetic brush portion comprising supplying positive potentials to said charging station and said cleaning station and minus potentials to said developing and transfer stations, and an a-c potential to said first erase station; and said circuit means further being operable to supply second predetermined bias potentials to the various stations in said system to effect transfer of residual toner from said cleaning station by said second magnetic brush portion to said photoconductor member, and conveyance of said residual toner by said photoconductor member back to said developer station for re-use concurrently with said copy-making mode.

13. A cleaning and recirculation system for a copier machine having a photoconductor member with first and second portions and charging, imaging and transfer stations, arranged for processing of images on said photoconductor member, comprising:
a charging station operable to uniformly charge said photoconductor member;
an imaging station to discharge said photoconductor member in accordance with light patterns derived from an original document;
a first erase station positioned adjacent the first portion of said photoconductor member;
a magnetic brush developer station positioned adjacent said photoconductor member and normally operable to develop images on said photoconductor member by deposition of toner on said photoconductor member following imaging thereof at said imaging station;
a transfer station operable to effect transfer of an image developed on said photoconductor to a receiving surface;
a second erase station positioned adjacent the second portion of said photoconductor member;
a cleaning station incorporating a magnetic brush member, said magnetic brush member having a first portion positioned adjacent the first portion of said photoconductor member, and normally operable to clean residual toner from said photoconductor member following transfer of an image from said photoconductor to a receiving surface at said transfer station, and said magnetic brush member having a second portion positioned adjacent the second portion of said photoconductor member and operable to convey residual toner onto the second portion of said photoconductor member; and
circuit means operable in a copy-making mode to supply first predetermined bias potentials to the various stations in said system to effect developing, and cleaning by said first magnetic brush portion comprising supplying positive potentials to said charging station and said cleaning station and minus potentials to said developing and transfer stations, and an a-c potential to said first erase station; and said circuit means further being operable to supply second predetermined bias potentials to the various stations in said system to effect transfer of residual toner from said cleaning station by said second magnetic brush portion to said photoconductor member, and conveyance of said residual toner by said photoconductor member back to said developer station for re-use concurrently with said copy-making mode, comprising:

14. A cleaning and recirculation system for a copier machine having various stations arranged for processing of images, comprising:
a photoconductor member;
a charging station operable to uniformly charge said 5
photoconductor member;
an imaging station to discharge said photoconductor
member in accordance with light patterns derived
from an original document;
a developing station positioned adjacent said
photoconductor member and normally operable to
develop images in the image areas on said
photoconductor deposition of toner on said
photoconductor member following imaging
thereof at said imaging station;
a cleaning station positioned adjacent said photocon-
ductor member and normally operable to clean
residual toner from said photoconductor member
following transfer of an image from said photocon-
ductor to a receiving surface at said transfer sta-
tion; and

circuit means operable in a copy-making mode to
supply first predetermined bias potential to the
various stations in said system to effect developing
and cleaning as set forth; and
auger means interconnecting said developer station
and said cleaning station and operable concur-
rently with copy-making operations to effect
transfer of residual toner from said cleaning sta-
tion to said developer station for re-use.

15. A cleaning and recirculation system for a copier
machine having a photoconductor member and charg-
ing, imaging and transfer stations arranged for
processing of images on said photoconductor member,
comprising:
an auxiliary member associated with said photocon-
ductor member;
a charging station operable to uniformly charge said
photoconductor member;
an imaging station to discharge said photoconductor
member in accordance with light patterns derived
from an original document;
a first discharge station position adjacent said
photoconductor member;
a magnetic brush developer station positioned ad-
jacent said photoconductor member and normally
operable to develop images on said photoconduc-
tor member by deposition of toner on said
photoconductor member following imaging
thereof at said imaging station;
a transfer station operable to effect transfer of an
image developed on said photoconductor member
to a receiving surface;
a second discharge station positioned adjacent the
said auxiliary member;
a cleaning station incorporating a magnetic brush
member, said magnetic brush member having a
first portion positioned adjacent said photocon-
ductor member, and normally operable to clean
residual toner from said photoconductor member
following transfer of an image from said photocon-
ductor to a receiving surface at said transfer sta-
tion, and said magnetic brush member having a
second portion positioned adjacent said auxiliary
member and operable to convey residual toner
onto said auxiliary member; and

circuit means operable in a copy-making mode to
supply first predetermined bias potentials to the
various stations in said system to effect developing,
and cleaning by said first magnetic brush portion,
and said circuit means further being operable to
supply second predetermined bias potentials to the
various stations in said system to effect transfer of
residual toner from said cleaning station by said
second magnetic brush portion to said auxiliary
member, and conveyance of said residual toner by
said auxiliary member back to said developer sta-
tion for re-use concurrently with said copy-making
mode.

* * * * *
UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,700,328
DATED : Oct. 24, 1972
INVENTOR(S) : Ronald V. Davidge, Henry C. Locklar, James C. Ralston, Robert T. Ritchie

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

Cancel claims 11 through 15.
On the title page, after the abstract, "15 Claims" should read --- 11 Claims ---.

Signed and Sealed this
Twenty-fourth Day of August 1982

[SEAL]

Attest:

GERALD J. MOSSINGHOFF
Attesting Officer
Commissioner of Patents and Trademarks