

[54] **COPYING MACHINE WITH BEAD PICKOFF ROLLER**

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[22] Filed: **Dec. 6, 1972**

[21] Appl. No.: **312,554**

[52] U.S. Cl. **118/637**

[51] Int. Cl. **G03g 13/08**

[58] Field of Search 117/17.5; 118/104, 636,
118/637; 101/DIG. 13; 346/74 ES

[56] **References Cited**

UNITED STATES PATENTS

3,574,301	4/1971	Bernhard	118/637
3,642,364	2/1972	Egnaczak	355/3

Primary Examiner—Morris Kaplan

[57] **ABSTRACT**

An electrostatic copying machine of the type having a moving photoconductive surface defined by an endless belt, and a development system such as a magnetic brush assembly for supplying toner particles to the surface, has a pickoff roller rotatably mounted adjacent the surface for removing any magnetic carrier beads which may have become attached to the surface at the development zone. The roller is non-magnetic, and has a magnet and a magnetic pole piece arranged therein for creating a magnetic field which attracts the beads to the roller and which is necessary to hold them on the roller so as to be conveyed away from said surface by said roller until reaching a location where the field decreases sufficiently to allow the beads at that location to descend via gravity into a receptacle where they can be collected for reuse.

2 Claims, 3 Drawing Figures

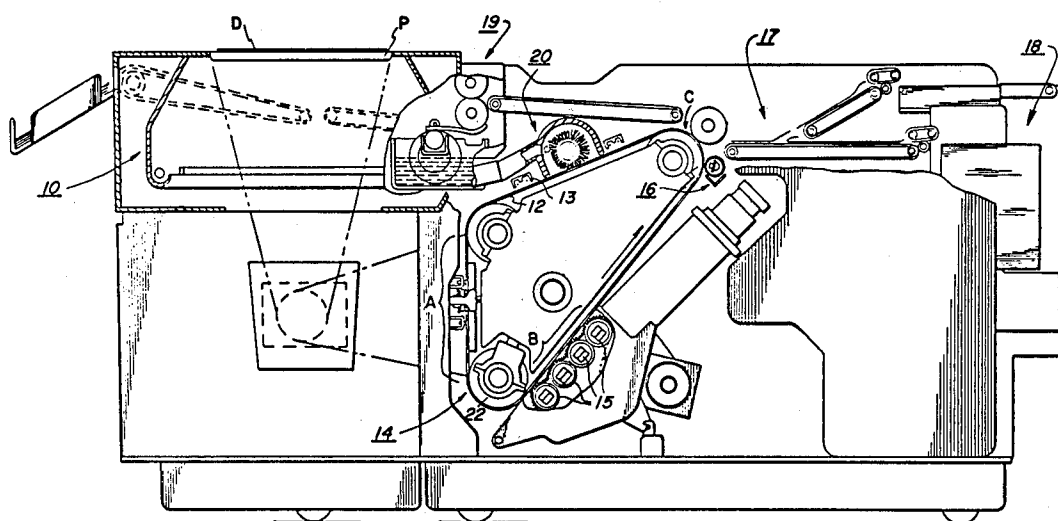
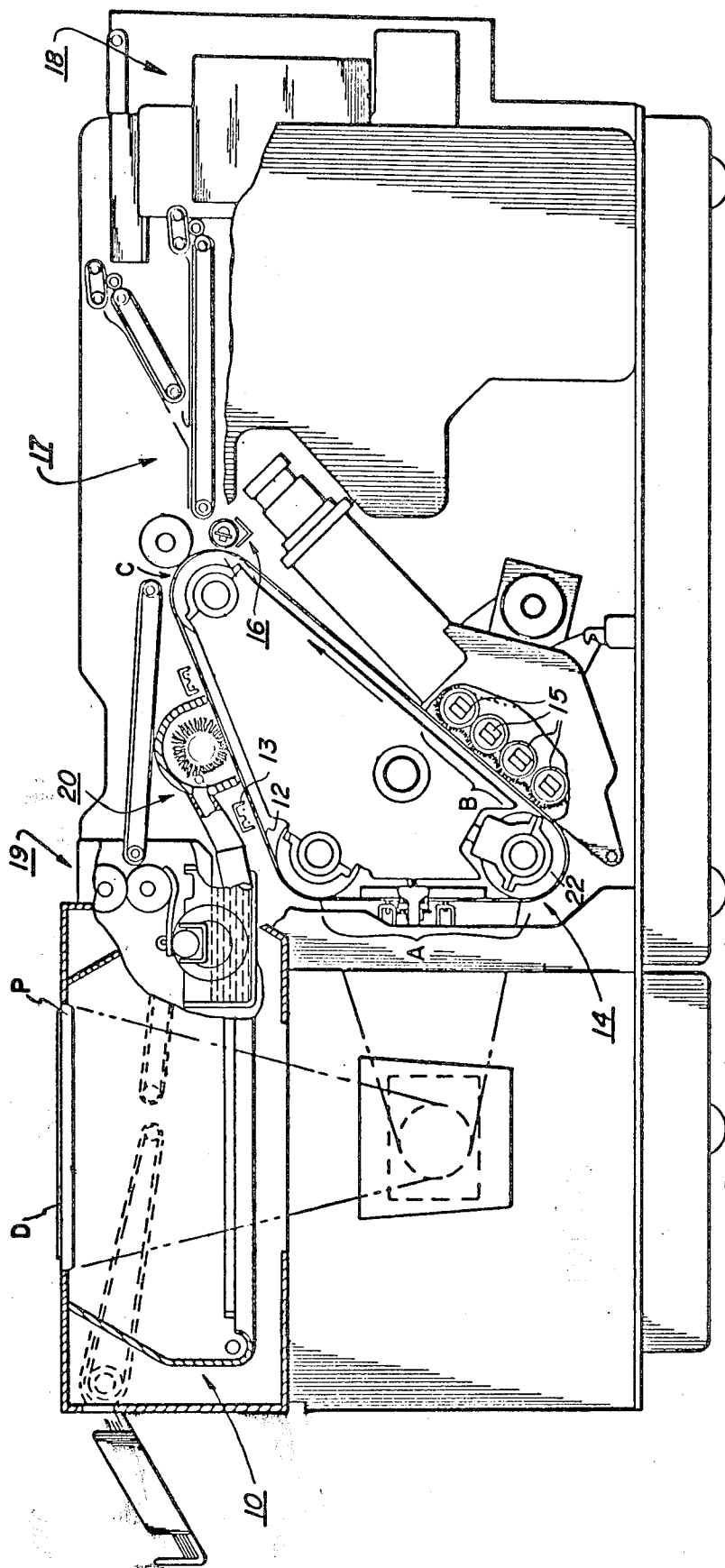


FIG. 1



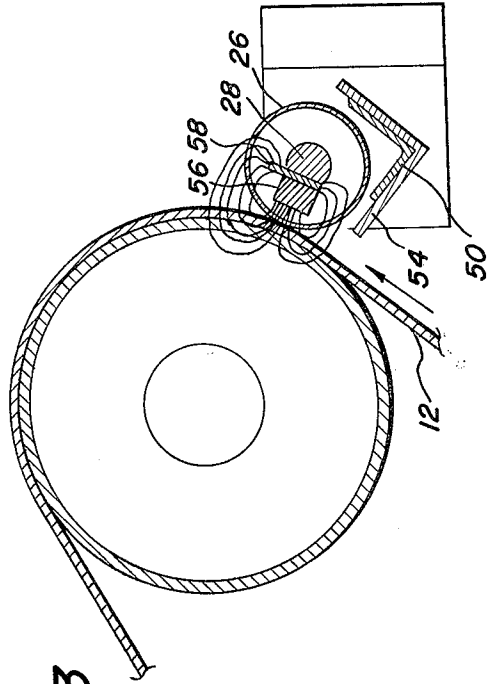


FIG. 3

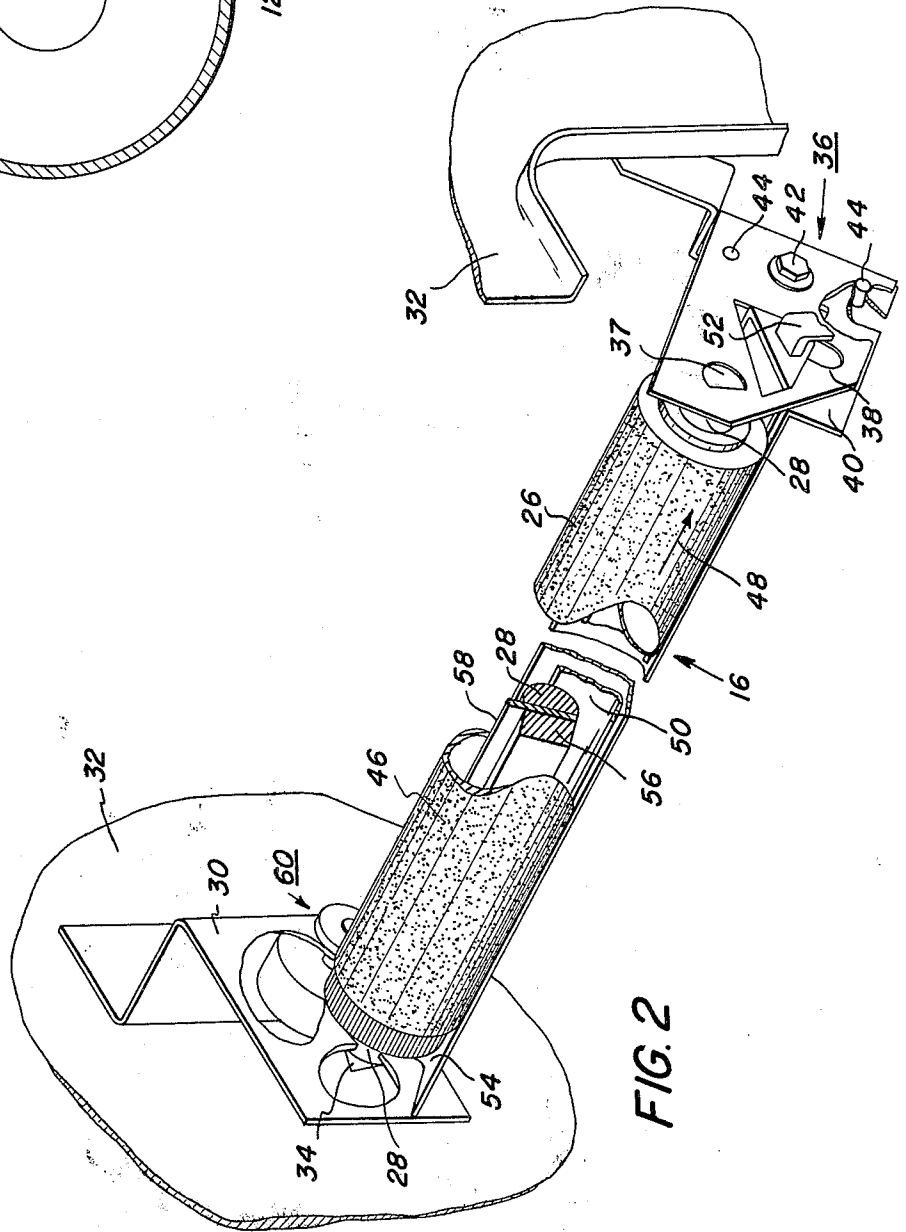


FIG. 2

COPYING MACHINE WITH BEAD PICKOFF ROLLER

BACKGROUND OF THE INVENTION

This invention relates to an improvement in an electrostatic copying machine (copier), but more particularly, to a copier having a pickoff roller for removing any carrier beads which may have become attached to a photoconductive surface of the copier.

In the practice of xerography as described in U.S. Pat. No. 2,297,691 to Chester F. Carlson, a xerographic surface comprising a layer of photoconductive insulating material affixed to a conductive backing is used to support electrostatic images. In the usual method of carrying out the process, the xerographic plate is electrostatically charged uniformly over its surface and then exposed to a light pattern of the image being reproduced to thereby discharge the charge in the areas where light strikes the layer. The undischarged areas of the layer thus form an electrostatic charge pattern or latent image in conformity with the configuration of the original pattern.

The latent electrostatic image may then be developed by contacting it with a finely divided electrostatically attractable material, such as a resinous powder. The powder is held in the image areas by the electrostatic fields on the layer. Where the field is greatest, the greatest amount of material is deposited; and where the field is least, little or no material is deposited. Thus, a powder image is produced in conformity with the image of the copy being reproduced. The powder is subsequently transferred to a sheet of paper or other transfer member and suitably affixed to thereby form a permanent print.

The latest concept for copiers utilizes high speed flash exposure of a document, and a moving photoconductive material in the form of an endless belt which is continuously charged. Additionally, such copiers are provided with a developing system which supplies toner particles in relatively large quantities for solid area coverage, such as a magnetic brush developing apparatus. Thus, after the belt passes the magnetic brush assembly for example, a xerographic powder image is formed on the belt which corresponds to the electrostatic latent image. This powder image is then transferred to a support surface (e.g. a sheet of paper) to which it is fused by a fusing assembly whereby the powder image is caused to adhere to the support surface permanently.

The electrostatically attractable developing material commonly used in developing systems comprises a pigmented resinous powder referred to here as a "toner" and a "carrier" of larger granular carrier beads formed with steel cores coated with a material removed in the triboelectric series from the toner so that a triboelectric charge is generated between the toner powder and the granular carrier. If the developing system is a magnetic brush assembly, the magnetizable carrier beads also provide mechanical control for the formation of brush bristles by virtue of magnetic fields so that the toner can be readily handled and brought into contact with the exposed xerographic surface. The toner is then attracted to the electrostatic latent image from the carrier bristles to produce a visible powder image on an insulating surface of the photoconductive material. Generally, in an endless belt printing machine configuration which employs a plurality of magnetic brushes,

the brushes are arranged for developing purposes with a run of the belt in the planar orientation.

In most copiers, however, some carrier beads will adhere to the photoconductive surface of the belt after the latter leaves the development zone. These adhering carrier beads prevent intimate contact between the support surface (e.g. a sheet of paper) and the toner particles, and they may affect the quality of the copy produced. In addition, because such adhering carrier beads are hard, they may abrade the photoconductive surface of the belt if not removed prior to reaching the cleaning zone. Consequently, it is highly desirable that all such carrier beads be removed from the belt after the latter leaves the developing zone. It is also desirable that the means used to remove such carrier beads be capable of being easily removed and replaced for servicing, etc., without contacting the surface of the belt in so doing.

SUMMARY OF THE INVENTION

The present invention is directed to a non-magnetic cylindrical pickoff roller rotatably mounted immediately adjacent to the moving photoconductive surface within the copier. A stationarily mounted magnet and pole piece located within the roller, creates a magnetic field necessary for attracting carrier beads to and holding them on the roller so as to be conveyed along a course away from the photoconductive surface. The magnetic field decreases sufficiently at a location along the course to permit the carrier beads at that location to descend via gravity into a receptacle located beneath the pickoff roller. The peripheral surface of the pickoff roller is rough finished to assist in conveying the carrier beads away from the photoconductive surface.

To insure that the pickoff roller can be easily removed and precisely replaced in its original mounted position, it is supported on a shaft, one end of which is conically tapered, while the other end thereof is supported in a bracket which is removably mounted within the machine. To release the roller the bracket is removed; the pickoff roller is then guided into the receptacle beneath it, and then the pickoff roller and receptacle are guided away from the photoconductive surface and out of the machine via a trough which supports the receptacle. To replace the pickoff roller the above procedure is reversed, the bracket being precisely relocated in its original position via a plurality of guide pins, thus precisely relocating the pickoff roller also.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic sectional view of an electrostatic copying machine embodying the principles of the invention.

FIG. 2 is a perspective view of the pickoff roller and the means for mounting it within the machine, with a portion of the roller broken away to show the magnet arrangement therein.

FIG. 3 is an enlarged sectional view of the pickoff roller and a portion of the belt which it is mounted adjacent to.

DETAILED DESCRIPTION OF THE INVENTION

For a general understanding of a copying machine in which the invention may be incorporated, reference is made to FIG. 1 in which the various system components for the machine are schematically illustrated. As

in all electrostatic systems of the type illustrated, a light image of a document to be reproduced is projected onto the sensitized surface of a xerographic plate to form an electrostatic latent image thereon. Thereafter, the latent image is developed with an oppositely charged developing material to form a xerographic powder image, corresponding to the latent image on the plate surface. The powder image is then electrostatically transferred to a support surface to which it may be fused by a device whereby the powder image is caused permanently to adhere to the support surface.

In the illustrated machine, an original D to be copied is placed upon the transparent support platen P fixedly arranged in an illumination assembly generally indicated by the reference numeral 10, arranged at the left end of the machine. While upon the platen, an illumination system flashes light rays upon the original thereby producing image rays corresponding to the informational areas on the original. The image rays are projected by means of an optical system for exposing the photosensitive surface of a xerographic plate in the form of a flexible photoconductive belt 12. The surface of the belt was made photosensitive by the previous step of uniformly charging the same by means of a corona generating device or corotron. In order to effect image processing, the belt 12 is arranged on a belt assembly generally indicated by the reference numeral 14.

The photoconductive belt assembly 14 is slidably mounted upon two support shafts, one of which is secured to the frame of the machine, and is adapted to drive a belt 12 in the direction of the arrow at a constant rate. During this movement of the belt, the reflected light image of an original on the platen is flashed upon the photoreceptor surface of the belt to produce electrostatic latent images thereon at an exposure station A.

As the belt surface continues its movement, the electrostatic image passes through a developing station B in which there is positioned a developer assembly which provides development of the electrostatic image by means of a plurality 15 of magnetic brush rollers as the same moves through the development zone; the operation of the latter is described more thoroughly in co-pending U.S. application Ser. No. 97,856, now U.S. Pat. No. 3,724,422, assigned to the same assignee. To remove any magnetic carrier beads which may adhere to the belt station B, a bead pickoff mechanism 16 is provided which will be discussed in detail below.

The developed electrostatic image is transported by the belt to a transfer station C where a sheet of copy paper is moved between a transfer roller and the belt at a speed in synchronism with the moving belt in order to accomplish transfer of the developed image solely by an electrical bias on the transfer roller. There is provided at this station a sheet transport mechanism generally indicated at 17 adapted to transport sheets of paper from a paper handling mechanism generally indicated by the reference numeral 18 to the developed image on the belt at the station C.

After the sheet is stripped from the belt 12, it is conveyed into a fuser assembly generally indicated by the reference numeral 19 wherein the developed and transferred xerographic powder image on the sheet material is permanently affixed thereto; the belt then moves past a cleaning station 20 where a brush and vacuum system removes any remaining toner particles on the belt.

As can be seen, the belt 12 is journaled for continuous movement upon three rollers 21, 22 and 23 positioned with their axes lying in a plane parallel to the straight portion of the belt 12 at station B. The photoconductive belt assembly 14 is slidably mounted upon two support shafts 24, and 25, with the roller 23 rotatably supported on the shaft 24 which is secured to the frame of the apparatus and is rotatably driven by a suitable motor and drive assembly (not shown) in the direction of the arrow at a constant rate. During exposure of the belt 12, the portion exposed is that portion of the belt running between rollers 21 and 22. During such movement of the belt 12, the reflected light image of such original document positioned on the platen is flashed on the surface of the belt to produce an electrostatic latent image thereon at exposure station A.

Referring to FIGS. 2 and 3, it can be seen that the bead pickoff mechanism 16 includes a cylindrical non-magnetic pickoff roller 26 which is rotatably mounted on a shaft 28 which extends from each end of the roller. The inner end of shaft 28 is supported in a bracket 30 which is secured to the frame 32 of the copying machine, and has a conical taper 34 formed thereon. The outer end of shaft 28 is supported by a two-piece bracket 36, this end of the shaft being D-shaped as indicated by the numeral 37 to prevent rotation of the shaft. The bracket 36 includes two other brackets 38 and 40, the former directly supporting the shaft 28, and the latter being directly secured to the frame 32. As can be seen bracket 38 is removably secured to bracket 40 by at least one bolt 42. The tolerances of the openings in brackets 30 and 36 through which the shaft 28 extends are such that the roller 26 is precisely located with respect to the belt 12 once the bead pickoff mechanism 16 is initially installed in its mounted condition as shown. When it is necessary to remove and replace the roller 26 and the shaft 28 on which it is rotatably mounted (e.g. for machine servicing), it is necessary that the roller be precisely relocated in its original mounted condition. To accomplish the same, bracket 38 is provided with a plurality of guide pins 44 which mate with corresponding openings in the bracket 40, both the guide pins and openings being manufactured to tolerances which will relocate the roller within the machine as desired. Merely securing and locating the bracket 38 by bolts alone would not satisfactorily relocate the bracket due to the relatively large amount of "play" existing between the bolts and the openings through which they would extend.

In removing and replacing the roller 26, it is also important that the belt 12 not be contacted by the rough finished peripheral surface 46 of the roller in order to prevent scratching or otherwise damaging the photoconductive surface of the belt. Thus, after releasing the roller 26 from its mounted condition by removing the bracket 38, the roller is pulled in the direction of the arrow 48. The roller will then gradually descend into the receptacle 50 because the taper 34 will be moving out of the opening in bracket 30. After the roller 26 has descended into the receptacle 50, the handle 52 of the receptacle is grasped and pulled in the direction of arrow 48 to slide both the receptacle and the roller outwardly along the trough 54, the latter being secured to brackets 30 and 40. Thus, the roller is released and guided away from the photoconductive surface of the belt 12 where it can be easily removed from the machine without contacting the belt 12.

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To create the magnetic field necessary to attract the beads from the belt 12 to the roller 26, and then to convey them to the top of the roller 26 (as viewed in FIG. 3) or slightly beyond where they can descend via gravity into the receptacle 50, a magnet 56 and a magnetic pole piece 58 are arranged as shown on the shaft 28. A magnetic field substantially as shown is created which will attract the beads to and hold them on the roller 26 until they are conveyed away from the belt 12 to approximately the top of the roller. Any magnetic field existing to the right of the top of roller 26 (as viewed in FIG. 3) is insufficient to hold the beads on the roller, and consequently they will descend into the receptacle 50. The magnet 50 and the magnetic pole piece 58 are specifically arranged to create the magnetic field necessary, both the rough finished surface 46 and the magnetic field being required to efficiently convey the beads away from the belt 12 to the top of the roller. The rough surface may be produced in various ways. For example, a layer of irregular particulate material may be adhered to the roller 26 by applying the material in a matrix of bonding adhesive by spraying, coating, "flocking," hot-melt spraying, or other known methods.

It is desirable to locate the magnet 56 quite close to the belt 12. For this reason, the roller 26 in the present embodiment is manufactured from thin-walled aluminum.

Thus, as can be seen, a stationary magnetic field is created, and when roller 26 is rotated by means of gears 60, the beads are picked off the belt 12 and conveyed along a course to a location (e.g., approximately the top of roller 26) where the magnetic field decreases

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sufficiently to permit the beads at that location to descend via gravity into the receptacle 50

What is claimed is:

1. The combination of a copying machine having a flexible belt mounted for movement around a closed path and defining a photoconductive surface, means for supporting a portion of said flexible belt as it moves around said closed path, and means including magnetic carrier beads for applying toner to said surface at a first location along said closed path, with means located immediately adjacent to said supported section for removing any of said carrier beads which may have become attached to said surface at said first location, said removing means comprising: a non-magnetic cylindrical pickoff roller mounted for rotation about its axis adjacent said surface, the peripheral surface of said pickoff roller being rough finished, a receptacle disposed beneath said pickoff roller, and means disposed within said pickoff roller for creating a magnetic field to attract said carrier beads from said surface to said pickoff roller and to hold said beads on said pickoff roller so as to be conveyed along a course away from said surface until said beads reach a location where the field decreases sufficiently to permit beads at said location to descend via gravity into said receptacle.

2. The combination according to claim 1, wherein said means for applying said toner comprises a magnetic brush assembly having a plurality magnetic brush rollers mounted for rotation about their axes adjacent said belt, said axes lying in a plane which is at least substantially parallel to said straight portion.

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