United States Patent

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[45] Patented **Apr. 27, 1971**

[54] **MECHANISM FOR DISPENSING TONER IN ELECTROGRAPHIC APPARATUS**
8 Claims, 4 Drawing Figs.

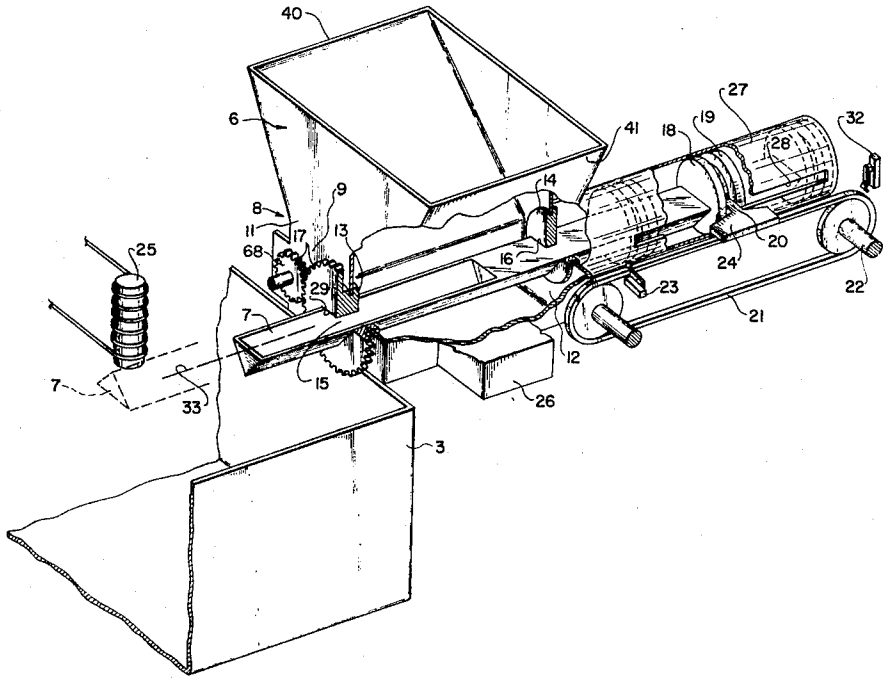
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[51] **Int. Cl.** **G01f 11/10**
[50] **Field of Search** ..... 222/357, 363, 333, 366, 345, 404, 181, 185, 359, 360, (Inquired)

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Primary Examiner—Stanley H. Tollberg
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ABSTRACT: A mechanism for dispensing toner into a developer reservoir in an electrographic machine has an elongated trough which moves from a position for receiving toner to a position over the developer reservoir where it is inverted for emptying. These movements are assisted by a rotatable seal in a housing for the trough through which the trough slides.



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SHEET 1 OF 2

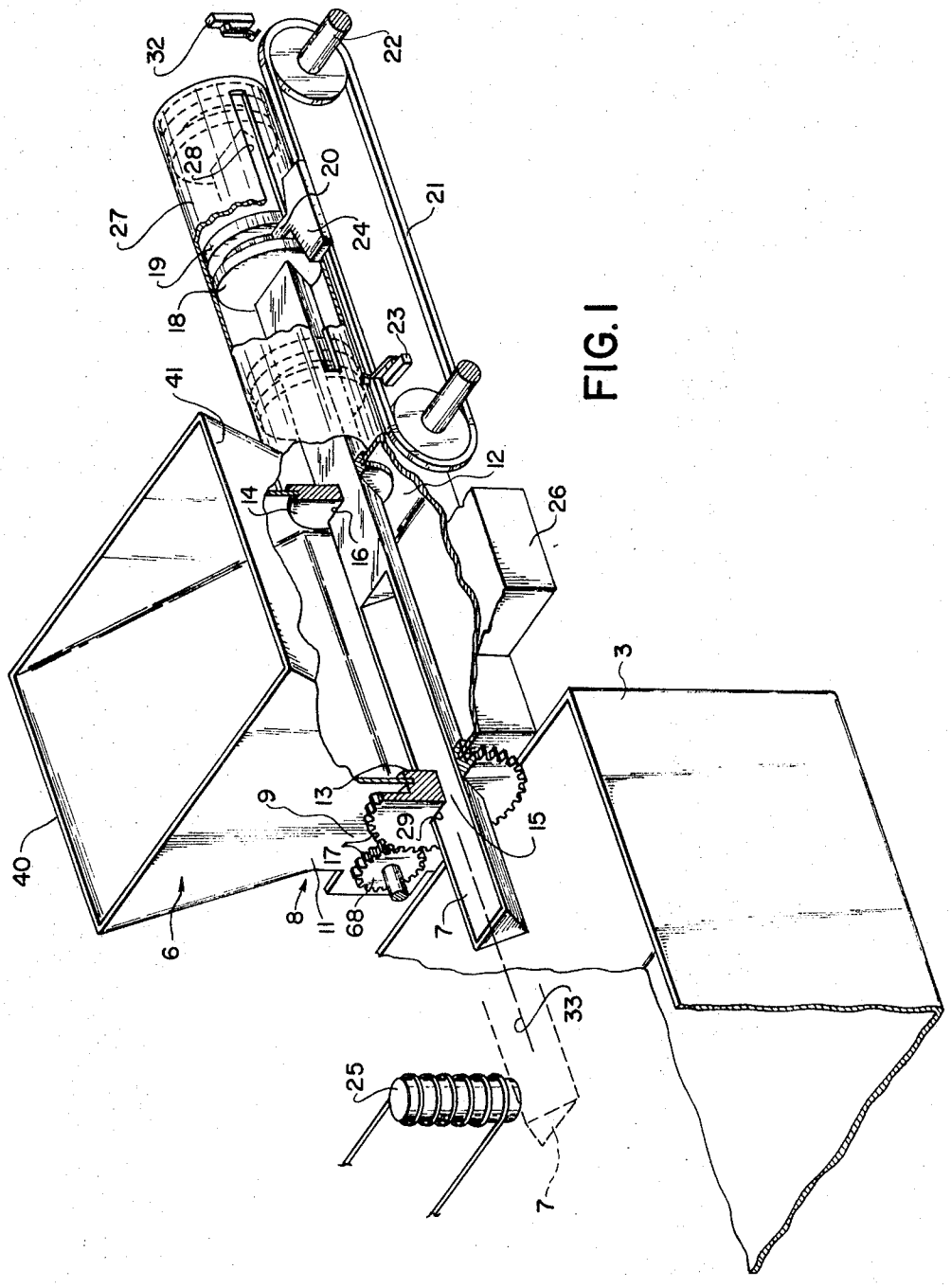
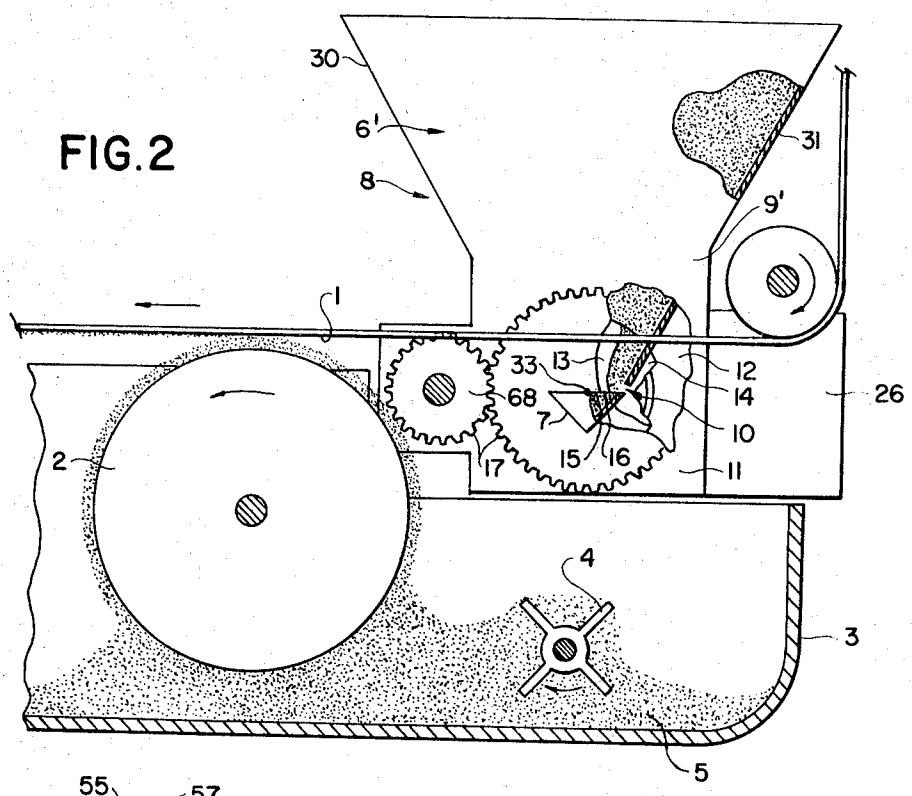


FIG. 1

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FIG. 2



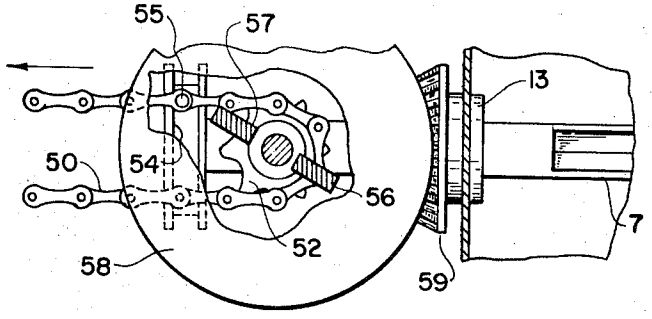


FIG. 3

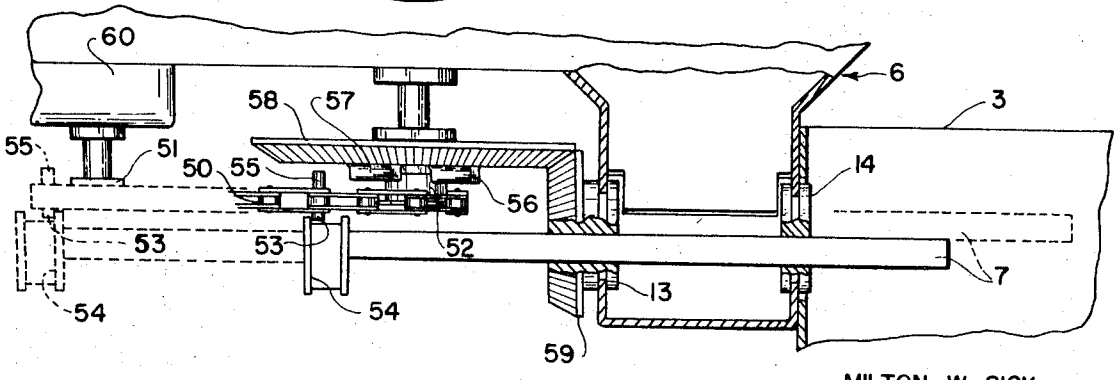


FIG. 4

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MECHANISM FOR DISPENSING TONER IN ELECTROGRAPHIC APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to electrography and, more particularly, to mechanisms for dispensing dry toner into a developer reservoir in an electrographic machine.

In certain forms of electrography, an electrical pattern or image is formed on an insulating surface. For example, in xerography, a photoconductive layer having a conductive backing is uniformly charged and then exposed to a pattern of activating radiation, thereby creating an electrostatic image in conformity with the pattern of radiation.

The image is developed by application of finely divided marking particles called "toner." One method of applying toner to such an electrostatic image is by mixing such toner with much larger ferromagnetic carrier particles and, using a magnetic field, transporting the mix, herein called a "developer," across the electrostatic image. Such a device is known as a "magnetic brush." Because most magnetic brushes commonly transport the developer from a developer reservoir upward into contact with the image-bearing surface and then to a position where the developer falls back into the developer reservoir for further mixing and reuse, it is convenient to position a magnetic brush directly below the surface to be toned.

As a series of electrical patterns are toned in an automatic machine, a toner supply in the machine must be replenished. This is commonly accomplished by continuously metering a small amount of toner reservoir into the developer reservoir. Thorough mixing of toner and carrier throughout the developer reservoir is important to provide a homogeneous toner concentration for an even developing operation.

A large number of mechanisms have been provided for dispensing toner into a developer reservoir. With some types of developing apparatus, for example, apparatus in which the electrical pattern-bearing surface is to one side or below the developing mechanism, the toner reservoir can be positioned directly above the developer reservoir where it can meter toner evenly across one dimension of the developer reservoir. However, in developing apparatus in which the image-bearing surface is directly above the developer reservoir, for example, in magnetic brush developing apparatus, toner is commonly dispensed into the developer reservoir from the side, using augers or the like. Such devices commonly deposit toner at one or more localized areas in the reservoir and are not generally successful in spreading the toner evenly across a single dimension of the reservoir. The result is a toned pattern or image that varies in density from one side to the other.

SUMMARY OF THE INVENTION

It is an object of this invention to dispense toner into a developer reservoir in an electrographic machine evenly across one dimension of the developer reservoir.

It is another object of this invention to evenly dispense toner into a developer reservoir from a toner reservoir positioned to one side of the developer reservoir, thereby allowing an electrical pattern-bearing surface to be positioned directly over the developer reservoir.

These and other objects are accomplished by an elongated toner-holding member which is first loaded with toner, then positioned over the developer reservoir and emptied, depositing toner evenly across a dimension of the developer reservoir.

It is a feature of the present invention to move the elongated member in a direction parallel to its elongated dimension, through a toner reservoir to pick up toner and then to a position over the developer reservoir where it can be inverted for emptying.

In accordance with another feature of the invention, a housing supporting the elongated member has a rotatable portion which serves to keep the housing sealed during both linear and rotary motion of the elongated member. The rotatable portion can be used as at least an element of a drive means for inverting the elongated member.

It is another feature of the invention to provide a means for agitating the elongated member when inverted to dislodge toner particles that may have a tendency to stick.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an embodiment of the invention, with portions broken away for clarity of illustration.

FIG. 2 is a partially schematic side section of a developer reservoir and a magnetic brush developing apparatus and a side elevation of a toner reservoir with a dispensing mechanism constructed according to the invention, with portions broken away for clarity of illustration.

FIG. 3 is a top view of an alternative drive means for the dispensing mechanism shown in FIG. 1 with portions eliminated and broken away for clarity of illustration.

FIG. 4 is a side elevation of the mechanism shown in FIG. 3, with portions in section for clarity of illustration.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 2, an electrostatic image carried on an insulating surface 1 is developed by application of toner using a magnetic brush 2 mounted in a developer reservoir 3 which reservoir contains a magnetic brush developer mix 5. The developer mix 5 is made up of ferromagnetic carrier particles and finely divided toner particles which are mixed by a mixing paddle 4. As toner is used up in the developing process, it must be replenished. Referring to FIGS. 1 and 2, toner dispenser 8 having a toner reservoir 6 (FIG. 1) or 6' (FIG. 2) into which toner is loaded, either by an operator or an automatic loading device, is positioned to one side of the developer reservoir 3.

The toner reservoir 6 shown in FIG. 1 has walls 40 and 41 sloping down to sidewalls of an auxiliary housing 9 below the toner reservoir 6. The toner reservoir 6' shown in FIG. 2 has walls 30 and 31 slanting downward to an opening 10 under which is positioned an auxiliary housing 9'. Referring to FIGS. 1 and 2, mounted in the auxiliary housing is an elongated, trough-shaped member 7 a portion of which is open at the top and positioned to receive toner either positioned in the auxiliary housing 9 or falling through the opening 10. The housings 9 and 9' have sidewalls 11 and 12 containing rotatable members 13 and 14, containing openings 15 and 16, respectively, in which the trough-shaped member 7 is mounted for sliding movement. Rotatable member 13 is coupled by gear teeth 17 to drive gear 68 which is driven by energizable drive means, not shown, so that troughlike member 7 can be rotated upon a longitudinal axis 33.

As shown in FIG. 1, at one end of trough-shaped member 7 remote from the developer reservoir 3 are discs 18 and 19 spaced to receive a drive pin 20. Drive pin 20 is coupled to a drive belt 21 which is reciprocally movable by a shaft 22 connected to a reversible drive means, not shown, to impart reciprocal movement to the troughlike member 7 in a direction parallel to the longitudinal axis 33.

In operation, when toner is required in developer reservoir 3, shaft 22 is rotated in a counterclockwise direction moving troughlike member 7 through housing 9, collecting toner from toner reservoir 6 in the open top portion as it moves. When troughlike member 7 is positioned over developer reservoir 3, an extension 24 of drive pin 20 trips a switch 23 which stops shaft 22 and actuates the drive means for drive gear 68. Gear 68 then rotates rotatable member 13 one-half turn around axis 33, thereby inverting trough-shaped member 7 to empty toner into the developer reservoir 3. Because electrographic toner has a tendency to cake in any container, thorough dislodging of toner from trough-shaped member 7 can be assisted by a solenoid 25, actuation of which is timed by suitable means, for example, rotation of gear 68, to shake trough-shaped member 7 when inverted. Similarly, even distribution of toner in the trough-shaped member 7 can be aided by a vibrating mechanism 26 timed to vibrate toner reservoir 6 while shaft 22 is moving in a counterclockwise direction. In practice, if the vibrating mechanism 26 is allowed to run when the trough

7 is in its inverted position, it will perform the shaking function, thereby eliminating the need for the solenoid 25. Triggered by a suitable timing means, for example, actuation of solenoid 25, drive shaft 22 is now turned in a clockwise direction to return trough-shaped member 7 into housing 9 and gear 68 is driven to turn rotatable member 13 to its original position. A switch 32 stops both mechanisms until the next demand for toner is made. A tubular housing 27 can be provided to accept the end of trough-shaped member 7 when not in position over developer reservoir 3, which housing contains a slot 28 for drive pin 20. If a high quality seal is provided in rotatable member 14, such a tubular housing is not necessary.

The toner reservoir 6' shown in FIG. 2 is shaped somewhat differently from that shown in FIG. 1. Sidewalls 30 and 31 in FIG. 2 are extended beyond their intersection with housing 9', forming an opening from which toner falls directly into trough-shaped member 7. In the apparatus shown in FIG. 1 trough-shaped member 7 merely moves through toner which fills housing 9 with toner metered accurately in the trough-shaped member 7 by an edge 29 as the trough-shaped member moves through opening 15.

Actuation of shaft 22 to begin a single dispensing cycle involving moving trough-shaped member 7 from underneath toner reservoir 6 to a position over developer reservoir 3, inverting trough-shaped member 7, erecting it and returning it to its original position, can be initiated in response to a signal from several sources well known in the art. For example, this signal may come from a button on a control panel on the machine pushed by an operator who recognizes the need for more toner from a visual inspection of a toned image. Alternatively, the signal may come from a particular number of cycles of the development mechanism or some other mechanism in the machine approximately related to use of toner. It may also come from an optical sensing device, not shown, positioned to sense the optical reflectivity on the surface of the magnetic brush 2 which device determines that the toner concentration of the developer mix 5 is low because of an increase in the reflectivity of the mix.

Referring to FIGS. 3 and 4, an alternative mechanism for driving the trough-shaped member 7 through the above-mentioned cycle of operations is disclosed. In this embodiment, a drive chain 50 driven in a single direction through an endless path accomplishes both longitudinal and rotational movement of the trough-shaped member 7. The chain 50 is mounted around a drive sprocket 51 and an idler sprocket 52. A longitudinal drive pin 53 carried by the chain fits in a slot 54 in the trough-shaped member 7. The desired longitudinal movement of the trough-shaped member is effected by one cycle of the longitudinal drive pin 53. The slot 54 is made much larger than the drive pin 53 so that as the drive pin is in the portion of its endless path around idler sprocket 52, the trough-shaped member 7 will remain stationary for a short time period in an extended position over the developer reservoir 3.

A rotational drive pin 55 is coupled to the side of chain 50 opposite that of longitudinal drive pin 53. Rotational drive pin 55 engages one of two protrusions 56 and 57 on the facing of a bevel gear 58, thereby turning bevel gear 58 one-half turn each time rotational drive pin 55 moves around idler sprocket 52. Bevel gear 58 engages a bevel gear 59 linked to the rotational member 13 for inverting trough-shaped member 7. A full rotation of trough-shaped member 7 is effected by having the circumference of bevel gear 58 twice the circumference of bevel gear 59.

In operation, a drive motor 60 responds to a signal for more toner by moving the chain 50 through one complete cycle and then stopping. The cycle moves the trough-shaped member 7 first under the toner reservoir 6 then over the developer reservoir 3, rotates it one full turn and then brings it back to its beginning position. It can be seen that the same series of steps can be accomplished with a bevel gear 58 which has the same circumference as bevel gear 59 by using two spaced rotational drive pins to turn bevel gear 58 one complete revolution in each cycle. With this latter arrangement, the two rotational drive pins can be spaced to provide for a stop in the rotational movement of the trough-shaped member 7 when in its inverted position during which stop, of course, it may be jarred with a solenoid as mentioned in the previous embodiments.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

We claim:

1. In an electrographic machine utilizing dry toner powder, a mechanism for dispensing toner from a first reservoir to a second reservoir having sidewalls which define length and width dimensions thereof, said mechanism comprising:
- elongate toner holding means mounted for movement from a first position for receiving toner from said first reservoir to a second position extending substantially across the width of said second reservoir at said particular location,
- means for moving said holding means from said first position to said second position, and
- means for at least partially emptying said holding means when in said second position to dispense toner into said second reservoir, substantially uniformally across the width of said second reservoir.

2. The dispensing mechanism according to claim 1 wherein said emptying means includes means for inverting said holding means and for agitating said holding means when inverted.

3. In combination with electrographic apparatus having a replenishment reservoir and a development reservoir, a mechanism for dispensing toner from said replenishment reservoir into and evenly across a width dimension of said development reservoir, said mechanism comprising:
- elongated toner holding means having a longitudinal axis,
- means supporting said holding means for translatory movement from a position in communication with said replenishment reservoir in a direction generally parallel to said axis to a position extending substantially across a dimension of said development reservoir and for rotational movement upon said axis,
- means for moving said holding means in a direction generally parallel to said axis, and
- means for rotating said holding means around said axis to empty toner evenly across said development reservoir.

4. A toner dispensing mechanism according to claim 3 wherein said supporting means includes:
- a housing below said first reservoir,
- a rotatable seal mounted in said housing, said seal including an opening in which said holding means is mounted for sliding movement generally parallel to said longitudinal axis.

5. A mechanism for uniformally dispensing toner into a developer reservoir of electrographic apparatus, said mechanism comprising:
- a toner replenishment reservoir having an elongated opening through which toner can move under force of gravity,
- a housing positioned below said elongated opening,
- open top, toner holding means mounted in said housing for sliding movement from a first position under said opening in said toner reservoir to a second position located over and substantially across a dimension of said developer reservoir,
- means for moving said toner holding means from said first position to said second position and for rotating said holding means upon an axis generally parallel to said movement to empty toner from said holding means into said developer reservoir.

6. In combination with electrographic apparatus having a magnetic brush development reservoir, a toner dispensing mechanism for dispensing toner into and uniformally across a dimension of said development reservoir, said mechanism comprising:
- toner replenishment reservoir means having first and second opposing walls,

elongated trough-shaped toner holding means mounted for sliding movement through said opposing walls,

means for moving a portion of said trough from a first position between said opposing walls to a second position over and extending substantially across a dimension of said development reservoir,

means for inverting said trough when in said second position.

7. The invention defined in claim 3 further comprising mixing means located in said development reservoir and beneath said toner holding means when in said second position.

8. The invention defined in claim 5 further comprising mixing means located in said development reservoir and beneath said toner holding means when in said second position.