Description

This invention relates to apparatus for the metering of toner powder in which the pressure of a rotating metering action is equalized inherently, thereby avoiding the use of vents.

This application is an improvement of the apparatus described in European patent application 0412923 entitled Toner Metering Apparatus. That apparatus has a rotating roller interacting with three flaps to meter toner as required both to and away from a developer roller chamber and a toner supply chamber. Air pressure created by the rotating roller is reduced by a vent between the two chambers. Vents, however, can become clogged. A device which inherently eliminates the pressure differential is more reliable and is potentially less expensive.

The apparatus of the foregoing patent application is the only similar structure known, and it has a symmetrical rotating roller and employs venting.

This invention employs a roller which is non-symmetrical along its length.

In accordance with this invention the metering roller has a different configuration along its length so that at some points it would be moving toner one way while at other points it would provide an enlarged area in the chamber receiving toner. This counteracts the build-up of air pressure between the two chambers between which the roller operates by permitting air to be redistributed in a single chamber and also possibly providing a more open path between the chambers. More specifically, the metering roller is elongated and the outer configuration is unsymmetrical so as achieve the metering action. Half of the length of the roller is configured so as to be the 90 degree rotation of the other half, so that the metering action is about equally divided between opposite locations in the metering cycle during revolutions of the roller. This achieves inherent equalization of pressure sufficient to avoid the need for any vent between the two chambers.

There will now be described, by way of example only, a preferred embodiment of the present invention, with reference to the accompanying drawings, in which:

Fig. 1 is a section view of the developer apparatus. Fig. 2a and Fig. 2b are detail views of the metering roller each turned 90 degrees with respect to the other.

The invention in the preferred embodiment resides in a replaceable cartridge 1 used with an electrophotographic printing device. As shown in Fig. 1 the venting structure of the earlier European application has been eliminated and the metering roller 3 is unsymmetrical, as shown in detail in Fig. 2a and Fig. 2b. Also, the sectioning of Fig. 1 should be understood as being outward of the middle of roller 3. Photoconductor drum 5 is also contained in cartridge 1, and the mechanisms shown in Fig. 1 interact with drum 5 to apply toner to it. Cartridge 1 includes a developer roller 7 which rotates in the direction of arrow 9 to carry toner 11 from the developer roller chamber 13 past the doctor blade 15 into contact with the photoconductor drum 5. The toner adder roller 16 rotates in the same direction as the developer roller 7.

Toner 11 comprises a blend of styrene-acrylic resin, wax, carbon black, silicon carbide, Aerosil and a charge control agent. The toner has a nominal particle size of 11 microns. Toner is supplied to the developer roller chamber 13 from a supply chamber 19 through the action of toner metering roller 3. During operation a paddle 21 constantly rotates within the supply chamber 19 to ensure that toner 11 does not agglomerate and is in the vicinity of the toner metering roller 3. The toner metering roller 3 cooperates with three flaps 23, 25, and 27, which extend continuously along the operative length of metering roller 3 and press against roller 3, to meter the toner 11 from the supply chamber 19 and to effect removal of excess toner 11 from the developer roller chamber 13 back to the supply chamber 19. Scraper fingers 29, which are positioned at regular intervals along and in relation to the operative length of metering roller 3, act to clean the surface of the toner metering roller 3 to ensure that the toner is dislodged therefrom. The flaps 23 and 25 and the fingers 29 are made of a thin flexible plastic material. Flap 27, which has the largest deflection, tends to take on a permanent set when plastic, and is of resilient metal to maintain its form, with the tip rounded to reduce frictional binding. For clarity in Fig. 1 flaps 23, 25 and 27 and fingers 29 are shown only as they press against the forward, sectioned part of roller 3.

The cartridge 1 is sealed so that toner 11 remains within the cartridge 1 until consumed by the action of developer roller 7 carrying the toner 11 to the drum 5. Unused toner on the developer roller 7 is returned to the developer roller chamber 13 upon continued rotation of the developer roller 7.

When the amount of toner supplied to the developer roller chamber 13 reaches an equilibrium level 31, it is necessary to maintain this equilibrium level without appreciably adding further amounts of toner to the developer roller chamber 13. In order to accomplish this, the toner metering roller 3 acts to remove toner 11 from the developer roller chamber 13 after the toner 11 reaches the equilibrium level. This is achieved by the interaction of the metering roller surface with the flaps 23, 25 and 27.

The roller 3 and flaps 23, 25, 27, 29 act together essentially as two toner metering devices of the kind shown in EP 0412923 side-by-side, out of phase with each other. Each flap extends along the length of the roller. At the boundary between the two halves of the roller the flaps may be cut or divided into two parts to enable each half of the device to operate in the same mannner as a single toner metering device. Alterna-

tively, the flaps may be made sufficiently flexible to enable each part of a flap to closely follow its respective half of the roller to achieve a similar effect.

As shown in Fig. 2a and Fig. 2b, metering roller 3 has opposing raised faces 33 connected by opposing flat surfaces 35. This configuration of faces 33 and flat surfaces 35 is positioned 90 degrees different from one another on two sides of roller 3, so that the half of roller 3 on one side of its longitudinal middle has the raised faces 33 offset 90 degrees from the raised faces 33 of the other half.

During operation, the opposing raised faces 33 necessarily move toward the chambers 13 and 19 simultaneously, thereby tending to sweep surrounding air primarily from supply chamber 19 to developer roller chamber 13. In accordance with this invention, however, as the raised faces 33 of one longitudinal side of roller 3 extend into the chambers 13 and 19, the flat surfaces 35 of the other half of the longitudinal side of roller 3 extend between the chambers 13 and 19. This dissipates any pumping action by the roller 3 between chambers 13 and 19 to eliminate significant pressure build-up between chamber 13 and 19.

During operation of the device disclosed in EP 0412923, rotation of the flattened roller along with the sealing against the roller of the flaps creates a varying volume in developer chamber. Without venting, this volume change creates unacceptably large air pressure variation in the chamber. Venting couples the small space in developer chamber to the relatively large air space in toner chamber. The volume change in chamber being a smaller percentage of the available volume for the affected air mass than that of chamber means that the resultant pressure variation is substantially reduced by venting to chamber.

In accordance with this invention, roller 3 causes a volume reduction on one side of chamber 13 at the same time it creates an expanded volume on the other side of chamber 13. Air is believed to shuttle back and forth from one side of chamber 13 to the other without any appreciable pressure rise, although air may also pass to chamber 19 in the direction of the flat surfaces of roller 3.

The need for a permanent vent between chambers 13 and 19 is eliminated. Furthermore, a tangible cost reduction is realized by the elimination of a tape cover used in the vent path to minimize toner flow through the vent path. More importantly, the potential of the vent becoming clogged is eliminated since no vent is employed.

It will be recognized that the metering roller 3 may take various surface configurations or be divided into more than two differently oriented sections, and that some venting may also be used as a supplement. Accordingly, patent coverage should be in accordance with such scope with particular reference to the following claims.

Claims

1. A developer apparatus for supplying toner to an electrostatically charged imaging surface (5) comprising a supply chamber (19) for containing a supply of toner, a developer chamber (13), developer means (7, 15) for removing toner from the developer chamber to the electrostatically charged surface, and metering means (3, 23, 25, 27, 29) comprising a flattened roller (3) engaging flap means (23, 25, 27, 29) to supply toner from the supply chamber to the developer chamber and for removing toner from the developer chamber back to the supply chamber when the level of the toner in the developer chamber exceeds an equilibrium level, said flattened roller having different orientations of its substantially flat surfaces (35) along the operating length of said roller to relieve air pressure increase within said developer chamber.

2. The developer apparatus as in claim 1 in which said flattened roller (3) has at least approximately one-half of its longitudinal length at a first configuration and at least approximately the other one-half of its longitudinal length rotated 90 degrees with respect to said first configuration.

3. The developer apparatus as in claim 1 or 2 in which said one-half parts of said roller are on opposite sides of its longitudinal length.

4. An electrostatic developer cartridge (1) comprising a supply chamber (19) for containing a supply of toner, a developer chamber (13), developer means (7, 15) for removing toner from the developer chamber to an electrostatically charged surface separate from said cartridge, and metering means (3, 23, 25, 27, 29) comprising a flattened roller (3) engaging flap means (23, 25, 27, 29) for supplying toner from the supply chamber to the developer chamber and for removing toner from the developer chamber back to the supply chamber when the level of the toner in the developer chamber exceeds an equilibrium level, said flattened roller having different orientations of its substantially flat surfaces (35) along the operating length of said roller to relieve air pressure increase within said developer chamber.

5. The cartridge as in claim 4 in which said said flattened roller (3) has at least approximately one-half of its longitudinal length at a first configuration and at least approximately the other one-half of its longitudinal length rotated approximately 90 degrees with respect to said first configuration.

6. The cartridge as in claim 4 or 5 in which said one-

tively, the flaps may be made sufficiently flexible to enable each part of a flap to closely follow its respective half of the roller to achieve a similar effect.

As shown in Fig. 2a and Fig. 2b, metering roller 3 has opposing raised faces 33 connected by opposing flat surfaces 35. This configuration of faces 33 and flat surfaces 35 is positioned 90 degrees different from one another on two sides of roller 3, so that the half of roller 3 on one side of its longitudinal middle has the raised faces 33 offset 90 degrees from the raised faces 33 of the other half.

During operation, the opposing raised faces 33 necessarily move toward the chambers 13 and 19 simultaneously, thereby tending to sweep surrounding air primarily from supply chamber 19 to developer roller chamber 13. In accordance with this invention, however, as the raised faces 33 of one longitudinal side of roller 3 extend into the chambers 13 and 19, the flat surfaces 35 of the other half of the longitudinal side of roller 3 extend between the chambers 13 and 19. This dissipates any pumping action by the roller 3 between chambers 13 and 19 to eliminate significant pressure build-up between chamber 13 and 19.

During operation of the device disclosed in EP 0412923, rotation of the flattened roller along with the sealing against the roller of the flaps creates a varying volume in developer chamber. Without venting, this volume change creates unacceptably large air pressure variation in the chamber. Venting couples the small space in developer chamber to the relatively large air space in toner chamber. The volume change in chamber being a smaller percentage of the available volume for the affected air mass than that of chamber means that the resultant pressure variation is substantially reduced by venting to chamber.

In accordance with this invention, roller 3 causes a volume reduction on one side of chamber 13 at the same time it creates an expanded volume on the other side of chamber 13. Air is believed to shuttle back and forth from one side of chamber 13 to the other without any appreciable pressure rise, although air may also pass to chamber 19 in the direction of the flat surfaces of roller 3.

The need for a permanent vent between chambers 13 and 19 is eliminated. Furthermore, a tangible cost reduction is realized by the elimination of a tape cover used in the vent path to minimize toner flow through the vent path. More importantly, the potential of the vent becoming clogged is eliminated since no vent is employed.

It will be recognized that the metering roller 3 may take various surface configurations or be divided into more than two differently oriented sections, and that some venting may also be used as a supplement. Accordingly, patent coverage should be in accordance with such scope with particular reference to the following claims.

Claims

1. A developer apparatus for supplying toner to an electrostatically charged imaging surface (5) comprising a supply chamber (19) for containing a supply of toner, a developer chamber (13), developer means (7, 15) for removing toner from the developer chamber to the electrostatically charged surface, and metering means (3, 23, 25, 27, 29) comprising a flattened roller (3) engaging flap means (23, 25, 27, 29) to supply toner from the supply chamber to the developer chamber and for removing toner from the developer chamber back to the supply chamber when the level of the toner in the developer chamber exceeds an equilibrium level, said flattened roller having different orientations of its substantially flat surfaces (35) along the operating length of said roller to relieve air pressure increase within said developer chamber.

2. The developer apparatus as in claim 1 in which said flattened roller (3) has at least approximately one-half of its longitudinal length at a first configuration and at least approximately the other one-half of its longitudinal length rotated 90 degrees with respect to said first configuration.

3. The developer apparatus as in claim 1 or 2 in which said one-half parts of said roller are on opposite sides of its longitudinal length.

4. An electrostatic developer cartridge (1) comprising a supply chamber (19) for containing a supply of toner, a developer chamber (13), developer means (7, 15) for removing toner from the developer chamber to an electrostatically charged surface separate from said cartridge, and metering means (3, 23, 25, 27, 29) comprising a flattened roller (3) engaging flap means (23, 25, 27, 29) for supplying toner from the supply chamber to the developer chamber and for removing toner from the developer chamber back to the supply chamber when the level of the toner in the developer chamber exceeds an equilibrium level, said flattened roller having different orientations of its substantially flat surfaces (35) along the operating length of said roller to relieve air pressure increase within said developer chamber.

5. The cartridge as in claim 4 in which said said flattened roller (3) has at least approximately one-half of its longitudinal length at a first configuration and at least approximately the other one-half of its longitudinal length rotated approximately 90 degrees with respect to said first configuration.

6. The cartridge as in claim 4 or 5 in which said one-

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half parts of said roller are on opposite side of its longitudinal length.

7. An electrostatic developer cartridge including a supply chamber (19), a developer chamber (13), and a metering apparatus including a rotatable roller (3) adapted to engage a flap means (23, 25, 27, 29) separating the supply and developer chambers, said roller being configured along its length such that as the roller is rotated a first part protrudes into and reduces the volume of one chamber, a second part of the roller at another point along the length of the roller defines a recess relative to the first part to enlarge the volume of that chamber, to relieve air pressure increase in that chamber.

Patentansprüche

1. Entwicklergerät zum Zuführen von Toner zu einer elektrostatisch geladenen Bilderzeugungsfläche (5), mit einer Versorgungskammer (19) für die Aufnahme eines Tonervorrats, einer Entwicklerkammer (13), einer Entwicklereinrichtung (7, 15), um Toner aus der Entwicklerkammer auf die elektrostatisch geladene Fläche zu entfernen, und mit einer Dosiereinrichtung (3, 23, 25, 27, 29), die eine abgeflachte Walze (3), an die Klappenvorrichtungen (23, 25, 27, 29) angreifen, umfaßt, um Toner aus der Versorgungskammer in die Entwicklerkammer zuzuführen und um Toner aus der Entwicklungskammer zurück in die Versorgungskammer zu entfernen, wenn der Pegel des Toners in der Entwicklerkammer einen Gleichgewichtspegel überschreitet, wobei die abgeflachte Walze unterschiedliche Orientierungen ihrer im wesentlichen flachen Flächen (35) entlang der Betriebslänge der Walze besitzt, um eine Luftdruckzunahme innerhalb der Entwicklerkammer abzubauen.

2. Entwicklergerät nach Anspruch 1, bei dem die abgeflachte Walze (3) wenigstens ca eine Hälfte ihrer Länge mit einer ersten Konfiguration besitzt und wenigstens ca die andere eine Hälfte ihrer Länge um 90 Grad gegenüber der genannten ersten Konfiguration verdreht ist.

3. Entwicklergerät nach Anspruch 1 oder 2, bei dem die Teile der einen Hälfte der Walze sich auf gegenüberliegenden Seiten ihrer Längserstreckung befinden.

4. Elektrostatische Entwicklerpatrone (1), mit einer Versorgungskammer (19) zur Aufnahme eines Tonervorrats, mit einer Entwicklerkammer (13), einer Entwicklereinrichtung (7, 15), um Toner aus der Entwicklerkammer auf eine elektrostatisch geladene Oberfläche, die von der Patrone getrennt ist, zu entfernen, und mit einer Dosiereinrichtung (3, 23, 25, 27, 29), die eine abgeflachte Walze (3), an die Klappenvorrichtungen (23, 25, 27, 29) angreifen, umfaßt, um Toner aus der Versorgungskammer in die Entwicklerkammer zuzuführen und um Toner aus der Entwicklungskammer zurück in die Versorgungskammer zu entfernen, wenn der Pegel des Toners in der Entwicklerkammer einen Gleichgewichtspegel überschreitet, wobei die abgeflachte Walze unterschiedliche Orientierungen ihrer im wesentlichen ebenen Flächen (35) entlang der Betriebslänge der Walze besitzt, um eine Luftdruckerhöhung innerhalb der Entwicklerkammer abzubauen.

5. Patrone nach Anspruch 4, bei der die abgeflachte Walze (3) wenigstens auf ca einer Hälfte ihrer Längserstreckung eine erste Konfiguration besitzt und wenigstens ca die andere Hälfte ihrer Längserstreckung um ca 90 Grad gegenüber der ersten Konfiguration verdreht ist.

6. Patrone nach Anspruch 4 oder 5, bei der die Teile der einen Hälfte der Walze sich auf gegenüberliegenden Seiten ihrer Längserstreckung befinden.

7. Elektrostatische Entwicklerpatrone, mit einer Versorgungskammer (19), einer Entwicklerkammer (13) und einem Dosiergerät mit einer sich drehenden Walze (3), an die in geeigneter Weise Klappenvorrichtungen (23, 25, 27, 29) angreifen, welche die Versorgungs- und Entwicklerkammern trennen, wobei die Walze entlang ihrer Länge in solcher Weise konfiguriert ist, daß dann, wenn die Walze gedreht wird, ein erster Teil in das Volumen der einen Kammer hinein ragt und dieses reduziert, ein zweiter Teil der Walze an einer anderen Stelle entlang der Länge der Walze eine Ausnehmung relativ zu dem ersten Teil definiert, um das Volumen dieser Kammer zu vergrößern, um daduch eine Luftdruckzunahme in der Kammer abzubauen.

Revendications

1. Appareil de développement pour amener une poudre de développement ou toner sur une surface électrostatiquement chargée de formation d'image (5), comprenant une chambre d'alimentation (19) pour contenir une réserve de toner, une chambre de développement (13), des moyens de développement (7,15) pour transférer le toner de la chambre de développement à la surface électrostatiquement chargée, et des

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moyens de dosage (3,23,25,27,29) comportant un rouleau aplati (3) en contact avec des volets flexibles (23,25,27,29) pour amener du toner de la chambre d'alimentation à la chambre de développement et pour enlever du toner de la chambre de développement, en retour à la chambre d'alimentation, lorsque le niveau du toner dans la chambre de développement dépasse un niveau d'équilibre, ledit rouleau aplati présentant différentes orientations de ses surfaces sensiblement planes (35) sur la longueur active dudit rouleau, afin d'éviter toute augmentation de la pression d'air dans ladite chambre de développement.

2. Appareil de développement suivant la revendication 1, dans lequel ledit rouleau aplati (3) présente, sur au moins environ la moitié de sa longueur, une première configuration et, sur au moins environ l'autre moitié de sa longueur, une même configuration tournée de 90 degrés par rapport à ladite première configuration.

3. Appareil de développement suivant la revendication 1 ou 2, dans lequel lesdites moitiés dudit rouleau sont sur des côtés opposés de son étendue longitutudinale.

4. Cassette de développement électrostatique (1), comprenant une chambre d'alimentation (19) pour contenir une réserve de poudre de développement ou toner, une chambre de développement (13), des moyens de développement (7,15) pour amener du toner de la chambre de développement à une surface électrostatiquement chargée séparée de ladite cassette, et des moyens de dosage (3,23, 25,27,29) comprenant un rouleau aplati (3) en contact avec des volets flexibles (23,25,27,29) pour transférer du toner de la chambre d'alimentation à la chambre de développement et pour enlever du toner de la chambre de développement en retour à la chambre d'alimentation lorsque le niveau du toner dans la chambre de développement dépasse un niveau d'équilibre, ledit rouleau aplati présentant des orientations différentes de ses surfaces sensiblement planes (35) sur la longueur active dudit rouleau, afin d'éviter une augmentation de la pression d'air à l'intérieur de ladite chambre de développement.

5. Cassette suivant la revendication 4, dans laquelle ledit rouleau aplati (3) présente une première configuration sur au moins environ la moitié de sa longueur et, sur au moins environ l'autre moitié de sa longueur, une configuration tournée de 90 degrés environ par rapport à ladite première configuration.

6. Cassette suivant la revendication 4 ou 5, dans laquelle lesdites moitiés dudit rouleau sont sur des côtés opposés de son étendue longitudinale.

7. Cassette de développement électrostatique comprenant une chambre d'alimentation (19), une chambre de développement (13) et un appareil de dosage comportant un rouleau rotatif (3) qui vient en contact avec des volets (23,25,27,29) séparant les chambres d'alimentation et de développement, ledit rouleau étant configuré sur sa longueur de sorte que, lorsque le rouleau tourne, une première partie fait saillie dans une chambre et réduit son volume, et une deuxième partie du rouleau, à un autre endroit sur la longueur du rouleau, définit un creux par rapport à la première partie de façon à augmenter le volume de cette chambre, pour limiter l'augmentation de la pression d'air dans cette chambre.