

Description

The present invention relates generally to printing and copying devices, and more particularly relates to electrophotographic printers and copiers utilizing magnetic brush structures to handle a developer material and deposit toner therefrom onto an organic or inorganic photoconductor drum.

For many years xerographic development processes were utilized in printers and copiers for the development of latent images borne on a photoconductive media. In modern electrophotographic copiers and printers, however, the conventional cascade xerographic process is seldom used, primarily due to the undesirably large size of its necessary components and its relatively low process speed. Instead, a development process commonly referred to as "magnetic brush" development is now widely used in place of the cascade xerographic development process.

In a conventional magnetic brush developer system utilized in an electrophotographic printer or copier, a magnetic roller is rotated within a sump structure in which a predetermined quantity of dry developer mix is disposed, the developer mix consisting of a magnetically attractable carrier material and a dry toner material removably adhered thereto. The rotating magnetic roller attracts a quantity of the developer and magnetically adheres it to its outer side surface, with the carrier portion of the attracted developer quantity being externally coated with toner and projecting radially outwardly from the rotating roller in bristle-like fashion, thus giving the side surface of the roller the appearance of a "brush".

The magnetically adhered quantity of developer is then rotated past a metering blade which "trims" the radially projecting developer material bristles to a predetermined, generally uniform length. The trimmed developer material rotationally exiting the metering blade is then rotated into close adjacency with a side surface portion of a rotating organic photoconductor drum. Previous to being brought into adjacency with the trimmed developer material on the magnetic roller, negatively charged "background" areas, and discharged "image" areas (corresponding to the printed indicia to be transferred to paper stock operatively fed through the printer or copier), are formed on the side surface portion of the rotating drum.

Toner from the trimmed developer layer is electrically stripped from its carrier material and forced onto the previously discharged image areas of the drum side surface portion the toner-covered discharged areas on the drum are then rotated into adjacency with the paper stock being fed through the machine, and the toner from the discharged drum areas is electrically drawn onto the paper stock and thermally cured thereon.

The drum side surface portion from which toner has been transferred to the moving paper stock is then sequentially rotated past a scraper blade which removes residual toner from the drum portion, a discharge lamp

device which removes residual electrical charge from the drum portion, a charging device (such as a scorotron) which negatively charges the drum portion, and a discharge device (such as a digitally controlled laser beam) which forms the electrically discharged image areas on the otherwise negatively charged drum portion. The drum side surface portion is then again rotated into adjacency with a trimmed quantity of developer externally carried by the magnetic roller.

After a given portion of the trimmed developer material carried by the rotating magnetic roller has transferred its toner constituent to the rotating drum, the now toner-depleted developer portion remains magnetically adhered to the roller and is rotated back into the developer sump at which time additional non-depleted developer material (i.e., developer containing both toner and carrier material) is magnetically adhered to the depleted developer layer and passed across the previously mentioned metering blade on its way to the side surface of the rotating drum. This conventional developer transfer scheme, used in conjunction with magnetic brush development, is commonly referred to as an "open loop" developer transfer path.

While the use of this open loop developer routing is widely accepted and practiced in the printer/copier art, it is subject to a variety of well known problems, limitations and disadvantages. For example, conventional open-looped magnetic brush development modules used in electrophotographic machines, such as printers and copiers, are quite susceptible to print quality degradation and variation over the operating life of the module. This is due in large part to the unavoidable progressive build-up of depleted developer material on the magnetic roller. As this depleted layer progressively thickens, the ratio of toner to carrier material in the overall developer layer approaching the metering blade also progressively diminishes.

Related to this problem are the problems of image density depletions and surges, and the difficulty of sufficiently meeting instantaneous demands for additional toner such as when graphics or other large image areas are to be printed. Additionally, the conventional open loop method of magnetic brush development tends to undesirably shorten the effective operating life of a given quantity of carrier material and the OPC drum.

US-A-4 731 632 discloses a toner development device for a copying machine, which includes a magnetic roller from which developer is scraped off by a primary scraper located within the developing box itself. In US-A-4 173 405 there is described a similar type of apparatus in which an auger transports developer, fed to it at one end from a sump, to holes along the length of a magnetic roller.

It would be highly desirable and it is an object of the present invention to provide improved magnetic brush development apparatus and methods which would eliminate or at least significantly reduce the aforementioned problems, limitations and disadvantages typically asso-

ciated with conventional magnetic brush development apparatus and methods of the type described above.

According to the present invention therefore, there is provided a method of applying toner to a moving toner transfer member in an image reproduction machine, by means of a rotating roller, the method further comprising the steps of:

adhering a quantity of developer material to a surface of the rotating roller, the developer material having separable toner and carrier constituents;
depositing toner onto the toner transfer member from the adhered quantity of developer material in a manner leaving toner-depleted developer material adhered to the roller surface;
removing the toner-depleted developer material from the rotating roller into a well;
adding toner to the removed toner-depleted developer material to form therewith a reconstituted developer material;
transferring the toner-depleted material from the well to a sump prior to the step of toner addition; and thereafter repeating the steps with reconstituted developer material being used; characterised in that:
the developer material is evenly deposited along the full length of the rotating roller; and
the toner addition step is performed by a mixer structure within the sump, the sump being adjacent to and disposed along the full length of the roller.

As used herein, the term "printing machine" (or "apparatus") is intended to encompass any type of image reproduction machine (including printers and copiers) which utilizes the transfer of a toner portion of a developer material to an electrically charged toner transfer member, such as a latent image bearing organic photoconductor drum (OPC).

In a preferred embodiment thereof, the apparatus includes a rotationally driven magnetic roller disposed in a developer sump adapted to hold a quantity of developer material having a ferrite or other magnetically comparable carrier constituent and a toner constituent. During operation of the development module, and rotation of the OPC, the roller operates to magnetically adhere a quantity of developer to its outer side surface and then rotationally transport the adhered developer into adjacency with a side surface portion of the rotating drum which electrically draws the toner constituent from the passing developer portion and deposits it onto "image" areas of the drum surface for subsequent transfer to paper stock, or other imprintable medium, being operatively fed through the machine.

The now toner-depleted developer portion still adhered to the magnetic roller is rotated generally back toward the developer sump. However, in sharp contrast to the open-looped operation of conventional magnetic brush-type development apparatus, the toner-depleted

developer is not permitted to simply remain on the roller for subsequent application thereon of non-depleted developer material.

Instead, according to the present invention, the development module is operated in a unique "closed loop" fashion which advantageously precludes the undesirable build-up of toner-depleted developer on the magnetic roller typically associated with the conventional open loop operation of magnetic brush development modules. The closed loop method of magnetic brush development control provided by the present invention basically comprises the steps of stripping away the toner-depleted developer from the magnetic roller prior to the rotation of the depleted developer into the developer sump; transferring the stripped-away, depleted developer into the sump; transferring toner from the toner cartridge into the developer sump; mixing the transferred toner and depleted developer within the sump to form reconstituted developer; and permitting an essentially developerless side surface portion of the rotating roller, entering the sump, to magnetically adhere thereto a quantity of reconstituted developer for subsequent rotational delivery thereof to the rotating OPC.

In an illustrated embodiment of the closed loop development module of the present invention, the structure utilized to carry out the aforementioned method preferably comprises a horizontally sloped recycling wall structure which underlies the magnetic roller and its associated developer sump. During rotation of the magnetic roller, first stripper blade means strip away the depleted developer from the roller and directs the detached developer into the upper end of the well, whereupon the developer travels by gravity into the lower end of the well.

Next, a rotating magnetic recycle roller disposed in the lower end of the wall picks up the depleted developer and rotationally delivers it into engagement with a second blade structure that strips the depleted developer from the recycle roller. This stripped off developer is then forced into the developer sump, via a suitable wall opening therein, at a location adjacent an inflow of toner from the toner cartridge. Mixer means, disposed within the developer sump, then operate to mix toner and depleted developer (i.e., the carrier developer constituent) entering the sump to form therefrom the reconstituted developer and deliver the same to an essentially developerless side portion of the magnetic roller being rotated through the sump.

In a preferred embodiment, the first stripper blade means comprise an elongated blade structure carried by the bottom wall of the recycling well and operatively contacting a lower side portion of the magnetic roller. A longitudinally spaced series of slots are formed laterally through the elongated blade structure and are operative to permit toner-depleted developer stripped away by the blade structure to pass therethrough and into the well for gravity delivery to the aforementioned recycle roller at the bottom end of the well.

Preferably, the previously mentioned mixer means

comprises a rotatable shaft extending through the developer sump, the shaft being parallel to and laterally spaced apart from the magnetic roller. Secured to the shaft in a longitudinally spaced apart orientation thereon are a plurality of parallel elliptical disc members whose axes are canted relative to the shaft axis. Adjacent pairs of discs longitudinally overlap one another, and the discs are provided with transversely projecting peripheral lips around their outer circumferences. During operation of the mixer means, the shaft is rotated in a direction opposite to the rotational direction of the magnetic roller. The rotating discs operate to mix toner and stripped away, depleted developer entering the sump, to form reconstituted developer. The rotating discs also function to lift the reconstituted developer over the edge of a mixing dam member, whereupon the reconstituted developer falls to the bottom of the sump for pick-up by a previously stripped side surface portion of the rotating magnetic roller. The lifting action of the rotating discs is enhanced by the previously mentioned peripheral lips thereon.

Compared to conventional open loop operation of magnetic brush-based development apparatus, the closed loop operation of the present invention provides a variety of desirable advantages including the provision of enhanced, more consistent and uniform printed image quality; the damping and stabilization of image density depletions and surges; and an improved ability to meet instantaneous demands for additional toner typically arising when graphics or other large image areas are to be printed or copied. Additionally, the effective operating life of the development module is beneficially increased.

Moreover, the closed loop magnetic brush development module of the present invention may be easily and relatively inexpensively incorporated into a wide variety of electrophotographic printing machines, and may be constructed using only a small number of simple and relatively inexpensive components. Additionally, principles of the present invention may be applied to other types of image reproduction machines in which a toner portion of a toner/carrier developer material is deposited on a toner transfer member, from a developer carrier roller, for subsequent deposition onto an imprintable medium such as paper stock.

One example of a method and apparatus according to the present invention will now be described with reference to the accompanying drawings, in which:

FIG 1 is a simplified schematic cross-sectional view through a portion of a representative electrophotographic printing machine, illustratively a laser printer, having operatively disposed therein an electrophotographic engine cartridge and includes a specially designed closed loop magnetic brush development module;

FIG. 2 is a perspective view of a portion of a toner/carrier mixer structure used in the development module;

FIG. 3 is a right side elevational view of the mixer

structure portion perspective shown in FIG. 2; and FIG. 4 is an enlarged scale perspective view of a portion of a specially designed stripper blade structure used in conjunction with a magnetic roller portion of the development module.

Schematically depicted in FIG. 1 is a portion of a representative printing machine, illustratively in the form of a laser printer 10, having a housing 12 within which is operatively disposed a specially designed electrophotographic engine cartridge 14 embodying principles of the present invention. Engine cartridge 14 is operatively drivable, in response to the operation of generally conventional control means 16 which effectuate and regulate the operation of the cartridge's mechanical and electrical components, to imprint predetermined images on an imprintable medium, such as paper stock 18, conventionally driven leftwardly through the housing 12 beneath the engine cartridge 14.

As schematically illustrated, the engine cartridge 14 includes, adjacent its left end, a conventional organic photoconductor drum (OPC) 20, a uniquely operative closed loop magnetic brush development module 22 positioned rightwardly adjacent OPC 20, and a generally conventional toner cartridge 24 removably secured to a right end portion of the development module 22. Toner cartridge 24 has disposed therein a quantity of dry toner powder material 26 which may be selectively delivered into a developer sump portion 28 of the development module 22, via a wall opening 30 in the toner cartridge, through the rotational operation or conventional toner lifter structures 32 disposed within the toner cartridge 24.

During operation of the engine cartridge 14, the OPC 20 is rotationally driven in a clockwise direction which causes each circumferential outer side surface portion of the rotating drum 20 to be sequentially passed by a scorotron charging unit 34, a digitally controlled laser beam 36 entering the cartridge 14 through an exposure slot 38, a side surface portion of a magnetic roller portion 40 of the development module 22 being rotationally driven in a counterclockwise direction, the leftwardly moving paper stock 18, a scraper blade 42 disposed on a toner collection housing 44, and a discharge lamp 46.

The operation of the rotating drum 20 is conventional, and will now be briefly described. As each circumferential outer side surface portion of the drum 20 passes the charging unit 34, it is negatively charged, and when the drum surface portion passes beneath the incoming laser beam 36, certain portions thereof are caused to be discharged, thereby forming the "image" areas of the drum surface which will later create the darkened image areas on the leftwardly moving paper stock 18. As the drum surface portion is rotated past the counter-rotating magnetic roller 40, toner 26 is electrically transferred onto the discharged image areas of the drum surface which is then rotated to a position above a transfer corotron 48 which electrically attracts the toner from these drum surface image areas onto the upper side surface

of the paper stock 18. The toner deposited onto the top side of the moving paper stock 18 is then passed under a conventional thermal fusing device 50 which thermally fuses the transferred toner onto the top side of the paper stock.

The drum surface portion is then further rotated in a clockwise direction into engagement with the scraper blade 42 which operates to strip away residual toner 26 from the drum and cause the stripped away residual toner 26 to fall into the toner collection housing 44. Finally, the representative drum side surface portion is rotated past the discharge lamp 46 which functions to remove the residual electric charge on the drum surface portion before it passes beneath the charging unit 34 and is uniformly re-charged to initiate a subsequent image reproduction cycle.

According to an important aspect of the present invention, the magnetic brush development module 22 is operated in a unique closed loop fashion which will now be described. Disposed within the sump 28 is a quantity of conventional developer material which has a ferrite or other magnetically comparable carrier constituent, and a toner constituent formed by a quantity of toner 26. During counterclockwise rotation of the magnetic roller 40, a quantity of developer is magnetically attracted to the side surface portion of the roller disposed within sump 28, and magnetically adhered to such side surface portion in the form of radially outwardly projecting "bristles" 52, the formation of such bristles 52 on the roller 40 giving rise to its common characterization as a "magnetic brush".

The developer bristles 52 initially deposited on the outer side surface of the roller 40 are passed under a conventional metering blade 54 to trim down the bristles 52, as they rotationally exit the sump 28, to a predetermined, generally uniform "height". The shortened bristles 52 are then rotated into adjacency with an exterior side surface portion of the rotating drum 20, at which point the toner constituent of the developer bristles is withdrawn from the carrier constituent thereof and transferred onto the discharge "image" area of the drum surface for subsequent transfer to the paper stock 18 as previously described.

Just subsequent to this toner transfer to the rotating drum 20, the operation of the magnetic brush development module 22 of the present invention makes a significant departure from the conventional "open loop" operation of previously utilized magnetic brush development devices. Specifically, with reference now to FIGS. 1 and 4, the toner-depleted developer 52_a (FIG. 4) remaining on the outer side surface of the magnetic roller 40 after toner transfer to the rotating drum 20 is not rotated back into the interior of the developer sump 28. Instead, essentially all of the toner-depleted developer 52_a is stripped away from the outer side surface of the roller 40 by means of a specially designed stripper blade 56 interiorly supported within a recycling well housing 58 which underlies the development module 22. The recycling well

housing 58 has a downwardly and rightwardly sloping bottom wall portion 60 which terminates at its left end with a leading edge portion 62 disposed adjacent the drum 20 and generally beneath the roller 40, and terminates at its right end with an upturned rear end wall portion 64 that extends to the bottom side of a left end portion of the toner cartridge 24.

As best illustrated in FIG. 4, the stripper blade 56 is laterally tilted in a leftward direction, and is provided along its top side edge portion with a sharpened edge 66 which engages the outer side surface of the rotating magnetic roller 40. During the illustrated counterclockwise rotation of the roller 40, the blade edge portion 66 scrapes away the toner-depleted developer 52_a, causing it to fall onto the top side surface of the bottom well housing wall 60 and creating a now-cleaned side surface portion 40_a on the roller 40 positioned to the right of the blade edge 66 as viewed in FIG. 4. This cleaned side edge portion of the roller is subsequently rotated into the developer sump 28.

By means of a longitudinally spaced series of slots 68 formed laterally through the scraper blade 56, the stripped away, depleted developer 52_a falling onto the bottom well housing wall 60 to the left of the blade 56 is permitted to pass rightwardly through the blade 56 as indicated by the arrows 70 in FIG. 4. The depleted developer 52_a rightwardly traversing the stripper blade 56 travels by gravity downwardly and rightwardly along the sloped bottom well housing wall 60 until it reaches a magnetic recycle roller 72 disposed in the lower right corner of the well housing 58, in a parallel relationship with the magnetic roller 40, and being driven in a clockwise direction as indicated in FIG. 1.

As the toner-depleted developer 52_a rightwardly reaches the rotating recycle roller 72, it becomes magnetically adhered to a left side surface portion thereof and is rotated into engagement with a leftwardly projecting stripper blade 74 (FIG. 1), carried by the toner cartridge 24, which strips away the developer 52_a and forces it into a generally triangularly cross-sectioned cavity 76 disposed at the juncture between the toner cartridge 24 and the developer sump 28 and communicating with the interior of the sump 28 via a passage 78 formed in the outer wall of the sump.

The depleted developer 52_a forced into the cavity 76 is, in turn, forced into the interior of the developer sump 28, via the passage 78, the depleted developer 52_a entering the sump 28 being adjacent toner 26 being delivered into the sump 28 through the toner cartridge wall opening 30. Upon their entry into the sump 28, the toner 26 and the depleted developer 52_a are drawn into a specially designed mixer structure 80 which will now be described in conjunction with FIGS. 1-3.

Mixer structure 80 includes an elongated drive shaft 82 which extends through the developer sump 28 in a parallel, rightwardly spaced relationship with the magnetic roller 40. Fixedly secured to the shaft 82 for rotation therewith are a plurality of longitudinally spaced, parallel

elliptical disc members 84 (only two of which being illustrated in FIGS. 2 and 3), each of the discs 84 having formed thereon laterally outwardly projecting peripheral lip portions 86 around their outer circumferences. As best illustrated in FIG. 3, the parallel discs 84 are not perpendicular to the shaft 82, but are canted relative to its longitudinal axis by an angle "A". Additionally, as also illustrated in FIG. 3, the longitudinal spacing between each adjacent pair of parallel discs 84 is such that they longitudinally overlap by a small distance "D". As a result, the depleted developer 52_a and the toner 26 are mixed longitudinally along shaft 82.

During the clockwise rotation of the mixer shaft 82, as indicated in FIGS. 1 and 2, the canted discs 84 are also rotated in a clockwise direction. Rotation of the discs 84 draws the depleted developer 52_a and the toner 26 entering the sump 28 to the right of the discs into the interior spaces between adjacent pairs of discs. The rotating discs mix the toner and previously depleted developer 52_a and form therefrom reconstituted developer 52' which is lifted to the top edge of an adjustable metering shield member 88 extending upwardly from the bottom wall of the sump 28 and positioned between the discs 84 and the magnetic roller 40. The reconstituted developer 52' is caused to spill leftwardly over the top edge of the metering shield 88 and fall toward the bottom of the sump 28 at which point it is magnetically attracted and adhered to the cleaned side surface portion 40_a of the roller 40 being rotated through the interior of the sump 28. Accordingly, the developer bristles 52 shown in FIG. 1 within the interior of sump 28 are formed essentially entirely from the reconstituted developer 52'.

The unique closed looped operation of the improved magnetic brush development module 22 just described provides a variety of operating advantages compared to the conventional open loop operation of magnetic brush development structures in which the toner-depleted developer is permitted to remain on the outer side surface of the rotating magnetic roller. For example, such closed loop operation of the development module 22 provides for enhanced, more consistent and uniform image quality on the paper stock 18, desirably dampers and stabilizes image density depletions and surges, and provides better capability for meeting instantaneous demands for additional toner typically arising when graphics or other large area images are to be printed upon the paper being fed through the printing machine.

Additionally, the use of such closed loop operating method in conjunction with the improved development module 22 beneficially prolongs the effective operating life of the module. The improved magnetic brush development module 22 of the present invention may be easily and relatively inexpensively constructed from a small number of relatively simple, yet quite reliable mechanical components. It will be readily appreciated by those skilled in this particular art that the various rotational motions imparted to the mechanical components of the engine cartridge 14 may be effected in a variety of conven-

tional manners which form no part of the present invention. Accordingly, the necessary drive structures required to impart such previously described rotationally motions have simply been schematically depicted in FIG. 1 as drive means 90.

The foregoing detailed description is to be clearly understood as being given by way of illustration and example only, the scope of the present invention being limited solely by the appended claims.

Claims

1. A method of applying toner to a moving toner transfer member (20) in an image reproduction machine, by means of a rotating roller (40), the method further comprising the steps of:

adhering a quantity of developer material (52) to a surface of the rotating roller (40), the developer material having separable toner (26) and carrier constituents;
depositing toner (26) onto the toner transfer member (20) from the adhered quantity of developer material in a manner leaving toner-depleted developer material (52a) adhered to the roller surface;
removing the toner-depleted developer material (52a) from the rotating roller (40) into a well (58);
adding toner (26) to the removed toner-depleted developer material (52a) to form therewith a reconstituted developer material (52');
transferring the toner-depleted material from the well to a sump (28) prior to the step of toner addition; and
thereafter repeating the steps with reconstituted developer material (52') being used; characterised in that:
the developer material (52) is evenly deposited along the full length of the rotating roller (40); and
the toner addition step is performed by a mixer structure (80) within the sump (28), the sump being adjacent to and disposed along the full length of the roller (40).

2. A method according to claim 1, for applying toner to an electrically charged organic photoconductor drum (20) in an electrophotographic printing machine, wherein the roller (40) is a magnetic roller in parallel adjacency with the drum, the toner carrier developer material (52) adhering magnetically to the rotating magnetic roller for rotational transport thereby into a facing relationship with the drum for electrical transfer thereto of toner (26) from the developer material, the toner-depleted developer material (52a) being stripped away from the rotating magnetic roller and mixed with toner (26) to form the



elliptical disc members 84 (only two of which being illustrated in FIGS. 2 and 3), each of the discs 84 having formed thereon laterally outwardly projecting peripheral lip portions 86 around their outer circumferences. As best illustrated in FIG. 3, the parallel discs 84 are not perpendicular to the shaft 82, but are canted relative to its longitudinal axis by an angle "A". Additionally, as also illustrated in FIG. 3, the longitudinal spacing between each adjacent pair of parallel discs 84 is such that they longitudinally overlap by a small distance "D". As a result, the depleted developer 52_a and the toner 26 are mixed longitudinally along shaft 82.

During the clockwise rotation of the mixer shaft 82, as indicated in FIGS. 1 and 2, the canted discs 84 are also rotated in a clockwise direction. Rotation of the discs 84 draws the depleted developer 52_a and the toner 26 entering the sump 28 to the right of the discs into the interior spaces between adjacent pairs of discs. The rotating discs mix the toner and previously depleted developer 52_a and form therefrom reconstituted developer 52' which is lifted to the top edge of an adjustable metering shield member 88 extending upwardly from the bottom wall of the sump 28 and positioned between the discs 84 and the magnetic roller 40. The reconstituted developer 52' is caused to spill leftwardly over the top edge of the metering shield 88 and fall toward the bottom of the sump 28 at which point it is magnetically attracted and adhered to the cleaned side surface portion 40_a of the roller 40 being rotated through the interior of the sump 28. Accordingly, the developer bristles 52 shown in FIG. 1 within the interior of sump 28 are formed essentially entirely from the reconstituted developer 52'.

The unique closed looped operation of the improved magnetic brush development module 22 just described provides a variety of operating advantages compared to the conventional open loop operation of magnetic brush development structures in which the toner-depleted developer is permitted to remain on the outer side surface of the rotating magnetic roller. For example, such closed loop operation of the development module 22 provides for enhanced, more consistent and uniform image quality on the paper stock 18, desirably dampens and stabilizes image density depletions and surges, and provides better capability for meeting instantaneous demands for additional toner typically arising when graphics or other large area images are to be printed upon the paper being fed through the printing machine.

Additionally, the use of such closed loop operating method in conjunction with the improved development module 22 beneficially prolongs the effective operating life of the module. The improved magnetic brush development module 22 of the present invention may be easily and relatively inexpensively constructed from a small number of relatively simple, yet quite reliable mechanical components. It will be readily appreciated by those skilled in this particular art that the various rotational motions imparted to the mechanical components of the engine cartridge 14 may be effected in a variety of conven-

tional manners which form no part of the present invention. Accordingly, the necessary drive structures required to impart such previously described rotationally motions have simply been schematically depicted in FIG. 1 as drive means 90.

The foregoing detailed description is to be clearly understood as being given by way of illustration and example only, the scope of the present invention being limited solely by the appended claims.

Claims

1. A method of applying toner to a moving toner transfer member (20) in an image reproduction machine, by means of a rotating roller (40), the method further comprising the steps of:

adhering a quantity of developer material (52) to a surface of the rotating roller (40), the developer material having separable toner (26) and carrier constituents;
depositing toner (26) onto the toner transfer member (20) from the adhered quantity of developer material in a manner leaving toner-depleted developer material (52a) adhered to the roller surface;
removing the toner-depleted developer material (52a) from the rotating roller (40) into a well (58);
adding toner (26) to the removed toner-depleted developer material (52a) to form therewith a reconstituted developer material (52');
transferring the toner-depleted material from the well to a sump (28) prior to the step of toner addition; and
thereafter repeating the steps with reconstituted developer material (52') being used; characterised in that:
the developer material (52) is evenly deposited along the full length of the rotating roller (40); and
the toner addition step is performed by a mixer structure (80) within the sump (28), the sump being adjacent to and disposed along the full length of the roller (40).

2. A method according to claim 1, for applying toner to an electrically charged organic photoconductor drum (20) in an electrophotographic printing machine, wherein the roller (40) is a magnetic roller in parallel adjacency with the drum, the toner carrier developer material (52) adhering magnetically to the rotating magnetic roller for rotational transport thereby into a facing relationship with the drum for electrical transfer thereto of toner (26) from the developer material, the toner-depleted developer material (52a) being stripped away from the rotating magnetic roller and mixed with toner (26) to form the



reconstituted developer material (52').

3. A method according to claim 2, wherein the step of stripping away the toner-depleted developer material (52a) is carried out by means of an elongate stripper blade member (56) having a series of longitudinally spaced openings (68) extending therethrough and a side edge portion (66), the stripper blade member being positioned in a parallel relationship with the magnetic roller (40) with the side edge portion (66) engaging the magnetic roller, and the stripped-away, toner-depleted developer material (52a) being caused to traverse the openings prior to the mixing of the toner-depleted developer material with the toner.
4. A method according to claim 2 or claim 3, the mixing structure including a shaft (82) on which are centrally secured a longitudinally spaced series of parallel disc members (84), the disc members having longitudinal axes extending at angles to the longitudinal axis of the shaft, the mixing being achieved by rotating the mixing structure (80) about the longitudinal axis of the shaft, and delivering toner (26) and toner-depleted developer material (52a) to a side portion of the rotating mixing structure.
5. Apparatus for applying toner to a moving toner transfer member (20) in an image reproduction machine, the apparatus comprising
 - a rotatable roller (40);
 - means (80) for feeding a quantity of developer material to a surface of the rotating roller, to be adhered thereto, the developer material having separable toner (26) and carrier constituents, toner being deposited onto the toner transfer member (20) from the roller (40) in a manner leaving toner-depleted developer material (52a) adhered to the surface of the rotating roller; and
 - means (56) for removing the toner-depleted developer material from the surface of the rotating roller; and
 - means (28) for adding toner to the toner-depleted developer material (52a) to form therewith a reconstituted developer material (52') for subsequent feeding to the roller; characterised in that:
 - the developer material feeding means (80) is adapted to evenly deposit developer material along the full length of the rotating roller (40);
 - the means (28) for adding toner to the toner-depleted developer material (52a), which is formed from a magnetically attractable carrier material, to form therewith a reconstituted developer material (52') for subsequent feeding to the roller, comprises sump means (28) disposed along the full length of the roller (40) for

receiving, from sources thereof, a toner material (26) and toner-depleted developer material to which the toner material is removably adherable, the sump means having mixer means (80) operable to mix toner and carrier material into a developer material (52); and

the means (28) for adding toner to the toner-depleted developer material (52a) further comprises recycling means (58) for receiving the stripped away, toner-depleted developer material and transferring it to the sump means for receipt by the mixer means (80) to form the reconstituted developer material.

6. Apparatus according to claim 5, for use with a developer material (52) which is a mix of a toner (26) and a magnetically attractable carrier developer material, wherein:

the toner transfer member (20) is electrically charged;

the roller (40) is a magnetic roller.

7. Apparatus according to claim 5 or claim 6, for use in an electrically charged printing machine drum magnetic brush development apparatus, wherein

the magnetic transfer roller (40) is rotatable to move an outer side surface portion thereof into the sump means (28) for magnetic deposition thereon of a quantity of the mixed developer material (52), and then out of the sump means into adjacency with an outer side surface portion of the drum (20) to permit electrical transfer thereto of toner from the mixed developer material (52), thereby converting the quantity of the mixed developer material to a toner-depleted developer material (52a); and

the means (56) for removing the toner-depleted developer material from the surface of the rotating roller comprises stripper means (56) for stripping away the toner-depleted developer material (52a) from the magnetic transfer roller in a manner causing the material to reenter the sump means in a cleaned, generally tonerless condition.

8. Apparatus according to claim 7, wherein the mixer means (80) includes:

a drive shaft (82) extending through the sump means (28) in a parallel, laterally spaced apart relationship with the magnetic roller (40),

a series of parallel disc members (84) anchored to the drive shaft at longitudinally spaced apart locations thereon, each of the disc members having its longitudinal axis forming an angle with the drive shaft axis.



9. Apparatus according to claim 8, wherein:
the paths of rotation of adjacent disc members
(84) overlap one another.

10. Apparatus according to claim 8 or claim 9, wherein
each disc member (84) is elliptical and has a
transverse lip (86) extending around its circumfer-
ential periphery.

11. Apparatus according to any of claims 7 to 9, wherein
the recycling means include:

well means (58) disposed beneath the sump
means (28) and operative to receive
toner-depleted developer material stripped
away from the magnetic roller means, and
transfer means (72-78) for transferring
toner-depleted developer material from within
the sump means.

12. Apparatus according to claim 11, wherein the trans-
fer means includes:

a cavity (76) disposed in an upper portion of the
well means,
a wall opening (78) in the sump means and
interconnecting the interiors of the sump means
and the cavity,
magnetic recycle roller means (72) disposed
within the well means beneath the cavity and
being rotatable to transport toner-depleted
developer material into the cavity from a bottom
portion of the well means, and
stripper blade means (74) projecting into the
cavity (76) and operative to remove
toner-depleted developer material from the
magnetic recycle roller means and cause the
removed toner-depleted developer material to
enter the well means through the cavity and the
well opening.

13. Apparatus according to claim 12, wherein:
the well means (58) has a sloping bottom wall
along which toner-depleted developer material may
move by gravity to the magnetic recycle roller means
(72).

14. Apparatus according to any of claims 11 to 13,
wherein the stripper means (56) includes:

an elongated stripper blade member (56) dis-
posed within the well means longitudinally extending
parallel to the magnetic transfer roller, and having a
first side edge portion secured to a bottom wall (60)
of the well means (58), a second side edge portion
(66) operatively engaging the magnetic transfer
roller (40), and a series of longitudinally spaced
openings (68) extending transversely therethrough.

15. Apparatus according to any of claims 7 to 14, further
comprising:

toner supply means (24), operatively sup-
ported adjacent the sump means, for supplying
toner to the sump means for use therein by the mixer
means.

16. An electrophotographic engine cartridge for a print-
ing machine, such as a printer or copier, through
which an imprintable medium (18) is moved, com-
prising:

rotationally drivable photoconductor drum
means (20) having a side surface portion oper-
atively chargeable, during rotation of the drum
means, to electrostatically attract and hold a
quantity of toner and rotationally transport the
quantity of toner into adjacency with the imprint-
able medium (18) for transfer thereto;
developer means, supported in operative adja-
cency with the drum means, for supplying toner
to the drum means, the developer means
including apparatus according to any of claims
7 to 15.

17. A printing machine such as a photocopier, laser
printer or the like, comprising:

a housing (12);
means (90) for moving an imprintable medium
through the housing; and
a cartridge according to claim 16.

Patentansprüche

1. Verfahren zum Auftragen von Toner auf ein sich
bewegendes Tonerübertragungselement (20) in
einem Bildervielfältigungsgerät mittels einer sich
drehenden Walze (40), wobei das Verfahren des
weiteren die folgenden Schritte umfaßt:

Anhaften einer Menge Entwicklermaterial (52)
an eine Oberfläche der sich drehenden Walze
(40), wobei das Entwicklermaterial voneinander
trennbare Toner (26)- und Trägerbestandteile
enthält;

Auftragen von Toner (26) auf das Tonerübertra-
gungselement (20) von der anhaftenden Menge
Entwicklermaterial, so daß an Toner armes Ent-
wicklermaterial an der Walzenoberfläche haf-
tenbleibt;

Entfernen des an Toner armen Entwicklermate-
rials (52a) von der sich drehenden Walze (40)
in eine Mulde (58);



Zusetzen von Toner (26) zu dem an Toner armen Entwicklermaterial (52a), um so ein wiederhergestelltes Tonermaterial (52') zu erzeugen;

Übertragen des an Toner armen Materials aus der Mulde in einen Behälter (28) vor dem Schritt des Zusetzens von Toner; und

anschließendes Wiederholen der Schritte, wobei wiederhergestelltes Entwicklermaterial (52') eingesetzt wird; **dadurch gekennzeichnet**, daß:

das Entwicklermaterial (52) gleichmäßig über die gesamte Länge der sich drehenden Walze (40) verteilt wird; und

der Schritt des Zusetzens von Toner durch eine Mischerstruktur (80) in dem Behälter (28) ausgeführt wird, wobei der Behälter an die Walze (40) angrenzt und sich über ihre gesamte Länge erstreckt.

2. Verfahren nach Anspruch 1 zum Auftragen von Toner auf eine elektrisch geladene organische Photoleitertrommel (20) in einem elektrophotographischen Druckgerät, wobei die Walze (40) eine Magnetwalze ist, die parallel an die Trommel angrenzt, wobei das Toner-/Träger-Entwicklermaterial (52) magnetisch an der sich drehenden Magnetwalze haftet und durch selbige der Trommel zur elektrischen Übertragung von Toner (26) aus dem Entwicklermaterial zugewandt drehend transportiert wird, wobei das an Toner arme Entwicklermaterial (52a) von der sich drehenden Magnetwalze abgestreift und mit Toner (26) vermischt wird, um das wiederhergestellte Entwicklermaterial (52') zu erzeugen.
3. Verfahren nach Anspruch 2, wobei der Schritt des Abstreifens des an Toner armen Entwicklermaterials (52a) mittels eines länglichen Abstreifklingenelementes (56) mit einer Reihe in Längsrichtung beabstandeter Öffnungen (68), die sich durch selbiges hindurch erstrecken, und einem Seitenkantenabschnitt (66) ausgeführt wird, wobei das Abstreifklingenelement parallel zu der Magnetwalze (40) angeordnet ist und der Seitenkantenabschnitt (66) in Kontakt mit der Magnetwalze ist, und das abgestreifte, an Toner arme Entwicklermaterial (52a) die Öffnungen durchläuft, bevor das an Toner arme Entwicklermaterial mit dem Toner vermischt wird.
4. Verfahren nach Anspruch 2 oder Anspruch 3, wobei die Mischstruktur eine Welle (82) enthält, auf der mittig eine in Längsrichtung beabstandete Reihe paralleler Scheibenelemente (84) befestigt ist,

wobei die Scheibenelemente Längsachsen haben, die im Winkel zur Längsachse der Welle verlaufen, wobei das Mischen ausgeführt wird, indem die Mischstruktur (80) um die Längsachse der Welle gedreht wird, und Toner (26) und an Toner armes Entwicklermaterial (52a) einem Seitenabschnitt der sich drehenden Mischstruktur zugeführt werden.

5. Vorrichtung zum Auftragen von Toner auf ein sich bewegendes Tonerübertragungselement (20) in einem Bildvervielfältigungsgerät, wobei die Vorrichtung umfaßt:

eine drehbare Walze (40);

eine Einrichtung (80), die einer Oberfläche der sich drehenden Walze eine Menge Entwicklermaterial zuführt, das daran anhaftet, wobei das Entwicklermaterial aus trennbaren Toner(26)- und Trägerbestandteilen besteht, wobei Toner von der Walze (40) so auf das Tonerübertragungselement (20) aufgetragen wird, daß an Toner armes Entwicklermaterial (52a) an der Oberfläche der sich drehenden Walze haften bleibt;

eine Einrichtung (56), die das an Toner arme Entwicklermaterial von der Oberfläche der sich drehenden Walze entfernt; und

eine Einrichtung (28), die dem an Toner armen Entwicklermaterial (52a) Toner zusetzt, um so ein wiederhergestelltes Entwicklermaterial (52') zu erzeugen, das anschließend der Walze zugeführt wird; **dadurch gekennzeichnet**, daß:

die Entwicklermaterial-Zuführeinrichtung (80) Entwicklermaterial über die gesamte Länge der sich drehenden Walze (40) gleichmäßig aufträgt;

die Einrichtung (28), die dem an Toner armen Entwicklermaterial (52a), das aus einem magnetisch anziehbaren Trägermaterial besteht, Toner zusetzt, um so ein wiederhergestelltes Entwicklermaterial (52') zu erzeugen, das anschließend der Walze zugeführt wird, eine Behältereinrichtung (28) umfaßt, die über die gesamte Länge der Walze (40) angeordnet ist und aus Quellen derselben ein Tonermaterial (26) und ein an Toner armes Entwicklermaterial aufnimmt, an dem das Tonermaterial lösbar haften kann, wobei die Behältereinrichtung eine Mischereinrichtung (80) aufweist, die Toner und Trägermaterial zu einem Entwicklermaterial (52) vermischen kann; und



- die Einrichtung (28), die dem an Toner armen Entwicklermaterial (52a) Toner zusetzt, des weiteren eine Rückführeinrichtung (58) umfaßt, die das abgestreifte, an Toner arme Entwicklermaterial aufnimmt und es zur Aufnahme durch die Mischereinrichtung (80) zu der Behältereinrichtung überführt, um das wiederhergestellte Entwicklermaterial zu erzeugen.
6. Vorrichtung nach Anspruch 5 zum Einsatz mit einem Entwicklermaterial (52), das eine Mischung aus einem Toner (26) und einem magnetisch anziehba-
ren Trägerentwicklermaterial ist, wobei:
- das Tonerübertragungselement (20) elektrisch
geladen ist;
- die Walze (40) eine Magnetwalze ist.
7. Vorrichtung nach Anspruch 5 oder Anspruch 6 zum Einsatz in einer Magnetbürstenentwicklungsvorrichtung einer elektrisch geladenen Druckgerä-
trotrommel, wobei
- die Magnetübertragungswalze (40) gedreht
werden kann und so einen Außenseitenoberflä-
chenabschnitt derselben in die Behältereinrich-
tung (28) bewegt, um eine Menge des gemisch-
ten Entwicklermaterials (52) magnetisch darauf
aufzutragen, und anschließend aus der Behäl-
tereinrichtung in die Nähe eines Außenseiten-
oberflächenabschnitts der Trommel (20), so
daß Toner aus dem gemischten Entwicklema-
terial (52) elektrisch darauf übertragen werden
kann, so daß die Menge des gemischten Ent-
wicklermaterials in ein an Toner armes Entwick-
lermaterial (52a) umgewandelt wird; und
- die Einrichtung (56), die das an Toner arme Ent-
wicklermaterial von der Oberfläche der sich dre-
henden Walze entfernt, eine Abstreifeinrichtung
(56) umfaßt, die das an Toner arme Entwick-
lermaterial (52a) so von der Übertragungswalze
abstreift, daß das Material in einem gereinigten,
im allgemeinen tonerlosen Zustand wieder in
die Behältereinrichtung eintritt.
8. Vorrichtung nach Anspruch 7, wobei die Mischerein-
richtung (80) enthält:
- eine Antriebswelle (82), die sich parallel zu der
Magnetwalze (40) und seitlich von ihr beabstan-
det durch die Behältereinrichtung (28) erstreckt,
- eine Reihe paralleler Scheibenelemente (84),
die an in Längsrichtung beabstandeten Positi-
onen an der Antriebswelle befestigt sind, wobei
die Längsachse jedes der Scheibenelemente
- einen Winkel zur Antriebswellenachse bildet.
9. Vorrichtung nach Anspruch 8, wobei:
die Drehwege benachbarter Scheibenele-
mente (84) einander überlagern.
10. Vorrichtung nach Anspruch 8 oder Anspruch 9,
wobei jedes Scheibenelement (84) elliptisch ist und
einen Querrand (86) aufweist, der um seinen
Umfangsrand herum verläuft.
11. Vorrichtung nach einem der Ansprüche 7 bis 9,
wobei die Rückführeinrichtung enthält:
- eine Muldeneinrichtung (58), die unterhalb der
Behältereinrichtung (28) angeordnet ist und an
Toner armes Entwicklermaterial aufnimmt, das
von der Magnetwalze abgestreift wird, und
- eine Übertragungseinrichtung (72-78), die an
Toner armes Entwicklermaterial aus dem Inne-
ren der Behältereinrichtung überträgt.
12. Vorrichtung nach Anspruch 11, wobei die Übertra-
gungseinrichtung enthält:
- einen Hohlraum (76), der in einem oberen
Abschnitt der Muldeneinrichtung angeordnet
ist,
- eine Wandöffnung (78) in der Behältereinrich-
tung, die das Innere der Behältereinrichtung
und des Hohlraums miteinander verbindet,
- eine Magnet-Rückführwalzeneinrichtung (72),
die unterhalb des Hohlraums in der Muldenein-
richtung angeordnet ist und so gedreht werden
kann, daß sie an Toner armes Entwicklermate-
rial von einem unteren Abschnitt der Muldenein-
richtung in den Hohlraum befördert, und
- eine Abstreifklingeinrichtung (74), die in den
Hohlraum (76) vorsteht und an Toner armes
Entwicklermaterial von der Magnet-Rückführ-
walzeneinrichtung entfernt, und bewirkt, daß
das entfernte, an Toner arme Entwicklermate-
rial über den Hohlraum und die Wandöffnung in
die Muldeneinrichtung eintritt.
13. Vorrichtung nach Anspruch 12, wobei:
die Muldeneinrichtung (58) eine geneigte
untere Wand aufweist, an der sich an Toner armes
Entwicklermaterial aufgrund der Schwerkraft zu
der Magnet-Rückführwalzeneinrichtung (72) bewe-
gen kann.
14. Vorrichtung nach einem der Ansprüche 11 bis 13,
wobei die Abstreifeinrichtung (56) enthält:



ein längliches Abstreifklingenelement (56), das in der Muldeneinrichtung angeordnet ist und sich in Längsrichtung parallel zu der Magnet-Übertragungswalze erstreckt und einen ersten Seitenkantenabschnitt aufweist, der an einer unteren Wand (60) der Muldeneinrichtung (58) befestigt ist, einen zweiten Seitenkantenabschnitt (66), der funktionell mit der Magnet-Übertragungswalze (40) in Kontakt ist, sowie eine Reihe von in Längsrichtung beabstandeten Öffnungen (68), die sich quer durch selbigen erstrecken.

15. Vorrichtung nach einem der Ansprüche 7 bis 14, die des weiteren umfaßt:

eine Tonerzuführeinrichtung (24), die funktionell an die Behältereinrichtung angrenzend angebracht ist und der Behältereinrichtung Toner zuführt, der darin durch die Mischereinrichtung verwendet wird.

16. Elektrophotographische Motorkartusche für ein Druckgerät, wie beispielsweise einen Drucker oder Kopierer, durch den ein bedruckbares Medium (18) hindurchbewegt wird, die umfaßt:

eine drehend antreibbare Photoleitertrommleinrichtung (20) mit einem Seitenoberflächenabschnitt, der bei Drehung der Trommleinrichtung funktionell geladen werden kann, um eine Menge Toner elektrostatisch anzuziehen und zu halten und die Menge Toner drehend in die Nähe des bedruckbaren Mediums (18) zu transportieren, um sie darauf zu übertragen;

eine Entwicklereinrichtung, die funktionell an die Trommleinrichtung angrenzend angebracht ist und der Trommleinrichtung Toner zuführt, wobei die Entwicklereinrichtung eine Vorrichtung nach einem der Ansprüche 7 bis 15 enthält.

17. Druckgerät, wie beispielsweise ein Photokopierer, ein Laserdrucker oder dergleichen, das umfaßt:

ein Gehäuse (12);

eine Einrichtung (90), die ein bedruckbares Medium durch das Gehäuse bewegt; und

eine Kartusche nach Anspruch 16.

Revendications

1. Procédé pour appliquer de l'encre en poudre à un organe de transfert d'encre en poudre (20) en mouvement dans une machine de reproduction d'images, au moyen d'un rouleau tournant (40), le pro-

cédé comprenant en outre les étapes consistant à:

- faire adhérer une quantité de matière formant révélateur (52) sur une surface du rouleau tournant (40), la matière formant révélateur ayant des constituants encre en poudre (26) et matière porteuse séparables;
 - déposer l'encre en poudre (26) sur l'organe de transfert d'encre en poudre (20) à partir de la quantité de matière formant révélateur d'une manière laissant la matière formant révélateur appauvrie en encre en poudre (52a) adhérent à la surface du rouleau;
 - enlever la matière formant révélateur appauvrie en encre en poudre (52a) du rouleau tournant (40) et la mettre dans un bac (58);
 - ajouter de l'encre en poudre (26) à la matière formant révélateur appauvrie en encre en poudre (52a) pour former avec celle-ci une matière formant révélateur reconstituée (52');;
 - transférer la matière appauvrie en encre en poudre du bac à un carter (28) avant l'étape d'ajout d'encre en poudre; et
 - après cela, répéter les étapes en utilisant la matière formant révélateur reconstituée (52'),
- caractérisé en ce que:
- la matière formant révélateur (52) est déposée uniformément sur toute la longueur du rouleau tournant (40); et
 - l'étape d'ajout d'encre en poudre est exécutée par une structure formant mélangeur (80) à l'intérieur du carter (28), le carter (28) étant voisin du rouleau (40) et disposé le long de toute la longueur de celui-ci.

2. Procédé selon la revendication 1, pour appliquer de l'encre en poudre à un tambour photoconducteur organique chargé électriquement (20) dans une machine à imprimer électrophotographique, dans lequel le rouleau (40) est un rouleau magnétique disposé parallèlement à proximité immédiate du tambour, la matière formant révélateur à encre en poudre et matière porteuse (52) adhérent magnétiquement au rouleau magnétique tournant pour transport par rotation par celui-ci jusqu'à une relation de face à face avec le tambour pour transfert électrique à celui-ci d'encre en poudre (26) provenant de la matière formant révélateur, la matière formant révélateur appauvrie en encre en poudre (52a) étant détachée du rouleau magnétique tournant et mélangée avec de l'encre en poudre (26) pour former de la matière formant révélateur reconstituée (52').

3. Procédé selon la revendication 2, dans lequel l'étape d'enlèvement de la matière formant révélateur appauvrie en encre en poudre (52a) est exécutée au moyen d'un organe en forme de lame allongée formant raclette (56) ayant une série d'ouvertures



res espacées longitudinalement s'étendant à travers celui-ci et une partie marginale latérale (66), l'organe en forme de lame racleuse allongée étant disposé en relation parallèle avec le rouleau magnétique (40), la partie marginale latérale (66) étant en prise avec le rouleau magnétique, et la matière formant révélateur appauvrie en encre en poudre (52a) étant amenée à passer par les ouvertures avant le mélange de la matière formant révélateur appauvrie en encre en poudre à l'encre en poudre.

4. Procédé selon la revendication 2 ou la revendication 3, la structure mélangeuse comportant un arbre (82) sur lequel est fixée centralement une série longitudinalement espacée d'organes parallèles en forme de disques (84), les organes en forme de disques ayant des axes longitudinaux s'étendant en formant un angle avec l'axe longitudinal de l'arbre, le mélange étant réalisé en faisant tourner la structure mélangeuse (80) autour de l'axe longitudinal de l'arbre et en délivrant de l'encre en poudre (26) et la matière formant révélateur appauvrie en encre en poudre (52a) à une partie latérale de la structure mélangeuse tournante.

5. Dispositif pour appliquer de l'encre en poudre à un organe de transfert d'encre en poudre (20) en mouvement dans une machine de reproduction d'images, le dispositif comprenant:

- un rouleau tournant (40);
 - des moyens (80) pour fournir une quantité de matière formant révélateur à une surface du rouleau tournant pour la faire adhérer à celle-ci, la matière formant révélateur ayant des constituants encre en poudre (26) et matière porteuse séparables, l'encre en poudre étant déposée sur l'organe de transfert d'encre en poudre (20) à partir du rouleau tournant (40) d'une manière qui laisse la matière formant révélateur appauvrie en encre en poudre adhérant à la surface du rouleau tournant;
 - des moyens (56) pour enlever la matière formant révélateur appauvrie en encre en poudre de la surface du rouleau tournant; et
 - des moyens (28) pour ajouter de l'encre en poudre à la matière formant révélateur appauvrie en encre en poudre (52a) pour former avec celle-ci une matière formant révélateur reconstituée (52') pour fourniture subséquente au rouleau tournant,
- caractérisé en ce que:
- les moyens d'alimentation en matière formant révélateur (80) sont adaptés pour déposer uniformément la matière formant révélateur sur toute la longueur du rouleau tournant (40);
 - les moyens (28) pour ajouter de l'encre en poudre à la matière formant révélateur appauvrie

en encre en poudre (52a), qui est formée à partir d'une matière porteuse pouvant être attirée magnétiquement, pour former avec celle-ci une matière formant révélateur reconstituée (52') pour fourniture subséquente au rouleau tournant, comprennent des moyens formant carter (28) disposés le long de toute la longueur du rouleau tournant (40) pour recevoir, en provenance de sources de celles-ci, une matière constituée par de l'encre en poudre (26) et une matière formant révélateur appauvrie en encre en poudre à laquelle la matière constituée par de l'encre en poudre peut adhérer de manière séparable, les moyens formant carter (28) ayant des moyens formant mélangeur (80) fonctionnant pour mélanger l'encre en poudre et la matière porteuse pour former une matière formant révélateur (52); et

- les moyens (28) pour ajouter de l'encre en poudre à la matière formant révélateur appauvrie en encre en poudre (52a) comprennent en outre des moyens de recyclage (58) pour recevoir la matière formant révélateur appauvrie en encre en poudre enlevée du rouleau tournant et la transférer aux moyens formant carter pour réception par les moyens formant mélangeur (80) pour former la matière formant révélateur reconstituée.

6. Dispositif selon la revendication 5, pour utilisation avec une matière formant révélateur (52) qui est un mélange d'une encre en poudre (26) et d'une matière porteuse pouvant être attirée magnétiquement, dans lequel:

- l'organe de transfert d'encre en poudre (20) est chargé électriquement; et
- le rouleau tournant (40) est un rouleau magnétique.

7. Dispositif selon la revendication 5 ou la revendication 6, pour utilisation dans un dispositif de développement à brosse magnétique à tambour chargé électriquement de machine à imprimer, dans lequel:

- le rouleau de transfert magnétique (40) peut tourner pour amener une partie d'une surface latérale extérieure de celui-ci dans les moyens formant carter (28) pour dépôt magnétique sur celui-ci d'une quantité de la matière mélangée formant révélateur (52) et ensuite sortir des moyens formant carter (28) pour venir à proximité immédiate d'une partie de la surface latérale extérieure du tambour (20) pour permettre le transfert électrique à celui-ci de l'encre en poudre provenant de la matière mélangée formant révélateur (52), en convertissant par ce moyen la quantité de matière mélangée formant



- révélateur en une matière formant révélateur appauvrie en encre en poudre (52a); et
- les moyens (56) pour enlever la matière formant révélateur appauvrie en encre en poudre de la surface du rouleau tournant (40) comprennent des moyens formant raclette (56) pour racle la matière formant révélateur appauvrie en encre en poudre (52a) pour l'enlever du rouleau de transfert magnétique d'une manière amenant la matière enlevée à repénétrer dans les moyens formant carter dans un état nettoyé, sensiblement sans encre en poudre. 5
8. Dispositif selon la revendication 7, dans lequel les moyens formant mélangeur (80) comprennent: 10
- un arbre d'entraînement (82) s'étendant d'un bout à l'autre des moyens formant carter (28) en relation parallèle au rouleau magnétique tournant (40) et espacé latéralement de celui-ci; 20
 - une série d'organes en forme de disque (84) calés sur l'arbre d'entraînements à des emplacements espacés longitudinalement sur celui-ci, chacun des organes en forme de disque ayant son axe longitudinal formant un angle avec l'axe de l'arbre d'entraînement. 25
9. Dispositif selon la revendication 8, dans lequel:
- les trajectoires de rotation des organes en forme de disque voisins (84) se recouvrent l'une l'autre. 30
10. Dispositif selon la revendication 8 ou la revendication 9, dans lequel: 35
- chaque organe en forme de disque (84) est elliptique et a une lèvre transversale (86) s'étendant autour de sa périphérie circonférentielle. 40
11. Dispositif selon l'une quelconque des revendications 7 à 9, dans lequel les moyens de recyclage comprennent: 45
- des moyens formant bac (58) disposés sous les moyens formant carter (28) et fonctionnant pour recevoir la matière formant révélateur appauvrie en encre en poudre enlevée du rouleau magnétique (40); et 50
 - des moyens de transfert (72-78) pour transférer la matière formant révélateur appauvrie en encre en poudre à partir de l'intérieur des moyens formant carter (28).
12. dispositif selon la revendication 11, dans lequel les moyens de transfert comprennent: 55
- une cavité (76) disposée dans une partie supérieure des moyens formant bac (58);
 - une ouverture dans une paroi (78) dans les moyens formant carter, interconnectant les intérieurs des moyens formant carter et de la cavité;
 - des moyens formant rouleau magnétique de recyclage (72) disposés à l'intérieur des moyens formant bac (58), sous la cavité, et pouvant tourner pour transporter la matière formant révélateur appauvrie en encre en poudre dans la cavité à partir d'une partie du fond des moyens formant bac; et
 - des moyens à lame formant raclette (74) dépassant dans la cavité (76) et fonctionnant pour enlever la matière formant révélateur appauvrie en encre en poudre des moyens formant rouleau magnétique de recyclage et amener la matière formant révélateur appauvrie en encre en poudre à pénétrer dans les moyens formant bac (58) par l'intermédiaire de la cavité (76) et de l'ouverture dans une paroi (78).
13. Dispositif selon la revendication 12, dans lequel:
- les moyens formant bac (58) ont une paroi de fond en pente le long de laquelle la matière formant révélateur appauvrie en encre en poudre peut se déplacer par gravité pour atteindre les moyens formant rouleau magnétique de recyclage (72).
14. Dispositif selon l'une quelconque des revendications 11 à 13, dans lequel les moyens à lame formant raclette (56) comprennent:
- un organe en forme de lame allongée formant raclette (56) disposé à l'intérieur des moyens formant bac et s'étendant longitudinalement parallèlement au rouleau magnétique de transfert, et ayant une première partie marginale latérale fixée à une paroi de fond (60) des moyens formant bac (58), une deuxième partie marginale latérale (66) fonctionnellement en prise avec le rouleau de transfert magnétique (40), et une série d'ouvertures espacées longitudinalement (68) s'étendant transversalement à travers celui-ci.
15. Dispositif selon l'une quelconque des revendications 7 à 14, comprenant en outre:
- des moyens d'alimentation en encre en poudre (24) supportés fonctionnellement pour être contigus aux moyens formant carter pour fournir de l'encre en poudre aux moyens formant carter pour utilisation dans ceux-ci par les moyens formant mélangeur.



16. Cartouche de coeur électrophotographique pour une machine à imprimer telle qu'une imprimante ou un photocopieur, dans laquelle un support imprimable (18) est mis en mouvement, comprenant:

- des moyens formant tambour photoconducteur entraînable en rotation (20) ayant une partie constituée par une surface latérale chargeable fonctionnellement pendant la rotation des moyens formant tambour pour attirer électrostatiquement et retenir une quantité d'encre en poudre et transporter par rotation la quantité d'encre en poudre pour l'amener à proximité immédiate du support imprimable (18) pour transférer à celui-ci; et
- des moyens de développement supportés à proximité fonctionnelle des moyens formant tambour pour fournir de l'encre en poudre aux moyens formant tambour, les moyens de développement comprenant un dispositif selon l'une quelconque des revendications 7 à 15.

17. Machine à imprimer telle qu'un photocopieur, une imprimante laser ou une machine analogue, comprenant:

- un boîtier (12);
- des moyens (90) pour mettre en mouvement un support imprimable dans le boîtier; et
- une cartouche selon la revendication 16.

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