

Description

FIELD OF THE INVENTION

The present invention relates generally to imaging systems and more particularly to liquid toner development systems.

BACKGROUND OF THE INVENTION

Proposals for various types of multicolor imaging apparatus and techniques appear in the patent literature. There is described in Japanese Patent document 58002863 to Kawamura an image recording device for use in a color printer which include nozzle heads which spray liquid coloring toner onto electrostatic latent images on the side of a photosensitive drum and thus develop images thereon. A single nozzle is provided for each color and the nozzles reciprocate along a nozzle guide. Alternating current apparatus is disposed between the nozzle and the drum in order to spread out the impingement area of the toner on the drum.

U.S. Patent 4,690,539 describes transfer apparatus in which a plurality of liquid images are transferred from a photoconductive member to a copy sheet. The liquid images, which include a liquid carrier having toner particles dispersed therein, are attracted from the photoconductive member to an intermediate web. A substantial amount of the liquid carrier is removed from the intermediate web and the toner particles are secured thereon. Thereafter, another liquid image having toner particles of a different color from the toner particles of the first liquid image is attracted to the intermediate member. Once again the liquid carrier material is removed from the web and the toner particles of the second liquid image are secured thereon. Thereafter, all of the toner particles are transferred from the intermediate member to the copy sheet, in image configuration.

U.S. Patent 3,900,003 describes a liquid developing device for use in multicolor electrophotographic copying machines, having a plurality of feed pipes for supplying different liquid color developers to a developing station, which feed pipes are connected to a common developer supply surface. Valves are provided in the feed pipes wherein each of the valves are actuated by an electrical signal to supply only one selected liquid color developer to the developing station at a time. The liquid developing device is also provided with a belt for removing residual liquid developer remaining on an image bearing member after development and with a plurality of blades for scraping and collecting the thus removed liquid developer, which are selected and actuated in correspondence with a selected color.

U.S. Patent 4,504,138 describes a method and apparatus for developing electrostatic latent images

formed on a photoconductor surface providing the steps of applying a thin viscous layer of electrically charged toner particles to an applicator roller preferably by electrically assisted separation thereof from a liquid toner suspension. A restricted passage is defined between the applicator roller and the photoconductor surface approximately the thickness of the viscous layer and the toner particles are transferred from the applicator roller to the photoconductor surface due to their preferential adherence to the photoconductor surface under the dominant influence of the electric field of the electrostatic latent image carried by the photoconductive surface.

U.S. Patent 4,400,079 describes a developing system for an electrophotographic copier in which a roller having a conductive outer surface is disposed adjacent to the imaging surface to form a gap. The roller is driven at a peripheral linear velocity substantially greater than the velocity of movement of the imaging surface and is supplied with liquid developer at a location spaced from the gap to cause the roller to inject the developer into the gap. The roller is coupled to a source of electrical potential.

U.S. Patent 4,342,823 describes a perforate development electrode and a method for developing electrostatic images directly on a final image bearing sheet, formed of electrophotographic material coated onto a substrate, by means of a perforate development electrode and liquid toner, without immersing the material in a bath of toner. The method comprises spraying liquid toner against pressure reducing means adjacent to the electrode to reduce and make uniform the pressure of the flowing liquid toner and flowing the liquid toner uniformly over and through the perforate development electrode and over the image side of the sheet without contacting the side opposite the image side with the toner.

U.S. Patent 4,233,385 describes a method of liquid development of charge images formed on a surface of a tape-like record carrier, for example by an electrostatic printer. The record carrier is simultaneously sprayed with developer liquid in two flows which are directed towards each other. As a result two separate, uniform and oppositely directed flow zones meeting at one common turbulent flow zone are obtained. Both during pre-development and final development the charge images are brought into contact with a large quantity of fresh developer liquid.

U.S. Patent 4,073,266 describes apparatus for developing a latent electrostatic image on an electrophotographic copying material by means of a toner dispersion. An infeed roller applies the toner dispersion to the copying material and downstream thereof, a distribution roller acts on the surface of the copying material. Squeegee rollers downstream of the distribution roller effect removal of unused toner. Toner which adheres to the distribution roller during application of voltage thereto is sprayed off and recovered for

recycling, the spraying agent being toner dispersion.

U.S. Patent 3,405,683 describes apparatus for the development of latent electrostatic images on an electrophotographic material with a liquid developer which includes means to feed the electrophotographic material through a pair of rotatable nip rolls and nozzle means adapted to simultaneously spray the electrostatic image and the nip roll which contacts the latent image.

U. S. Patent 3,867,708 describes a liquid toner system for developing an electrostatic image on a substrate in which liquid toner is supplied to a developer roller along its length by means of a header tube disposed parallel to the developer roller and having a plurality of feed holes along its length.

U.S. Patent 4,522,484 describes a two stage development system. In the first stage a weak latent image on a photoconductor is developed by pumping liquid developer through a nozzle stated to be adapted to discharge the developer between the photoconductor and a reverse roller. The roller is biased to a potential greater than that of the background regions of the weak image and below that of the image regions of the weak image.

US-A- 3 910 231 describes an imaging apparatus with the features of the preamble of claim 1.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a simplified liquid toner development system especially adapted for multi-color electrophotographic imaging systems.

There is therefor provided, in a preferred embodiment of the invention, liquid toner imaging apparatus including an image bearing surface, apparatus for developing an image on the image bearing surface using a liquid toner including carrier liquid and pigmented particles, and apparatus for transferring a developed image from the image bearing surface to a substrate, wherein the apparatus for developing includes a developer electrode having a developer surface portions of which sequentially come into propinquity with the image bearing surface and subsequently go out of propinquity therewith, each portion forming a development region during its propinquity, and a stationary nozzle for providing liquid toner of a given color to the development region by supplying liquid toner onto a portion of the developer electrode, wherein the nozzle is spaced at least 8.4 mm from any other nozzle which supplies liquid toner of the given color to the development region.

In a preferred embodiment of the invention the nozzle supplies the liquid toner to a portion of the developer surface after it leaves the development region. In a preferred embodiment of the invention only a single stationary nozzle is provided for supplying liquid toner of a given color.

In a preferred embodiment of the invention the developer electrode is situated generally below the image bearing surface.

In a preferred embodiment of the invention the image bearing surface moves in a given direction at the development region and the developer electrode is a rotating roller spaced from the image bearing surface, wherein the developer surface moves in a direction opposite to the given direction at the development region.

In a preferred embodiment of the invention the apparatus is a multi-color imaging system including apparatus for sequentially developing images on the image bearing surface using a plurality of liquid toners each including carrier liquid and pigmented particles of a given color and apparatus for sequentially transferring a developed image of the given color from the image bearing surface to a substrate.

In a preferred embodiment of the invention the nozzle supplies a stream of liquid toner having a component of velocity toward the development region. In a preferred embodiment of the invention the stream also has a component of velocity parallel to the development region.

There is further provided, in a preferred embodiment of the invention, liquid toner imaging apparatus including an image bearing surface, apparatus for developing an image on the image bearing surface using a liquid toner including carrier liquid and pigmented particles, and apparatus for transferring a developed image from the image bearing surface to a substrate, wherein the apparatus for developing includes a single developer electrode having a developer surface portions of which sequentially come into propinquity with the image bearing surface and subsequently go out of propinquity therewith, each portion forming a development region during its propinquity, and a stationary nozzle for providing liquid toner of a given color to the development region, wherein the nozzle is spaced at least 8.4 mm from any other nozzle which supplies liquid toner of the given color to the development region.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

Fig. 1 is a side, partial sectional generalized illustration of multi-color imaging apparatus constructed and operative in accordance with a preferred embodiment of the present invention;
Fig. 2 is a partial perspective view of a preferred embodiment of the apparatus of Fig. 1;
Fig. 3 is a partial perspective view of a preferred embodiment of the apparatus of Fig. 1;
Fig. 4 is a partial perspective view of an alterna-

tive preferred embodiment of the apparatus of Fig. 1;

Fig. 5 is a partial perspective view of another preferred embodiment of the apparatus of Fig. 1; and Fig. 6 is a cross-sectional view of a nozzle of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference is now made to Fig. 1 which illustrates a multicolor electrostatic imaging system constructed and operative in accordance with a preferred embodiment of the present invention. As seen in Fig. 1 there is provided an image bearing surface typically embodied in a rotating photoconductive drum 10. Operatively associated with photoconductive drum 10 is photoconductor charging apparatus 11 and imaging apparatus 12, for example a laser scanner, for providing a desired latent image on drum 10. The latent image normally includes image areas at a first electrical potential and background areas at another electrical potential.

Also associated with photoconductive drum 10 are a multicolor liquid developing assembly 16, an excess liquid removal assembly 18, an intermediate transfer member 20 and a resilient scraper cleaning station 22.

Developing assembly 16 preferably includes a developer roller electrode 17 spaced from photoconductive drum 10 and typically rotating in the same sense as drum 10, as indicated by arrows 19. This rotation provides for the surface of drum 10 and roller 17 to have opposite velocities in their region of proximity. Developing assembly also includes multicolor toner supply assembly 14, for providing colored toner to develop latent images on photoconductive drum 10 and a plurality of color specific toner cleaning assemblies 32 for removal of excess toner from developer roller 17. Developing assembly 16 is described hereinbelow in greater detail.

Photoconductive drum 10, photoconductor charging apparatus 11 and imaging apparatus 12 may be any suitable drum, charging apparatus and imaging apparatus such as are well known in the art.

Excess liquid removal and image compacting assembly 18 typically includes a biased squeegee roller 21 which is urged against drum 10. Squeegee roller 21 is preferably formed of resilient conductive polymeric material, and charged to a potential of several hundred to a few thousand volts with the same polarity as that of the charge on the toner particles.

Intermediate transfer member 20 may be any suitable intermediate transfer member such as those described in U.S. Patent 4,999,677 and PCT publication WO 91/03006, and is arranged for electrophoretic transfer of the image thereto from the image bearing surface. Intermediate transfer member 20 is pre-

ferably associated with a pressure roller 24 for subsequent transfer of the image onto a further substrate 25, such as paper, preferably by heat and pressure. A fuser 26 may be associated with substrate 25, for fixing the image thereon, if further fixing is required.

Cleaning station 22 may be any suitable cleaning station such as the resilient blade shown in Fig. 1 or that described in U.S. Patent 4,439,035.

In accordance with one embodiment of the invention, after development of each image in a given single color, the single color image is transferred to intermediate transfer member 20. Subsequent images in different colors are sequentially transferred onto intermediate transfer member 20. When all of the desired images have been transferred to intermediate transfer member 20, the complete multi-color image is transferred from transfer member 20 to substrate 25. Pressure roller 24 therefore produces operative engagement between intermediate transfer member 20 and substrate 25 only when transfer of the composite image to substrate 25 takes place.

Alternatively, each single color image is transferred to the paper after its formation. In this case the paper is fed through the machine once for each color or is held on a platen (not shown) and contacted with intermediate transfer member 20 during image transfer. As a further alternative, the intermediate transfer member 20 is omitted and the developed single color images are transferred sequentially directly from drum 10 to substrate 25.

Reference is now made additionally to Figs. 2 and 3 which are perspective illustrations of parts of the apparatus of Fig. 1. Fig. 2 includes photoconductive drum 10, developer electrode 17 and multicolor supply assembly 14. Fig. 3 shows the lower portion of the apparatus including the arrangement of a plurality of liquid toner reservoirs 40, 42, 44 and 46 and associated apparatus.

Multicolor toner supply assembly 14, receives separate supplies of colored toner from four different reservoirs 40, 42, 44 and 46, typically containing Yellow, Magenta, Cyan and Black liquid toners respectively. Pumps 48 may be provided at the entrances of respective supply conduits 56, for providing a desired amount of pressure to feed the colored toner to multicolor supply assembly 14.

In commonly assigned PCT application PCT/NL90/00069, filed May 14, 1990, (WO-A-90/14619, published 29.11.90), a number of multicolor supply assemblies are described each of which includes a plurality of jet nozzles for each color. In the aforementioned PCT application the maximum spacing between nozzles is 8.4 mm. The present inventors have found that, surprisingly, for an effective imaging width at least as large as 21.6 cm (8.5"), only one properly designed stationary supply nozzle 57 is required for each color.

The nozzles of the present invention have an in-

ternal diameter of about 3 mm, representing an area about 9 times that of the nozzles of the jet assemblies disclosed in the above mentioned PCT application PCT/NL90/00069. Nozzles 57 are grouped together, one for each color, and are preferably axially centered along developer electrode 17. The stream of liquid developer exiting from the nozzles impinges with a relatively low velocity on developer roller 17 before its region of propinquity with photoconductive drum 10. The velocity is high enough to form an excess of liquid toner at said point of propinquity which corresponds to a development region 59. Surprisingly, it has been found that such a stream spreads along the roller at the region of propinquity as shown in Fig. 2, and provides even development of the latent image. Furthermore, it has been found that the use of a low liquid toner velocity improves the quality of the image formed. The total rate of supply of liquid toner is controlled to form a well defined sheet of liquid toner on developer roller 17, without overflowing the sides of the roller.

Fig. 4 shows an alternative configuration of nozzles useful for wider imaging areas or for systems in which the toner velocity is further reduced. In this case two sets of nozzles are used to supply developer liquid to the developer roller for development of the latent image. In general the nozzles for a particular color are spaced at a center-to-center distance greater than 8.4 mm. In particular the preferred spacing is greater than 25.4 mm (1") and less than 203 mm (8"). Alternatively the spacing can be greater than 250 mm and less than 1000 mm.

It should be noted in both Figs. 2 and 4 that the liquid toner preferably is supplied to the region of the developer electrode which is leaving the region of its propinquity with the photoconductive drum 10.

The width of the stationary nozzle is preferably less than 250 mm.

Returning now to Figs. 1 and 3, color specific toner cleaning assemblies 32 (except for the black assembly) are selectively brought into operative association with developer roller 17 only when toner of a color corresponding thereto is supplied to development region 59 thereon by supply assembly 14. For clarity these cleaning assemblies are not shown in Figs 2 and 4. Examples of cleaning assemblies useful in the present invention are shown in the above referenced PCT application.

Each of cleaning assemblies 32 includes a preferably resilient blade member 34. Associated with each of the cleaning assemblies 32 is a toner collection conduit 150 which serves to collect the toner removed by the cleaning assembly 32 from the developing electrode and thus to prevent contamination by mixing of the various colors. Toner conduit 150 returns the removed material to the respective toner reservoir for redispersion and reuse.

As noted above, the toner collected by cleaning assemblies 32 is recycled to the corresponding toner

reservoirs. The black toner collection assembly is always engaged, and any material which may have passed the earlier cleaning assemblies is removed and added to the black reservoir. In practice, little if any material passes blade member 34 of a given cleaning assembly.

It is seen that the toner at the developer interface is removed from the development region quickly after the flow is interrupted. This allows for almost instant change of developer color at development region 59. Additionally developer roller 17 is well cleaned between colors, so that cross-contamination between colors is practically non-existent.

The outer surfaces of the supply nozzles are tapered at their exit ends, as shown in Fig. 6, in order to reduce the wall thickness at the output face of the extensions to a minimum. It is believed that this reduction reduces dripping of the liquid developer. Except for the configuration and orientation of the nozzles, the toner supply system and cleaning assemblies 32 of the present invention can include any or all of the features of the toner supply systems and cleaning systems described in the above referenced PCT application.

Developer roller 17 is typically maintained at +200 Volts when the voltage of the image areas of the photoconductor 10 is approximately +1000 Volts and the voltage on the background areas of the photoconductor 10 is approximately +100 Volts. The above voltages are suitable for the use of negatively charged toner and a selenium coated photoconductor drum. If it is desired to use a positively charged toner or another type of photoconductor material, correspondingly different voltages will be appropriate.

An alternative preferred supply assembly is shown in Fig. 5. In this embodiment of the invention one supply nozzle 157 similar in construction to the nozzles of Figs. 2 and 4 are provided near the ends of the developer drum for each color and are operative to supply a stream of liquid toner onto developer roller 17 near its center. Nozzles 157 are oriented to provide a component of flow velocity in the direction of development region 59, in order to provide filling of the region with liquid developer. As in the embodiments of Figs. 2 and 4, the velocity and amount of toner and the angle of the nozzles with the developer roller are adjusted to fill the development region with toner without providing an excess which would run over the ends of roller 17.

An exemplary preferred toner for use in the invention is the toner described in Example 1 of U.S. Patent 4,794,651. For color toners the carbon black is replaced by color pigments as is known in the art. Other liquid toners as known in the art can also be used in the practice of the invention.

Associated with each of reservoirs 40, 42, 44 and 46 are typically provided containers 66 of concentrated toner material. Container 66 is preferably of a con-

struction described in U.S. Patent Application Serial Number 07/570,777 entitled LIQUID TONER REPLENISHMENT SYSTEM, (US-A- 5 083 165, published 21.1.92).

In accordance with a preferred embodiment of the invention, containers 66 contain toner concentrate and are operative to add toner particles dispersed in carrier liquid to their respective reservoirs when these have a deficiency of toner particles. Preferably an optical detector 132 in a respective reservoir measures the optical density of the liquid toner therein. When the density is below a first predetermined level, motor 96 is activated by controller 97 and displaces a plunger inside container 66 to transfer a measured amount of toner concentrate from container 66 to its respective toner reservoir thereby to increase the toner particle concentration to the required level.

The optical density of each of the colored toner dispersions is preferably separately measured by an optical density measurement circuit 132. Exemplary forms of such apparatus are shown in U.S. Patents 4,579,253 or 4,860,924. A signal responsive to the density is fed into a toner dispenser control system 97 which is operative to activate the motor and to dispense a given amount of toner concentrate from containers 66 into the specific reservoir.

Charge director is preferably included with the toner concentrate in a proper amount.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described hereinabove. Rather the scope of the present invention is defined only by the claims which follow:

Claims

1. Liquid toner imaging apparatus comprising:
 - an image bearing surface (10);
 - means (16) for developing an image on the image bearing surface using a liquid toner including carrier liquid and pigmented particles; and
 - means (20) for transferring a developed image from the image bearing surface (10) to a substrate (25),
 wherein the means for developing comprises:
 - a developer electrode (17) having a movable developer electrode surface whereby portions of the developer electrode surface sequentially come into propinquity with the image bearing surface (10) and subsequently leave propinquity therewith, each portion forming a development region (59) during its propinquity, the developer electrode surface having a given width in the direction perpendicular to its motion; characterized in that said means for developing also

comprises:

a single stationary nozzle (57) having a width substantially narrower than the given width of the developer electrode surface or a plurality of stationary nozzles (57, 157) having a center to center spacing of greater than 8.4 mm operative for providing liquid toner of a given color to the development region (59) by supplying the liquid toner onto a portion of the developer electrode (17).

2. Liquid toner imaging apparatus according to claim 1 wherein the developer electrode (17) is a single developer electrode and wherein the means for development is operative to substantially complete development of the image on the image bearing surface (10) at the development region (59).
3. Apparatus according to claim 1 or claim 2 wherein:
 - the means for developing (16) comprises means for sequentially developing images on the image bearing surface (10) using a plurality of liquid toners each including carrier liquid and pigmented particles of a given color; and
 - the means for transferring (20) comprises means for sequentially transferring a developed image of the given color from the image bearing surface (10) to a substrate (25).
4. Apparatus according to any of the preceding claims wherein the width of said stationary nozzle or nozzles (57, 157) is less than 250 mm.
5. Apparatus according to any of the preceding claims wherein the nozzle (57, 157) is spaced more than 250 mm from any other nozzle which supplies liquid toner of the given color to the development region (59).
6. Apparatus according to any of the preceding claims and comprising at least two stationary nozzles (57, 157) each spaced between about 250 to 1000 mm from the nearest other nozzle which supplies liquid toner of the given color to the development region (59).
7. Apparatus according to any of claims 1-5 wherein only a single stationary nozzle (57) is provided for supplying liquid toner of a given color.
8. Apparatus according to any of the preceding claims wherein the nozzle or nozzles (57) is/are arranged to supply the liquid toner to a portion of the surface of the developer electrode after it leaves the development region.
9. Apparatus according to any of the preceding



struction described in U.S. Patent Application Serial Number 07/570,777 entitled LIQUID TONER REPLENISHMENT SYSTEM, (US-A- 5 083 165, published 21.1.92).

In accordance with a preferred embodiment of the invention, containers 66 contain toner concentrate and are operative to add toner particles dispersed in carrier liquid to their respective reservoirs when these have a deficiency of toner particles. Preferably an optical detector 132 in a respective reservoir measures the optical density of the liquid toner therein. When the density is below a first predetermined level, motor 96 is activated by controller 97 and displaces a plunger inside container 66 to transfer a measured amount of toner concentrate from container 66 to its respective toner reservoir thereby to increase the toner particle concentration to the required level.

The optical density of each of the colored toner dispersions is preferably separately measured by an optical density measurement circuit 132. Exemplary forms of such apparatus are shown in U.S. Patents 4,579,253 or 4,860,924. A signal responsive to the density is fed into a toner dispenser control system 97 which is operative to activate the motor and to dispense a given amount of toner concentrate from containers 66 into the specific reservoir.

Charge director is preferably included with the toner concentrate in a proper amount.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described hereinabove. Rather the scope of the present invention is defined only by the claims which follow:

Claims

1. Liquid toner imaging apparatus comprising:
 - an image bearing surface (10);
 - means (16) for developing an image on the image bearing surface using a liquid toner including carrier liquid and pigmented particles; and
 - means (20) for transferring a developed image from the image bearing surface (10) to a substrate (25),
 wherein the means for developing comprises:
 - a developer electrode (17) having a movable developer electrode surface whereby portions of the developer electrode surface sequentially come into propinquity with the image bearing surface (10) and subsequently leave propinquity therewith, each portion forming a development region (59) during its propinquity, the developer electrode surface having a given width in the direction perpendicular to its motion; characterized in that said means for developing also

comprises:

a single stationary nozzle (57) having a width substantially narrower than the given width of the developer electrode surface or a plurality of stationary nozzles (57, 157) having a center to center spacing of greater than 8.4 mm operative for providing liquid toner of a given color to the development region (59) by supplying the liquid toner onto a portion of the developer electrode (17).

2. Liquid toner imaging apparatus according to claim 1 wherein the developer electrode (17) is a single developer electrode and wherein the means for development is operative to substantially complete development of the image on the image bearing surface (10) at the development region (59).
3. Apparatus according to claim 1 or claim 2 wherein:
 - the means for developing (16) comprises means for sequentially developing images on the image bearing surface (10) using a plurality of liquid toners each including carrier liquid and pigmented particles of a given color; and
 - the means for transferring (20) comprises means for sequentially transferring a developed image of the given color from the image bearing surface (10) to a substrate (25).
4. Apparatus according to any of the preceding claims wherein the width of said stationary nozzle or nozzles (57, 157) is less than 250 mm.
5. Apparatus according to any of the preceding claims wherein the nozzle (57, 157) is spaced more than 250 mm from any other nozzle which supplies liquid toner of the given color to the development region (59).
6. Apparatus according to any of the preceding claims and comprising at least two stationary nozzles (57, 157) each spaced between about 250 to 1000 mm from the nearest other nozzle which supplies liquid toner of the given color to the development region (59).
7. Apparatus according to any of claims 1-5 wherein only a single stationary nozzle (57) is provided for supplying liquid toner of a given color.
8. Apparatus according to any of the preceding claims wherein the nozzle or nozzles (57) is/are arranged to supply the liquid toner to a portion of the surface of the developer electrode after it leaves the development region.
9. Apparatus according to any of the preceding



claims wherein the developer electrode (17) is situated generally below the image bearing surface (10).

10. Apparatus according to any of the preceding claims wherein the image bearing surface (10) is arranged to move in a given direction at the development region (59) and the developer electrode is a rotating roller (17) spaced from the image bearing surface (10), wherein the developer surface is arranged to move in a direction opposite to the given direction at the development region.
11. Apparatus according to any of the preceding claims wherein the nozzle or nozzles (57) is/are operative to supply a stream of liquid toner having a component of velocity toward the development region as it leaves the nozzle.
12. Apparatus according to claim 11 wherein the stream also has a component of velocity parallel to the development region as it leaves the nozzle (157).
13. Apparatus according to any of the preceding claims wherein the nozzle (157) is placed near one edge of the development width.

Patentansprüche

1. Flüssigtoner-Bilderzeugungsgerät, mit einer bildtragenden Fläche (10), einer Einrichtung (16) zum Entwickeln eines Bildes auf der bildtragenden Fläche unter Verwendung eines Flüssigtoners, der eine Trägerflüssigkeit und pigmentierte Teilchen enthält, und einer Einrichtung (20) zum Übertragen eines entwickelten Bildes von der bildtragenden Fläche (10) auf ein Substrat (25), wobei die Einrichtung zum Entwickeln folgendes enthält:
eine Entwickler-Elektrode (17) mit einer bewegbaren Entwickler-Elektrodenfläche, wobei Abschnitte der Entwickler-Elektrodenfläche aufeinanderfolgend in die Nähe zu der das Bild tragenden Fläche (10) gelangen und anschließend diese Nähe wieder verlassen, wobei jeder Abschnitt eine Entwicklungszone (59) während seiner Nahposition bildet und wobei die Entwickler-Elektrodenfläche eine gegebene Weite in einer Richtung senkrecht zu ihrer Bewegung besitzt, dadurch gekennzeichnet, daß die Einrichtung zum Entwickeln folgendes aufweist:
eine einzelne stationäre Düse (57) mit einer Weite, die wesentlich enger ist als die gegebene Weite der Entwickler-Elektrodenfläche, oder eine

Vielzahl von stationären Düsen (57, 157) mit einem Mitten-zu-Mitten-Abstand von mehr als 8,4 mm, die dafür ausgebildet sind, um den Flüssigtoner einer gegebenen Farbe an die Entwicklungszone (59) abzugeben und zwar durch Zuführen des Flüssigtoners auf einen Abschnitt der Entwickler-Elektrode (17).

2. Flüssigtoner-Bilderzeugungsgerät nach Anspruch 1, bei dem die Entwickler-Elektrode (17) aus einer einzelnen Entwickler-Elektrode besteht und bei dem die Einrichtung zum Entwickeln dafür ausgebildet ist, um die Entwicklung des Bildes auf der das Bild tragenden Fläche (10) bei der Entwicklungszone (59) im wesentlichen vollständig zu entwickeln.
3. Gerät nach Anspruch 1 oder 2, bei dem die Einrichtung zum Entwickeln (16) eine Vorrichtung enthält, um aufeinanderfolgend Bilder auf der das Bild tragenden Fläche (10) unter Verwendung einer Vielzahl von Flüssigtonern zu entwickeln, von denen jeder eine Trägerflüssigkeit und pigmentierte Teilchen einer gegebenen Farbe enthält, und bei dem die Einrichtung zum Übertragen (20) eine Vorrichtung aufweist, um aufeinanderfolgend ein entwickeltes Bild einer gegebenen Farbe von der das Bild tragenden Fläche (10) auf ein Substrat (25) zu übertragen.
4. Gerät nach einem der vorhergehenden Ansprüche, bei dem die Weite der genannten stationären Düse oder Düsen (57, 157) kleiner ist als 250 mm.
5. Gerät nach irgendeinem der vorhergehenden Ansprüche, bei dem die Düse (57, 157) um mehr als 250 mm von irgendeiner anderen Düse beabstandet ist, die Flüssigtoner einer gegebenen Farbe der Entwicklungszone (59) zuführt.
6. Gerät nach irgendeinem der vorhergehenden Ansprüche, mit wenigstens zwei stationären Düsen (57, 157), die jeweils zwischen ca. 250 bis 1000 mm von der am nächstliegenden anderen Düse beabstandet sind, die Flüssigtoner einer gegebenen Farbe der Entwicklungszone (59) zuführt.
7. Gerät nach irgendeinem der Ansprüche 1 bis 5, bei dem lediglich eine stationäre Düse (57) vorgesehen ist, um Flüssigtoner einer gegebenen Farbe zuzuführen.
8. Gerät nach irgendeinem der vorhergehenden Ansprüche, bei dem die Düse oder Düsen (57) dafür ausgebildet ist bzw. sind, um Flüssigtoner einem Abschnitt der Oberfläche der Entwickler-Elektro-



de zuzuführen, nachdem dieser die Entwicklungszone verlassen hat.

9. Gerät nach irgendeinem der vorhergehenden Ansprüche, bei dem die Entwicklungs-Elektrode (17) allgemein unterhalb der das Bild tragenden Fläche (10) gelegen ist. 5
10. Gerät nach irgendeinem der vorhergehenden Ansprüche, bei dem die das Bild tragende Fläche (10) dafür ausgebildet ist, um sich in einer gegebenen Richtung bei der Entwicklungszone (59) zu bewegen und bei dem die Entwickler-Elektrode aus einer rotierenden Rolle (17) besteht, die von der das Bild tragenden Fläche (10) beabstandet ist, wobei die Entwicklerfläche dafür ausgebildet ist, sich in einer Richtung entgegengesetzt zu der gegebenen Richtung bei der Entwicklungszone zu bewegen. 10 15
11. Gerät nach irgendeinem der vorhergehenden Ansprüche, bei dem die Düse oder Düsen (57) dafür ausgebildet ist bzw. ausgebildet sind, um einen Strom aus einem Flüssigentwickler mit einer Geschwindigkeitskomponente zur Entwicklungszone hin zuzuführen, wenn dieser die Düse verläßt. 20 25
12. Gerät nach Anspruch 11, bei dem der genannte Strom auch eine Geschwindigkeitskomponente parallel zu der Entwicklungszone aufweist, wenn dieser die Düse (157) verläßt. 30
13. Gerät nach irgendeinem der vorhergehenden Ansprüche, bei dem die Düse (157) näher bei einer Kante der Entwicklungsbreite plaziert ist. 35

Revendications

1. Appareil de formation d'image par toner liquide comprenant: 40
 - une surface (10) de support d'image;
 - un moyen (16) pour développer une image se trouvant sur la surface de support d'image en utilisant un toner liquide comprenant un liquide porteur et des particules pigmentées; et 45
 - un moyen (20) pour transférer de la surface (10) de support d'image à un substrat (25) une image développée.
 - appareil dans lequel le moyen de développement comprend : 50
 - une électrode de développement (17) comportant une surface mobile d'électrode de développement, grâce à quoi des parties de la surface d'électrode de développement viennent successivement dans une position de proximité par rapport à la surface (10) de support d'image et, ensuite, s'éloignent de cette surface, chaque 55

partie formant une région de développement (59) pendant qu'elle se trouve dans sa position de proximité, la surface d'électrode de développement ayant une largeur donnée dans la direction perpendiculaire à son déplacement, caractérisé en ce que ledit moyen de développement comprend aussi :

un seul ajutage fixe (53) ayant une largeur substantiellement plus étroite que la largeur donnée de la surface d'électrode de développement ou une pluralité d'ajutages fixes (57, 157) présentant un espacement, de centre à centre, plus grand que 8,4 mm et fonctionnant de manière à fournir un toner liquide d'une couleur donnée à la région de développement (59) en amenant le toner liquide sur une partie de l'électrode de développement (17).

2. Appareil de formation d'image à toner liquide selon la revendication 1, dans lequel l'électrode de développement (17) est une seule électrode de développement et dans lequel le moyen de développement fonctionne de manière à achever substantiellement le développement de l'image se trouvant sur la surface (10) de support d'image, au niveau de la région de développement (59).
3. Appareil selon la revendication 1 ou 2 dans lequel :
 - le moyen de développement (16) comprend un moyen pour développer successivement des images se trouvant sur la surface (10) de support d'image en utilisant une pluralité de toners liquides comprenant chacun un liquide porteur et des particules pigmentées d'une couleur donnée; et
 - le moyen de transfert (20) comprend un moyen pour transférer successivement de la surface (10) de support d'image à un substrat (25) une image développée ayant la couleur donnée.
4. Appareil selon l'une quelconque des revendications précédentes dans lequel la largeur du ou desdits ajutages fixes (57, 157) est inférieure à 250 mm.
5. Appareil selon l'une quelconque des revendications précédentes, dans lequel l'ajutage (57, 157) est espacé de plus de 250 mm de tout autre ajutage qui fournit du toner liquide de la couleur donnée à la région de développement (59).
6. Appareil selon l'une quelconque des revendications précédentes et comprenant au moins deux ajutages fixes (57, 157) espacés chacun d'environ 250 à 1000 mm de l'autre ajutage le plus proche qui fournit le toner liquide de la couleur don-



née à la région de développement (59).

7. Appareil selon l'une quelconque des revendications 1-5, dans lequel un seul ajutage fixe (57) est utilisé pour fournir le toner liquide d'une couleur donnée. 5
8. Appareil selon l'une quelconque des revendications précédentes, dans lequel le ou les ajutages (57) sont disposés de manière à fournir le toner liquide à une partie de la surface de l'électrode de développement après son départ de la région de développement. 10
9. Appareil selon l'une quelconque des revendications précédentes, dans lequel l'électrode de développement (17) est située, d'une façon générale, en dessous de la surface (10) de support d'image. 15
10. Appareil selon l'une quelconque des revendications précédentes, dans lequel la surface (10) de support d'image est disposée de manière à se déplacer dans une direction donnée au niveau de la région de développement (59) et l'électrode de développement est un rouleau tournant (17) espacé de la surface (10) de support d'image, la surface de développement étant disposée de manière à se déplacer dans une direction opposée à la direction donnée au niveau de la région de développement. 20 25 30
11. Appareil selon l'une quelconque des revendications précédentes, dans lequel le ou les ajutage(s) fonctionne(nt) de manière à fournir un courant de toner liquide qui présente une composante de vitesse en direction de la région de développement quand il quitte l'ajutage. 35
12. Appareil selon la revendication 11, dans lequel le courant présente aussi une composante de vitesse parallèle à la région de développement quand il quitte l'ajutage (157). 40
13. Appareil selon l'une quelconque des revendications, dans lequel l'ajutage (157) est placé près d'un des bords de la largeur de développement. 45

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