United States Patent [19]

Fraser

[11] **3,880,119**

[45] **Apr. 29, 1975**

[54] **DEVELOPMENT APPARATUS**

[75] Inventor: **Lawrence J. Fraser**, Rochester, N.Y.

[73] Assignee: **Xerox Corporation**, Stamford, Conn.

[22] Filed: **Dec. 20, 1973**

[21] Appl. No.: **426,997**

[52] **U.S. Cl.** **118/636**; 117/17.5; 118/637

[51] **Int. Cl.** **G03g 13/00**

[58] **Field of Search** ..... 118/636, 637, DIG. 24; 117/17.5

[56] **References Cited**

UNITED STATES PATENTS

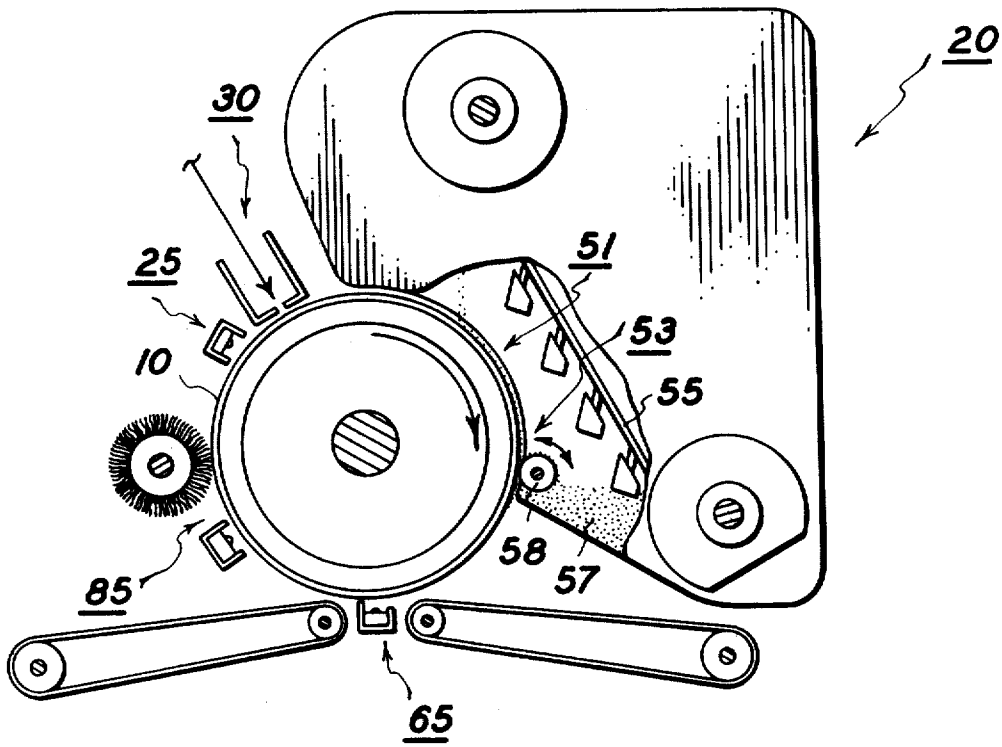
2,892,446	6/1959	Olden	118/637
3,542,579	11/1970	Gundlach	118/637
3,678,895	7/1972	Ohta et al.	118/637
3,698,926	10/1972	Furuichi	118/637
3,754,962	8/1973	Berlier et al.	117/17.5

Primary Examiner—Mervin Stein
Assistant Examiner—Leo Millstein

[57] **ABSTRACT**

An improved copier system in which a photoconductive member bearing a latent electrostatic image is developed by cascade development followed by magnetic development in one mode of operation when solid area image development is desired and by cascade development alone when line or edge development is desired. A magnetic development roll unit is positioned at the lower part of the development housing of the development system in close proximity to the photoconductive member being developed. The photoconductive member is selectively developed by the magnetic development roll unit upon operational development thereof. A control button on the copier control panel sets the development mode of operation as desired.

4 Claims, 2 Drawing Figures



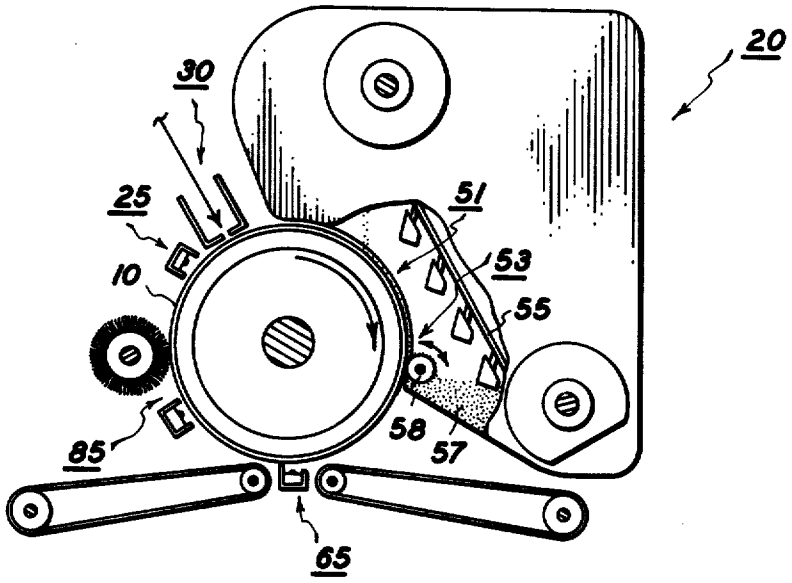


FIG. 1

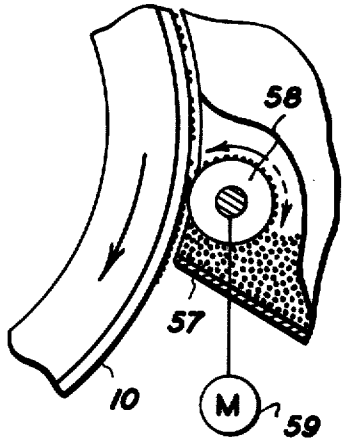


FIG. 2

DEVELOPMENT APPARATUS

This application relates to an improved copier system and in particular to a dual mode development system enabling line or edge copy development or solid area development depending on the desired mode of operation of the copier system.

It is well known to employ open cascade development in a xerographic copier system where high quality edge or line development occurs. Also it is well known to use magnetic developer units for developing solid area portions of electrostatic images. It will be appreciated that more developer material must be employed in the case of the magnetic developer units due to the greater areas of development occurring in this type of development system. It will be further appreciated that with the greater amount of developer material utilized in a development system cleaning of the photoconductive member and the replacement of the development material in the system is of much greater concern than for example in an open cascade development system in which only edge or line development occurs.

It is known to employ a cascade conveyor system such as bucket conveyors to move or transport developer material to the vicinity of a magnetic roll development unit as indicated for example by U.S. Pat. Nos. 3,599,605, 3,638,614 and 3,647,293. Further it is previously known to use a magnetic developer unit to remove residual developer material from a photoconductive surface which has been developed by a cascade development as indicated for example in U.S. Pat. No. 3,697,926. The present invention is an improvement over the above systems since it enables either cascade development or combined cascade and magnetic development of the images according to the desired mode of operation i.e. edge or solid area development.

It is therefore the primary object of this invention to improve electrostatographic copier systems.

It is a further object of the present invention to enable a wide latitude of development capability of electrostatic images.

It is a further object of the present invention to provide dual mode of operation for a developer system producing high quality images of either line copy of solid area copy.

It is a further object of the present invention to enable wide latitude of development of electrostatic images without inefficient consumption of developer materials and/or cleaning efficiency of xerographic surfaces.

It is a further object of the present invention to provide copier systems capable of dual modes of operation to produce high quality images for either edge or solid area development depending on the document information to be reproduced.

These and other objects of the invention are accomplished generally speaking by employing a magnetic developer unit in conjunction with a cascade development system to effect either cascade development alone or cascade development in combination with magnetic development at the option of a machine operator.

The above objects and further features of the invention will be best understood in connection with the drawings in which:

FIG. 1 illustrates schematically the xerographic copier components including the improved developer system according to the present invention; and

FIG. 2 is a partial view of FIG. 1 illustrating details of the invention

As shown in FIG. 1, a xerographic photoreceptor **10** constructed in the form of a drum is rotated past a series of xerographic processing stations including the improved development station **20** according to the present invention.

Xerographic drum **10** has a photoconductive layer as is known in reusable xerography which is charged by a corona device **25** before being exposed by an optical system **30** to patterns of light and dark corresponding to the document information to be reproduced. The latent electrostatic image formed on the surface of the xerographic drum is then advanced through a development station **20** which includes cascade development sub-station **51** and magnetic development sub-station **53** as will be described more fully hereinafter.

After passing through the development stations the xerographic drum is advanced through a transfer station which effects transfer of the developed latent electrostatic image onto a copy sheets by a corona device **65** as is known by those skilled in the art. Upon transfer of the image to the sheets the image is fused onto the sheets at the fusing station before being delivered to a paper tray or the like. The xerographic drum **10** continues through a cleaning station **85** where the residual image is cleaned from the surface thereof by suitable cleaning devices as is known by those skilled in the art. The drum is now ready for another cycle as previously described where the foregoing processing stations perform the functions in the same manner. It will be appreciated that when the document information is line type or alphanumeric information that less developer material is used than for example when solid areas or graphic document information are to be copied. In the latter large areas of the copy sheet must be covered with the xerographic developer material. With the present invention line copy or alphanumeric information may be reproduced or solid area information as desired at the option of a machine operator.

In accordance with the present invention the developer station **20** includes the cascade development substation **51** which includes a bucket conveyor **55** for transporting two-component developer material from the sump **57** of the developer station to an elevated position where it is then cascaded over the surface of the xerographic drum thereby developing the latent electrostatic images thereon. The developer material cascaded across the drum surface includes two-component developer made up of ferro magnetic carrier granules and electroscopic toner particles called toner a scavenging action occurs removing background material on the carrier as is known by those skilled in the art. It will be appreciated that with no further action that high quality line copy may be reproduced by this development system. The cascade development system is not capable of producing high quality solid area development.

In accordance with the present invention a magnetic development roll unit is positioned at the lower portion of the development station in close proximity to the drum surface. The magnetic developer sub-station **52** has a rotating cylinder **58** which is rotated about a magnetic field to effect the desired development. As shown

in FIG. 2 development occurs when cylinder **58** is rotated in a counter-clockwise direction developer material is carried into contact with the images being developed. On the other hand when cylinder **58** is rotated in a clockwise direction, as indicated by dashed arrow, brushing of developer material with the image does not occur. The direction of rotation of cylinder **58** is controlled by a button on the control panel (not shown) which will cause rotation in a direction for the desired development. The drive of the cylinder may be accomplished by a reversible drive motor **59** or the like which receives a signal from machine control.

It will now be appreciated that a new and novel development of copies for both line and/or solid areas is effected and which is quite efficient in the use of developer material. Consequently, cleaning efficiency of the xerographic member and conservation of materials is optimized. With the present system quality development is obtained either for edge of line development and for the solid area development in a single system at the option of a machine operator.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in its operation may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. In a xerographic copier system in which a xerographic member bearing latent electrostatic images is advanced through processing station for producing high quality copies, improved development apparatus for developing line or solid area copies comprising

first development means for cascading a two-component magnetic developer material across a moving xerographic member bearing latent electrostatic images to be developed,

second development means including magnetic development means positioned in the path of said latent electrostatic image subsequent to the first development means,

said magnetic development means having an operative condition for development of solid area portions of the latent electrostatic images and an inoperative condition when no development occurs thereof,

means for actuating magnetic development means to cause development of the solid area portions of the images at the option of the operator.

2. Apparatus according to claim **1** in which said magnetic development means is driven by a reversible drive which causes development of the images when moving in a first direction and non-development when moving in a second direction.

3. Apparatus according to claim **2** wherein said magnetic development means comprises a cylindrical member rotatable on an axis in close proximity to said xerographic member.

4. Apparatus according to claim **3** wherein said xerographic member is in the form of a drum and said cylindrical member is positioned to receive at least a portion of the cascading developer material across the drum surface.

* * * * *