April 30, 1968 K. J. SWYLER 3,380,437

TRANSVERSELY RECIPROCATING FLUIDIZED BED DEVELOPMENT APPARATUS

Filed July 21, 1966 2 Sheets-Sheet 1

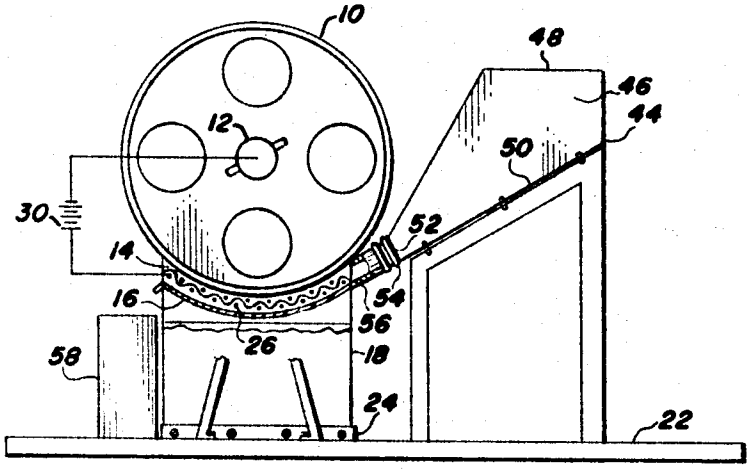

FIG. 1

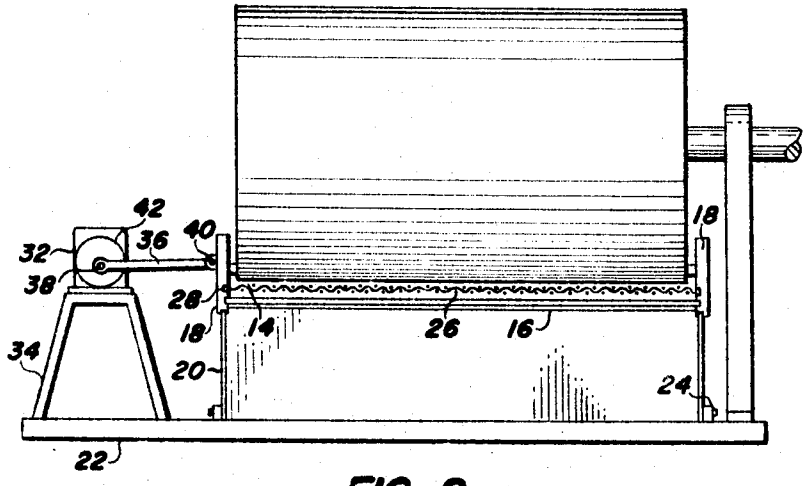

FIG. 2

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TRANSVERSELY RECIPROCATING FLUIDIZED BED DEVELOPMENT APPARATUS

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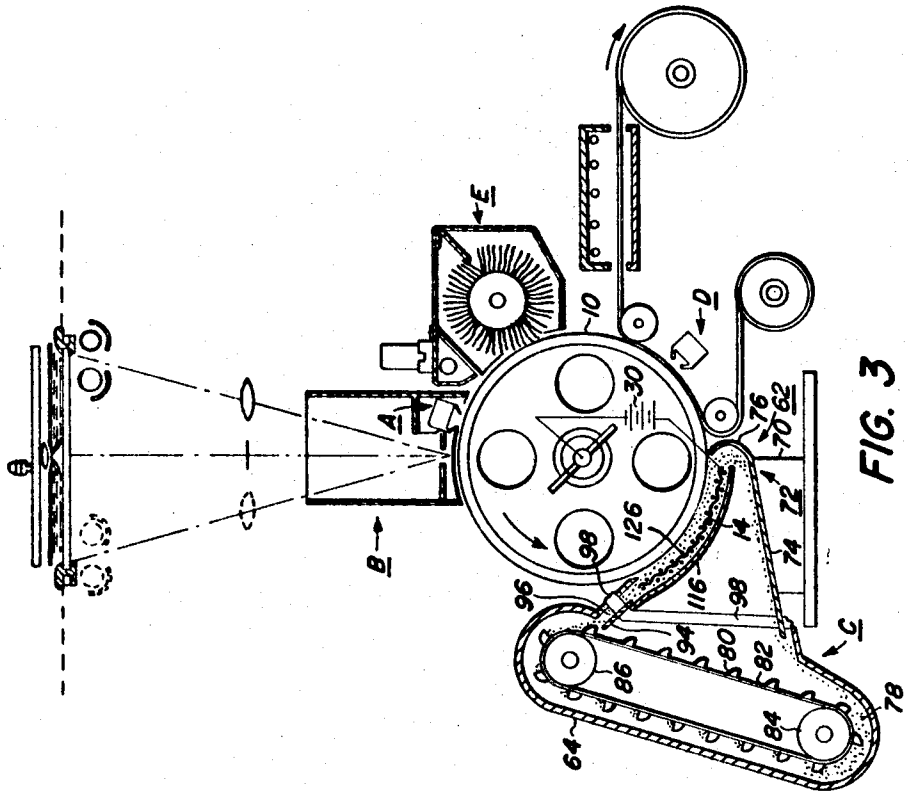

FIG. 3

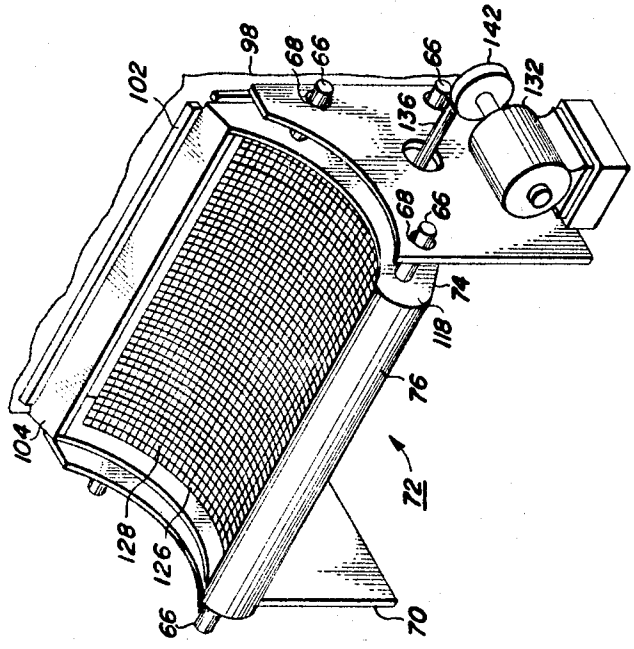

FIG. 4

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United States Patent Office 3,380,437
Patented Apr. 30, 1968

3,380,437

TRANSVERSELY RECIPROCATING FLUIDIZED BED DEVELOPMENT APPARATUS

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Filed July 21, 1966, Ser. No. 566,842
4 Claims. (Cl. 118—637)

ABSTRACT OF THE DISCLOSURE

Xerographic apparatus for developing latent electrostatic images with a fluidized bed of two-component developer material. The developing apparatus includes a developer supporting plate positioned beneath a rotatable latent electrostatic image-bearing surface to be developed. The plate is constrained for reciprocation transverse to the direction of rotation of the image-bearing surface. A development electrode is positioned adjacent the surface to be developed for improved development capabilities. Means are also provided for feeding a quantity of fresh developer into the development zone across the developer supporting plate.

This invention relates in general to developing electrostatic images, and in particular relates to apparatus for developing electrostatic images by utilizing vibrational forces to fluidize a two-component developer material.

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

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

The electrostatically attractable developing material commonly used in xerography consists of a pigmented resinous powder referred to here as "toner" and a coarse granular material called "carrier." The carrier is usually coated with a material removed in the triboelectric series from the toner so that a triboelectric charge is generated between the powder and the granular carrier. Such charge causes the powder to adhere to the carrier. The carrier also provides mechanical control so that the toner can be readily handled and brought into contact with the exposed xerographic surface. The powder particles are then attracted to the electrostatic image to produce a visible powder image on the xerographic surface.

A method of xerographic development of latent electrostatic images by fluidizing a two-component developer material in a development zone is described in U.S. patent application Series No. 566,847 copending herewith. As described in that case, a quantity of two-component developer material is vibrated beneath a latent electrostatic

image. The vibrations are so rapid that they cause the developer material to suspend itself in a fluidized mass or bed. As an image bearing xerographic surface is passed through the development zone, it is contacted by the fluidized or constantly moving developer and image areas of the xerographic surface are developed with the toner material in the developer.

The present invention constitutes new xerographic development apparatus adapted to carry out fluidized bed development as described above and incorporates advantageous features over other xerographic systems.

Earlier embodiments of fluidized bed development machinery, as described for example in the aforementioned patent application, had no provision for retoning carrier particles which became depleted of toner due to the toner deposition in image areas. The present invention, on the other hand, takes advantage of the inherent low friction properties of the fluidized developer material to continuously introduce freshly toned carried particles into and out of the development zone. Due to the fluidized state of the developer in the development zone, the coefficient of friction between the developer and the tray is reduced. A slight tilt of the fluidized bed will thus result in a flowing action of the entire fluidized bed in the direction of tilt. By introducing a supply of freshly toned carrier to the high side of the tilted development zone and concurrently collecting the depleted developer as it flows past the lower part of the development zone, freshly toned carrier can be supplied to the image areas. This characteristic of a fluidized bed of developer to flow is advantageous for use in xerographic machinery which require a continuous supply of developer such as automatic machinery.

Development electrodes are commonly used in xerography to provide solid area development. The electrode consists of a grounded or biased member positioned as closely as possible to the xerographic surface to create an electric field in conjunction with the electrostatic image. Since development electrodes should be as close as possible to the xerographic surface it has been a continuous problem in automatic machines to provide an electrode that could be positioned close enough to the surface to create the electric field without interfering with developer flow. One approach to this problem has been to position an electrode plate or grid parallel to the xerographic surface and spaced therefrom. With such an approach, if the electrode is too distant from the xerographic surface, the effect is reduced and solid area capabilities are minimized. If, on the other hand, the electrode is too close to the xerographic surface, the developer which flows parallel to the image and electrode, is susceptible of jamming between the closely spaced electrode and xerographic surface.

The presence of a development electrode within the development zone adjacent the image bearing surface has another beneficial aspect. By simply constructing the electrode in the form of a wire network or the like, such wire network may be employed as the developer vibrating instrument. By contrasting the developer supporting tray as used in the above-referred-to device with the wire network of the present device, it is clearly seen that the mass of the vibration imparting elements will be greatly reduced. With the reduction of mass of the vibrational elements, the energy required to rapidly reciprocate the vibration-imparting elements is reduced with corresponding decreases in noise and extraneous vibrations.

One solution to the problems of solid area coverage, continuous developer flow and the high mass of the vibrator has already been described in U.S. patent application Serial No. 566,944. The instant invention incorporates modified structures which solve the same problems but, simultaneously therewith solve the problem of

striations and tracking found in the apparatus discussed in the aforementioned applications.

Striations are a fault of development systems wherein the developed image and final copy are characterized by underdeveloped strips across the image generally perpendicular or transverse to the movement of the image bearing surface. It is caused by an uneven contacting of the image bearing surface by the developer material. Striations occur in fluidized bed development systems which vibrate the developer material in the direction of the image movement. These striations are caused by the slapping effect that waves of fluidized developer have on the image bearing surface. These waves have crests in the direction of developer vibration, perpendicular to the movement of the image. As an image bearing surface is moved through the vibrating developer, it is rhythmically being slapped by these fluidized bed developer waves. This periodic slapping of the image bearing surface by the developer constitutes the uneven developer presentation to the image which causes the striations.

The reorientation of the reciprocations of the developer vibrating elements, in accordance with the present invention, eliminates those aforementioned transverse waves of developer. Since the reciprocation is across the movement of the image, developer waves, if any are in fact formed, are not perpendicular to the direction of image movement. Consequently, the elimination of these transverse waves results in the elimination of their effect, viz., striations.

The problem of tracking is still encountered in conventional cascade development as well as other development systems. Tracking, or unwanted development streaks in the deposition of toner along the direction of movement of the image occurs when developer is caused to move in a constant linear path relative to the image. If one quantity of developer material includes a mass of undertoned carrier particles, or carrier particles which have been depleted of toner then that mass of carrier will be present along one line of the image bearing surface until it is replaced by properly toned carrier flowing through the development zone. Since the developer and image bearing surface move in straight line relative to each other, the improperly developed image portion will be extended over one straight length of the image area.

In the apparatus of the instant invention, the vibratory elements are guided for reciprocation in a path transverse to the movement of the image. As such, the developer particles are constantly moving into and out of contact with the image as well as across the image surface in a compound movement. The movement of developer across the path of movement of the image is unique in the field of fluidized bed development. This movement dissipates the effects of undertoned carrier by causing toned carrier to contact the image bearing surface at different sections across its path of movement through the development zone. As such, what would formerly have been a streak of underdeveloped image will now become developed since such line on the image will be contacted by masses of properly toned carrier on either side of the mass of undertoned carrier.

The transverse reciprocation of the developer also tends to eliminate tracking for another reason. As two adjacent quantities of developer, one properly toned and the other undertoned, are reciprocated in contiguous relationship, the transverse agitation of the first quantity causes some of those developer particles to become intermixed with the adjacent second quantity at the interface of the two quantities. Conversely some of the undertoned carrier from the second quantity will be caused to move into the developer of the first quantity. This intermixing of the toned and undertoned carrier at similar interfaces across the extent of the development zone thus tends to spread out and reduce undertoned carrier quantities within the zone. This characteristic effect of the traversely reciprocating fluidized bed thus tends to minimize tracking by presenting uniformly toned carrier to all portions of the image.

The mounting of the vibratory elements for movement transverse to the movement of the image bearing surface also lends itself to a mechanical arrangement of the vibratory elements unique in the fluidized bed development art. The arrangement, as described herein, is mounted independently of the main drum drive shaft as well as the other processing stations. Since the vibrational elements are independently mounted, their movement within the development station does not effect, by vibration, the movement within any other station of the system.

It is therefore an object of the present invention to develop latent electrostatic images.

It is a further object of this invention to improve fluidized bed development of xerographic images.

A further object of the invention is to eliminate tracking in the development of latent electrostatic images.

A further object of the invention is to eliminate striations in the development of latent electrostatic images.

These and other objects of this invention are obtained by applying a vibrational force to a two-component developer material in a direction transverse to the path of movement of a latent electrostatic image bearing surface and by applying the vibrational force so rapidly that the mass developer material will be suspended in a fluidized mass to contact and develop images on the surface.

For a better understanding of the invention, as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in connection with the accompanying drawings wherein:

FIGURE 1 is an end sectional view of the developing apparatus constructed in accordance with the invention.

FIGURE 2 is a front view of the development apparatus as shown in FIGURE 1.

FIGURE 3 is a diagrammatic section view illustrating xerographic development apparatus adapted for continuous and automatic operation which embodies the development apparatus of the instant invention.

FIGURE 4 is an upper right perspective view of the vibrating elements as shown in FIGURE 3.

Essentially the apparatus of the invention illustrated in the described embodiments, includes a developer supporting plate positioned beneath at least a portion of a latent electrostatic image bearing drum and concentric therewith. Development electrode wires are positioned in the development zone between the plate and image bearing surface. Means are then provided to reciprocate the electrode wires and developer supporting plate beneath the rotating drum in a direction across the path of movement of the drum. When two-component developer is introduced between the plate and image, the vibratory motion imparted thereto by the wires and plate causes the vibrated developer to suspend itself in a fluidized mass or bed in contact with the image in the same manner as described in the above cited co-pending applications, Serial No. 566,847 and 566,944. The continued vibration imparted to the developer causes the individual particles to move into and out of contact with the image-bearing surface. The orientation of the vibration across the movement of the image-bearing surface imparts a compound motion to the developer within the development zone. As such, the developer not only moves along the direction of motion of the image due to its general mass flow but also moves transverse with respect thereto. This compound movement of the developer with respect to the image eliminates tracking and striations which might otherwise occur if the developer were vibrated in another direction.

The transfer of the toner particles from their associated carrier beads to image areas principally occurs during this contact period. The deposition of toner to image areas is physically caused either by the attraction of the image exceeding the attraction of the carrier for the toner or the toner being jarred loose from the carrier by the force of contact as it strikes the xerographic surface whereupon the change in the image areas attract the loose toner.

As the developer is suspended within the fluidized bed it has the appearance of a fluid with the entire bed of developer being of a substantially homogeneous density throughout. This uniform density across the length of the development zone insures the presentation of even quantities of developer to all portions of the image across the xerographic surface. Consequently, the possibility of underdeveloped strips of image areas caused by the uneven presentation of developer to the image areas is minimized.

The developer composition may be of the conventional type as presently employed in commercial xerographic machines which use cascade techniques. Such a composition is defined, for example, in Walkup Patent 2,618,551. An example of such a composition comprises carrier beads of glass or steel covered with and encased in a suitible coating such as vinyl chloride which imparts the necessary triboelectric properties to the toner upon contact. The toner, usually a pigmented resinous material or the like which can be used to develop xerographic images, may be blends or copolymers of styrene and n-butyl methacrylate, pigmented with about 10 percent carbon black. A typical carrier sixe is 30–50 mesh. A typical toner size is 5–10 microns.

In the illustrated embodiment of FIGURE 1, a latent electrostatic image is adapted to be formed on a xerographic surface shaped in the form of a drum **10**. While a drum has been shown as readily adapted for use in this type of a system, it should be understood that any xerographic surface such as a plate or belt may be similarly employed. The drum shaped xerographic surface is mounted on a main drum drive shaft **12**, for rotation in either direction. The motion of the drum acts to sequentially bring the various portions of the image bearing surface into the development zone **14**, for development within the fluidized bed of developer.

Positioned immediately beneath a portion of the drum is an arcuate plate **16**, shaped concentrically with the drum **10**. The arcuate plate **16** is mounted adjacent opposite ends of the drum by rigid mounting plates **18**. The lower portions of these mounting plates are attached to flexible metallic sheets **20**, the lower ends of which are mounted to a base **22** by any suitable mounting mechanism. As shown herein brace bars **24** adjacent the interface of the flexible sheets **20**, and base **22** provide the attachment.

Also positioned in the development zone between the drum **10**, and arcuate plate **16**, is a vibratory screen **26**. The vibratory screen is also mounted arcuately and concentric with both the drum and arcuate plate. The opposite ends of the screen as shown in FIGURE 2 are mounted into the mounting plates **18**, of the vibrational elements through any suitable insulating barrier **28**, as of polyurethane foam or the like. The screen is adapted to be grounded or receive an electrical bias by a potential source **30**. Such electrical connection is adapted to render the screen a development electrode for the establishment of an electric field adjacent the image.

Motion to the vibrational elements is imparted by any suitable motor means. The apparatus as disclosed in this embodiment for causing the vibration is a motor **32** mounted on a suitable table **34**, in alignment with the mounting plate **18**. A connecting rod **36**, is formed with apertured ends **38**, **40**. The first aperture end **38**, is pivotally connected to the rotating circular drive plate **42**, of the motor **32** off center from the axis of the plate to thereby cause an oscillation of the connecting rod **26**. The opposite end **40**, of the connecting rod **36**, is pivotally attached to the adjacent mounting plate **18**, of the vibrating elements. As such upon rotation of the motor **32**, and circular drive plate **42**, the vibrating elements will be oscillated toward and away from the motor **32**, in a direction transverse with respect to the movement of the image bearing surface.

When such motion is imparted to the vibratory elements with two-component developer in the development zone **14** above the arcuate plate **16**, the vibrations imparted to the developer by the screen **26** as well as the plate **16** will cause the developer to rise, suspending itself in a fluidized mass or bed throughout the space of the development zone **14** between the arcuate plate **16**, and the image bearing surface of the drum **10**. The motion of the screen **26**, which is concurrent with the motion of the arcuate plate **16**, by virtue of their common connection through the mounting plates **18**, provides the majority of vibration for fluidizing the developer. Furthermore, when the potential is applied to the screen to cause a development electrode effect, solid area capabilities are obtained and readily controlled.

In order to achieve a mass flow of developer through the development zone **14**, a developer supply hopper **44** is positioned to one side of the arcuate plate. The hopper is provided with front, back and side walls **46** and an open top surface **48** for the addition of more developer. The lower face **50** thereof is inclined in a direction towards the development zone **14** for gravity feed of the developer. Positioned adjacent the outlet orifice **52** of the hopper are flexible hose-like connecting elements **54**, connecting the hopper **44** with an intermediate chute **56** which is secured to the arcuate plate **16**. The hopper **44** flexibly connecting elements **54** and chute **56** extends the entire length of the development zone for gravity feeding developer along the entrance portion of the development zone. By this simple arrangement additional developer may be poured through the development zone to replace the developer which becomes depleted of toner as toner is depleted to the image through development.

To collect the toner-depleted developer as it flows beyond the development zone, any suitable bucket means **58** or the like may be positioned adjacent the development zone **14** on the side thereof remote from the hopper **44** and input chute **56**. As the developer in the development zone is forced from the development zone by the introduction of freshly toned developer, the depleted developer is being continually forced from the development zone and gravity dropped into the collector bucket.

The effect of the mass flow of developer along the direction of the image movement in combination with the reciprocation of the vibration imparting elements transverse with respect to the mass flow, imparts a compound motion to the developer as it moves through the development zone. As discussed above, this compound motion of developer along the path of image movement, as well as transverse with respect thereto, eliminates striations and tracking in the developed image which have been prevalent in many forms of development systems.

In operation, a latent electrostatic image is first formed on the drum **10**. The drum is then set in motion by any conventional power source not shown. Concurrent with the movement of the drum, the vibration imparting elements are set in motion by activation of the motor **32**. This is done with a supply of two-component developer in the hopper which will be gravity fed through the development zone. At the same time, the screen **26** is given an electrical bias to thereby produce a development electrode field adjacent the image bearing surface. The vibrations of the arcuate plate **16** and screen **26** thus cause developer thereabove to fluidize itself for contacting and developing the image on the drum. After one or plural passes of the drum through the development zone **14**, motions of the drum and vibrational elements may be stopped since development has been accomplished.

Shown in FIGS. 3 and 4 is xerographic apparatus embodying the present invention constructed for continuous and automatic operation. The elements of this machine are all conventional in the xerographic art with the exception of the development station which forms the basis of the present invention. For the purpose of the present disclosure, the several xerographic processing stations in the path of movement of the xerographic surface may be briefly described as follows:

A charging station A, at which a uniform electrostatic

charge is deposited on the photoconductive layer of the xerographic drum;

An exposure station B, at which the light or radiation pattern of copy to be reproduced is projected onto the drum surface to dissipate the drum charge in the exposed areas thereof to thereby leave a latent electrostatic image of copy to be reproduced;

A developing station C, which forms the basis of the present invention, at which a xerographic developing material, including toner particles having an electrostatic charge opposite to that of the electrostatic latent image, are moved into contact with the drum surface, whereby the toner particles adhere to the electrostatic latent image to form a xerographic powdered image in the configuration of the copy being reproduced;

A transfer station D, at which the xerographic powder image is electrostatically transferred from the drum surface to a transfer material or a support surface; and,

A drum cleaning and discharge station E, at which the drum surface is brushed to remove residual toner particles remaining thereon after image transfer, and at which the drum surface is exposed to a relatively bright light source to effect substantially complete discharge of any residual electrostatic charge remaining thereon.

The xerographic development apparatus illustrated in the embodiment of FIGURES 3 and 4, is constructed of two major sections, a developer vibrating assembly **62**, and a developer recirculation assembly **64**. The purpose of the developer vibrating assembly is to impart the vibratory motion to two-component developer adjacent the latent electrostatic image bearing surface. The purpose of the developer recirculation assembly is to move developer to the input end of the developer vibrating assembly after it has been moved beyond the developer vibrating elements.

The developer vibrating elements as shown in FIGURES 3 and 4 are quite similar to those shown in the first embodiment. The arcuate plate **116**, is positioned concentric with the drum in an area vertically offset from the vertical center line of the drum **10**, to facilitate rapid movement of developer through the development zone **14**. The opposite ends of the arcuate plate **116** are secured by suitable means to mounting plate **118** positioned adjacent the opposite end faces of the drum. The mounting plates are provided at each end with suitable guide pins **66**, three for example, for mounting through aligned apertures **68** in guide plates **70**. The cooperation of the guide pins **66** and apertures **68** restrains the arcuate plate **116** and the rest of the vibratory elements for motion in a purely reciprocatory longitudinal path.

In the same manner as described in the first embodiment a suitable screen **126** is secured concentric with and between the drum **10** and arcuate plate **116** for aiding in vibrating the developer material. The screen is grounded or provided with a bias from any suitable source of potential **30** to thus create an electric field adjacent the image. To allow a bias to be placed on the screen **126** but not the plate **116** the screen is mounted in the end plates **118** through suitable insulating barriers **128** as of polyurethane foam or the like as described in the first embodiment.

In order to guide the vibrated developer in a return path towards the developer recirculation assembly **64**, a plate **72** with a J-shaped cross-section is also secured at its opposite ends between the mounting plates **118**. The plate **72** is thus vibrated with the arcuate plate **116** and screen **126** during operation for maintaining the developer in a fluidized state. The developer thus exhibits a movement down the longer leg **74** of the plate **72** towards the developer recirculation assembly **64** after reversing direction at the curved portion **76**.

The developer recirculation assembly **64** is similar to the conventional type employed in most cascade development units. In the lower portion of this housing a developer sump **78** is provided containing a supply of two-component developer for feeding into the development zone **14**. A bucket conveyor assembly comprising a plurality of buckets **80** mounted on a flexible endless belt **82** is held in position by two rollers **84** and **86**. One of these rollers **84**, is connected to a suitable power source, not shown, for moving the buckets in the direction of the arrows as shown in FIGURE 3. The buckets act to raise the developer from the sump **78** to an elevated position for gravity feed to the development zone **14**. The entire system is enclosed and has adjacent one side there a toner dispenser **90** for adding toner to the system to thereby replace toner which has been depleted due to development of images.

Also within the developer recirculating assembly are an upper and lower plate **92**, **94** spanning the distance across the developer recirculating assembly **64**. This distance is the equivalent of the length of the drum **10**. These plates act as a developer input chute **96**, for the introduction of developer into the space between the arcuate plate **116** and drum **10**. This chute **96** is fixed with respect to the developer recirculaitng assembly and does not vibrate with the other vibratory elements of the machine.

To insure that the entire development system is closed in the areas between the developer recirculating assembly **64** and the developer vibrating assembly **62**, flexible connecting elements **98** are employed to span the distance between these two assemblies. As shown in FIGURES 3 and 4 this flexible connecting assembly comprises a series of, four for example, flexible sheets. A gum rubber film or the like may be readily employed. A first flexible sheet is connected above the space between these two assemblies and may be connected by any adhesive material with a bracing member, as backing bar **102**, to insure a non-porous connection. A supplemental bar **104** secured between the mounting plates may hold the vibratory end of this sheet. Similar sheets may be employed on the opposite sides of the connection and a fourth sheet may span the lower portion of the juncture. As such, the developer recirculating assembly **64**, the developer vibrating assembly **62**, the portion of the drum **10** being developed and the flexible connecting elements **98** define a closed development system.

Motion to the developer vibrating assembly may be accomplished by a motor **132** similar to that employed in the embodiment of FIGURES 1 and 2. The motor **132** is adapted to be positioned adjacent one of the vibratory mounting plates **118**. A connecting rod **136** with apertured ends similar to that employed and shown in FIGURE 2 is positioned for the connecting mounting plate **118** to the rotating circular plate **142** of the motor. The end of the connecting rod which is pivotally mounted to the motor is offset slightly with respect to the center of the circular plate of the motor to thereby convert the rotation of the drive plate to a reciprocation of the vibrating elements.

To operate the development apparatus of the embodiment of FIGURES 3 and 4 it is first necessary to activate the various processing stations outlined above. Such activation may be done by a general cycle initiating means similar to that used in any of the known continuous and automatic xerographic machines. Such general cycle initiating means will activate all operative stations including the drum driving means, developer conveying apparatus and the vibrating instrumentalities in the development zone in addition to initiating the bias on the screen.

As the image bearing surface passes the development zone the developer conveyor is continually bringing the two-component developer into the input chute for gravity feeding developer to the development zone above the arcuate plate. As the developer contacts the arcuate plate and electrode screen, the continuous vibrations encountered reciprocate the developer between the arcuate plate and image bearing surface.

The ground or bias on the vibrating electrode screen establishes an electric field adjacent the image. In addition to creating the field, the vibrations of the screen assist in fluidizing the developer contacted thereby. The screen, as mentioned above, is of such mesh as to allow the vibrated developer particles to freely move between the arcuate plate and image bearing surface without interference from the screen.

As the fluidized cloud of developer flows past the arcuate plate and image it contacts the vibrating arcuate portion of the J-shaped plate. Here the direction of the entire fluidized bed of developer reversed. The fluidized bed continues to move in this reverse direction back towards the sump. It is noted that longer leg portion of the J-shaped plate is tilted in the desired direction of flow to facilitate the developer return to the sump. As the developer passes the final portion of the J-shaped plate it moves into contact with the sump area of the developer recirculating assembly. Since this portion of the system is not in vibration, the fluidized bed is dissipated and the developer resettles in the sump for subsequent recycling through the development zone.

While the present invention as to its object and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby; but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. In a xerographic machine which develops latent electrostatic images on image-bearing members with a two-component developer material comprising carrier particles and an electrostatically attractable powder, the machine being of the type having a developer-supporting surface adapted to support two-component developer material, means to retain the developer-supporting surface in a region spaced beneath at least a portion of an electrostatic image-bearing member, means to move the latent electrostatic image-bearing member in a direction across the developer supporting surface for sequentially bringing new portions of the image-bearing member above the developer-supporting surface, and developer vibrating means capable of producing a fluidization of two-component developer material supported on the developer-supporting surface so that the developer material will suspend itself in a fluidized mass to contact and develop images on the image-bearing member, the improvement comprising

means to reciprocate the developer vibrating means to move the vibrated developer in a direction of movement substantially transverse to the direction of movement of the latent electrostatic image-bearing member to thereby provide for developer movement across the image-bearing member as the image-bearing member passes above the developer-supporting surface and vibrating developer material.

2. The apparatus as set forth in claim **1** wherein the developer vibrating means includes the developer-supporting surface and a network of conductive elements, the network being positioned between the developer-supporting surface and image-bearing member, the network also being apertured to such extent as to freely allow the movement of the vibrated two-component developer material therethrough.

3. The apparatus as set forth in claim **2** wherein the wire network is a development electrode.

4. The apparatus as set forth in claim **3** wherein the image-bearing member is drum shaped and the developer-supporting plate and network are each arcuately shaped, concentric with a portion of the drum shaped image-bearing member and further including

means to guide the vibrations of the developer-supporting surface and network for reciprocation axially with respect to the axis of the drum shaped image-bearing member.

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