June 25, 1963 H. E. TRUMBULL 3,095,325

TONER DISPENSER DRIVE MECHANISMS

Filed Dec. 23, 1960 3 Sheets-Sheet 1

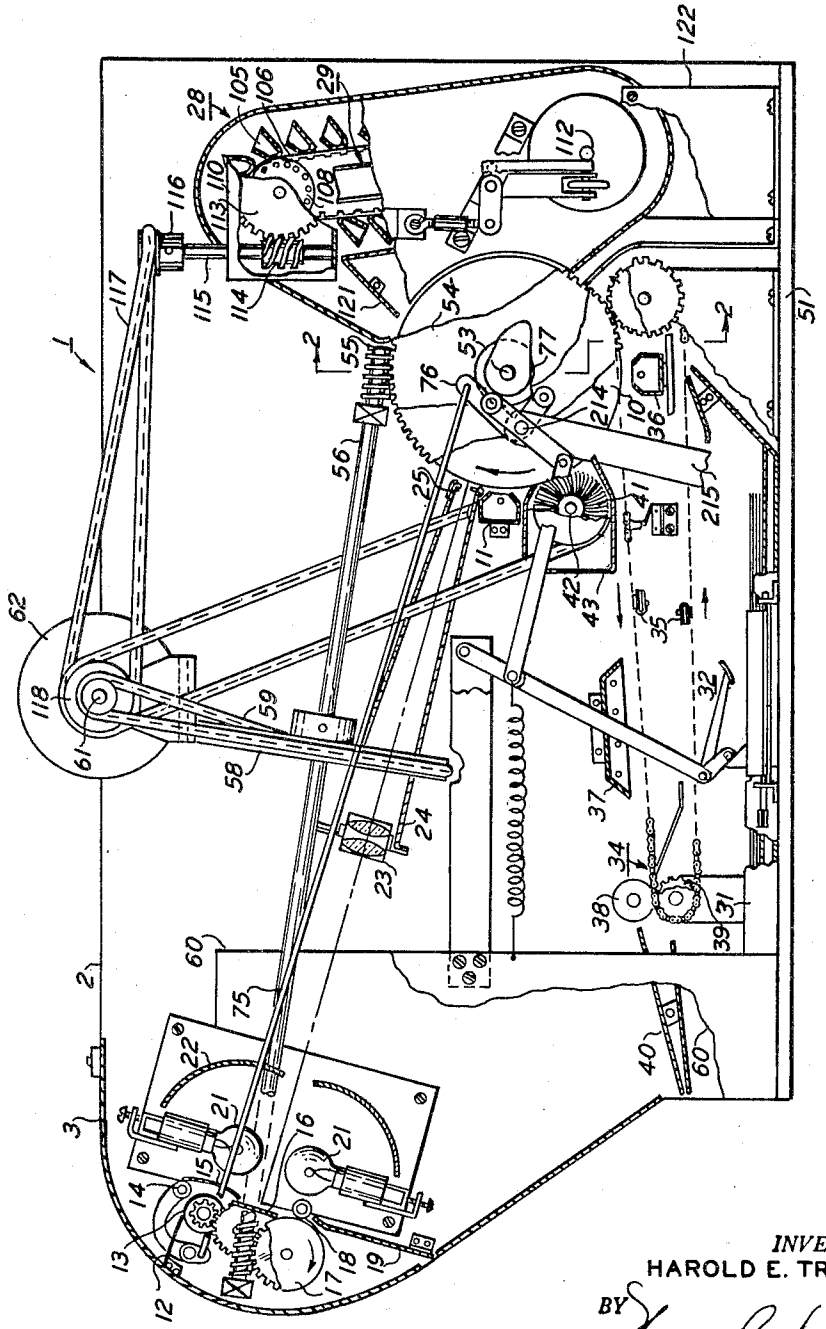


FIG. 1

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TONER DISPENSER DRIVE MECHANISMS

Filed Dec. 23, 1960 3 Sheets-Sheet 2

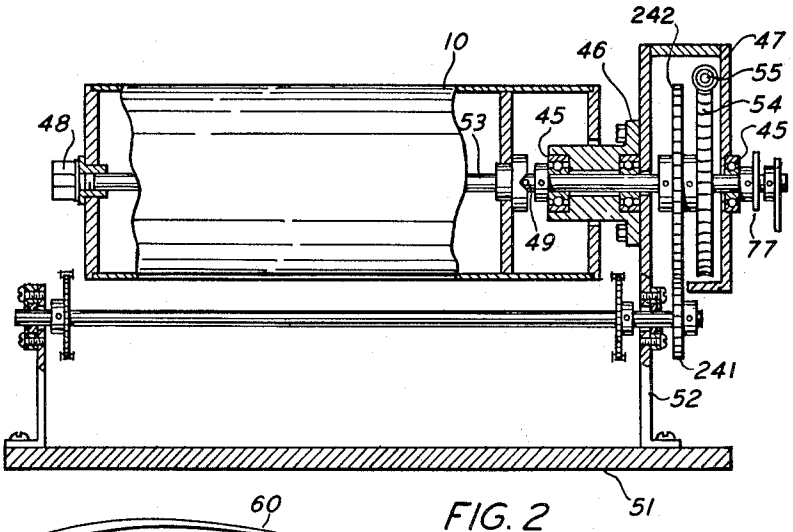



FIG. 2

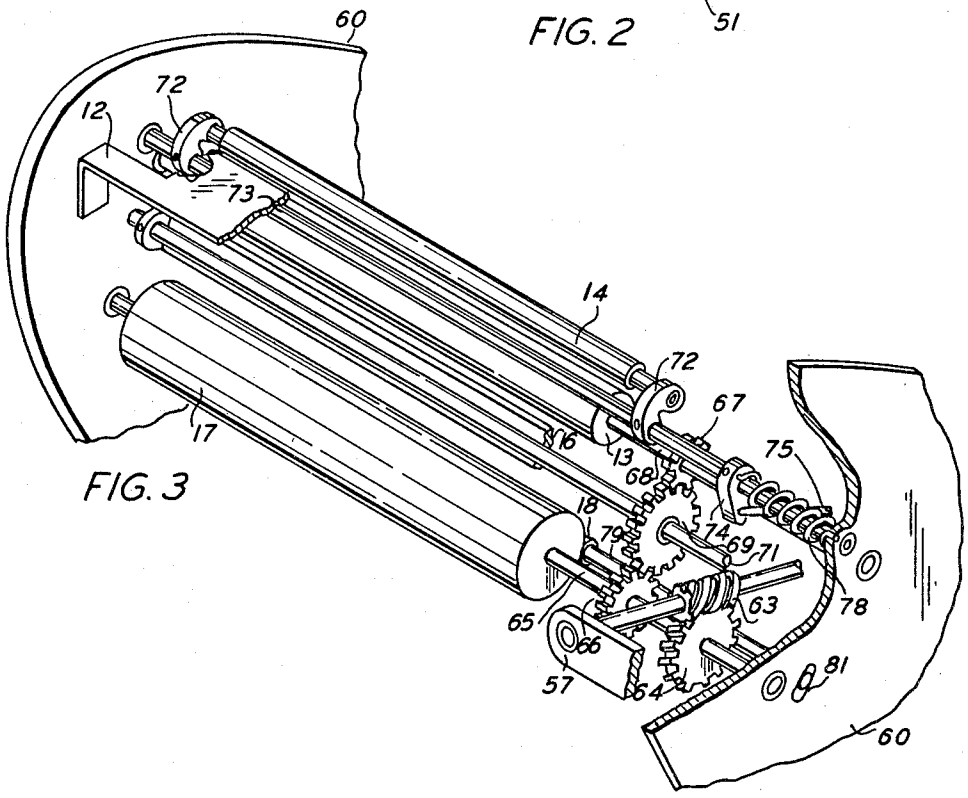



FIG. 3

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TONER DISPENSER DRIVE MECHANISMS

Filed Dec. 23, 1960 3 Sheets-Sheet 3

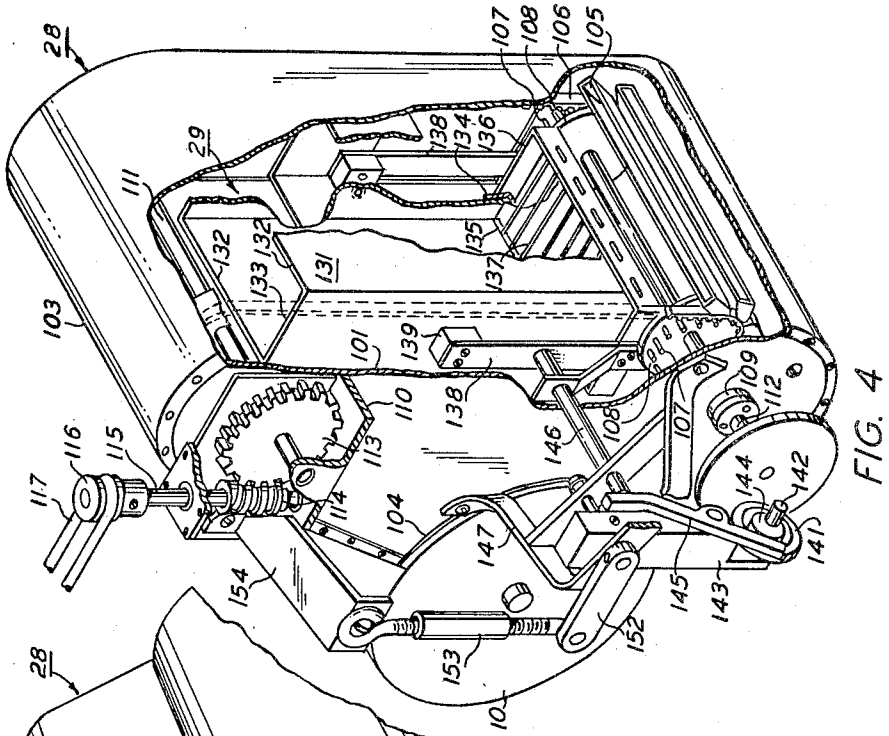



FIG. 4

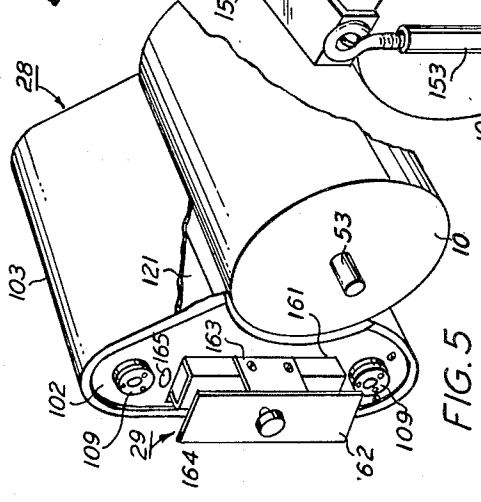



FIG. 5

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United States Patent Office 3,095,325 Patented June 25, 1963



3,095,325

# TONER DISPENSER DRIVE MECHANISMS

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Filed Dec. 23, 1960, Ser. No. 85,947
5 Claims. (Cl. 118—7)

This invention relates to improvements in apparatus for dispensing powder or granulated material, and, particularly, to improvements in xerographic toner dispensing drive apparatus.

More specifically, the invention relates to an improved toner dispenser drive apparatus that is particularly adapted for use in a xerographic developing apparatus wherein, in order to develop the electrostatic latent image formed on a xerographic plate, it is required to dust the image with a developer powder, whereby the powder particles are selectively attracted to the charged areas of the plate to form a visible powder particle image of the electrostatic latent image.

In the process of xerography, for example, as disclosed in Carlson Patent 2,297,691, issued October 6, 1942, a xerographic plate, comprising a layer of photoconductive insulating material on a conductive backing, is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the plate areas in accordance with the light intensity which reaches them and thereby creates an electrosatic latent image on or in the plate coating.

Development of the image is effected with developers which comprise, in general, a mixture of a suitable pigmented or dyed electrostatic powder, hereinafter referred to as toner, and a granular carrier material, which latter functions to carry and to generate triboelectric charges on the toner. In addition, the granular material functions to provide mechanical control to the powder, or to carry the powder to an image surface and, simultaneously, to provide almost complete homogeneity of charge polarity. In the development of the image, the toner powder is brought into surface contact with the coating on the xerographic plate and is held thereon electrostatically in a pattern corresponding to the electrostatic latent image. Thereafter, the developed xerographic image is usually transferred to a support material to which it may be fixed by any suitable means.

In the mixture of toner particles and carrier material, the toner particles, which are many times smaller than the carrier particles, adhere to and coat the surface of the carrier particles due to the electrostatic attraction between them. During development, as the powder-coated carrier particle roll or tumble over the xerographic plate carrying an electrostatic latent image of opposite polarity to the charge on the toner, toner particles are pulled away from the carrier by the charged latent image and deposit on the plate to form a powder image, while the partially denuded carrier particles pass off the plate. As toner powder images are formed, additional toner particles must be supplied to the developer mixture in proportion to the amount of toner deposited on the plate.

If prints, made by the xerographic process, have heavy deposits of toner in image areas of good contrast and non-image areas have a gray veiling, the toner concentration in the developer mixture is too great. If the prints have low contrast images, the quantity of toner particles in the developer mixture is insufficient. Thus, in order continually to obtain prints of good quality, the quantity of toner powder in the developer mixture must be held reasonably constant by the addition of toner to the developer mixture



in proportion to the amount of toner deposited on the plate.

It is, therefore, the principal object of this invention to improve apparatus for dispensing powder or granulated material. Another object of this invention is to improve the operation of a toner dispensing drive system whereby accurately metered amounts of toner are added to the developer mixture in a xerographic machine in relation to the amount of toner used by the machine to make a xerographic copy. A further object of the invention is to improve powder dispenser drive apparatus whereby an automatic metering arrangement controls the rate of discharge from the dispenser.

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:

FIG. 1 illustrates with the right-hand cover removed and parts broken away, a preferred embodiment of a xerographic reproducing apparatus adapted for continuous and automatic operation;

FIG. 2 is a sectional view taken long line 2—2 of FIG. 1;

FIG. 3 is a right-hand perspective view of the front of the machine with parts of the frame broken away to show the document feed mechanism of the apparatus;

FIG. 4 is a right-hand perspective view or the developer mechanism with parts broken away to show the general arrangement of its structural elements;

FIG. 5 is a left-hand perspective view of the developer mechanism with the toner dispenser partly removed.

Referring now to the drawings, there is shown, a desk top xerographic reprducing machine used for producing xerographic reproductions from a moving original. The xerographic apparatus of the invention is adapted for installation, is a suitable, essentially light-tight enclosure or cabinet.

The enclosure, generally designated **1**, constructed in a conventional manner, includes a left-hand side plate **2**, a right-hand side plate (not shown) and a top cover plate **3** which also extends over the ends of the machine. The top cover plate is provided with a suitable ingress opening for copy, and openings are provided through which the copy and the reproduction can be discharged from the machine, and through which a supply of support material, such as paper or the like, can be inserted.

As shown in FIG. 1, the xerographic apparatus comprises a xerographic plate including a photoconductive layer or light-receiving surface on a conductive backing and formed in the shape of a drum, generally designated by numeral **10**, which is journaled in the frame to rotate in the direction indicated by the arrow to cause the drum surface sequentially to pass a plurality of xerographic processing stations.

For the purpose of the present disclosure, the several xerographic processing stations in the path of movement of the drum surface may be described functionally, as follows:

A charging station, at which a uniform electrostatic charge is deposited on the photoconductive layer of the xerographic drum; an exposure station, at which a 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 and thereby form a latent electrostatic image of the copy to be reproduced;

A developing station, at which a xerographic developing material including toner particles having an electrostatic charge opposite to that of the electrostatic latent image are cascaded over the drum surface, whereby the toner particles adhere to the electrostatic latent image to

form a xerographic powder image in the configuration of the copy to be reproduced;

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

A drum cleaning and discharge station, at which the drum surface is first charged and then 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.

In general, the charging apparatus or corona charging device **11** includes a corona discharge array of one or more discharge electrodes that extend transversely across the drum surface and are energized from a high potential source and are substantially enclosed within a shielding member.

Next subsequent thereto in the path of motion of the xerographic drum is an exposure station. This exposure station may be one of a number of types of mechanisms or members such as desirably an optical scanning or projection system or the like designed to project a line copy image onto the surface of the photoconductive xerographic drum from a suitable original.

In the embodiment shown, documents to be reproduced are fed in turn manually on the document receiving guide **12** between driven feed roller **13** and idler roller **14** which is periodically biased into frictional contact with feed roller **13** or a document sandwiched therebetween. When in feeding relation to each other, these rollers advance the document along guide **15** then across the illuminated gate **16** into the bite of document feed out rollers **17** and **18** which feed it along guide **19** to be discharged from the machine.

The document is illuminated by lamps **21** connected to a suitable source of power and mounted in front of light reflectors **22**. A lens **23** is mounted in the light path from the slotted light reflector to focus a flowing image onto the xerographic drum.

A light shield **24** adapted to protect the xerographic drum from extraneous light and to support the lens is positioned adjacent the drum surface. A slot aperture **25** in the light shield extends transversely to the path of movement of the light receiving surface of the drum to permit reflected rays from the document focused by the lens secured to the end of the light shield to be directed against a limited transverse area of the light-receiving surface as it moves past the slot aperture.

Adjacent to the exposure station is a developing station C in which there is positioned a developer apparatus **28** including a developer housing having a lower or sump portion for accumulating developer material. Mounted within the developer housing is a driven bucket-type conveyor used to carry the developer material previously supplied to the developer housing to the upper portion of the developer housing from where the developer material is cascaded over a hopper chute onto the drum.

As the developer material cascades over the drum toner particles of the developer material adhere electrostatically to the previously formed electrostatic latent image areas on the drum to form a visible xerographic powder image; the remaining developer material falling off the peripheral surface of the drum into the bottom of the developer housing. Toner particles consumed during the developing operation to form the xerographic powder images are replenished by a toner dispenser **29**, of the type disclosed in copending Hunt application, Serial No. 776,976, filed November 28, 1958, now Patent No. 3,013,703, mounted within the developer housing.

Positioned next adjacent to the developing station is the image transfer station which includes suitable sheet feeding mechanism adapted to feed sheets of paper successively to the xerographic drum in coordination with the presentation of the developed image on the drum at the transfer station. The sheet feeding mechanism includes a sheet source such as tray **31** for a plurality of sheets of a suitable support material, that is, sheets of paper or the like, separating means **32** adapted to feed the top sheet of the stack of suport material to a sheet conveyor mechanism **34** having paper grippers **35** thereon which carry the sheet support material into contact with the rotating xerographic drum in coordination with the appearance of a developed image at the transfer station.

The transfer of the xerographic powder image from the drum surface to the support material is effected by means of a corona transfer device **36** that is located at or immediately after the point of contact between the support material and the rotating xerographic drum. The corona transfer device **36** is substantially similar to the corona discharge device that is employed at the charging station in that it also includes an array of one or more corona discharge electrodes that are energized from a suitable high potential source and extend transversely across the drum surface and are substantially enclosed within a shielding member. In operation, the electrostatic field created by the corona transfer device is effective to tack the transfer material electrostatically to the drum surface and simultaneously with the tacking action, the electrostatic field is effective to attract the toner particles comprising the xerographic powder image from the drum surface and cause them to adhere electrostatically to the surface of the support material.

As the paper gripper mechanism continues to move forward in its closed circuit, it will strip the support material from the xerographic drum and carry it to a fixing device, such, for example, heat fuser **37**, whereat the developed and transferred xerographic powder image on the support material is permanently fixed thereto, the trailing edge of the support material being supported by guide **88** suitably mounted to extend between the chains of the sheet conveyor.

After fusing, the finished copy is preferably discharged from the apparatus at a suitable point for collection externally of the apparatus. To accomplish this there is provided a pair of delivery rolls **38** and **39** by means of which the copy is discharged from the machine through guide **40** after it is released by the gripper mechanism. Suitable cam means are provided at the receiving and delivery stations of the conveyor mechanism to actuate the paper gripper at these stations to receive or discharge a sheet of support material.

The next and final station in the device is a drum cleaning station whereat any powder remaining on the xerographic drum after the transfer step is removed.

To remove any residual powder remaining on the drum there is provided a brush **41** of such construction as to apply extremely light pressure to the surface of the drum to dislodge any powder particles that may adhere thereto. The brush is mounted on shaft **42** journaled within dust hood **43** that is formed to encompass approximately two-thirds of the brush area.

As shown As shown in FIGS. 1 and 2, the drum **10** is mounted on horizontal driven shaft **53** and the drum is positioned on the left-hand side of the machine, viewed from the front, with the xerographic components of the machine mounted around the drum.

Shaft **53** rotates in bearings **45** mounted in the flanged bearing housing **46** secured to frame plate **52** attached to base plate **51** and in the gear housing **47** attached to frame plate **52**. The free end or left-hand end of the shaft **53** is threaded to receive thumb nut **48** by means of which the notched hub of the xerographic drum is forced into driven engagement with the pin **49** fixed on the shaft.

A compound gear, including worm gear **54** and pinion gear **242** is secured to shaft **53** between the right-hand face of frame plate **52** and the gear housing **47**. The worm gear **54** is driven by worm **55** attached to one end of main drive shaft **56** which also carries at its opposite end a worm **63** to drive the document scanning mechanism described in detail hereinafter. The main drive shaft is

suitably journaled in the gear housing **47** and in bearing support **57** fixed to the right-hand frame plate **60** supporting the document scanning mechanism. Main drive shaft **56** is connected operatively to the motor **62** by belt **59**, which runs on pulleys **58** and **61** fixedly mounted on shaft **56** and on the end of the shaft of the motor **62**, respectively. The motor is connected to a source of electric power (not shown) and is controlled by switching means described hereinafter.

In general, electrostatic charging of the xerographic drum in preparation for the exposure step and the electrostatic charging of the support surface to effect transfer are accomplished by means of corona generating devices whereby an electrostatic charge is applied to the respective surface. Although any one of a number of types of corona generating devices may be used, a corona generating device of the type disclosed in Vyverberg Patent 2,836,725 is used for both the corona charging device **11** and the corona transfer device **36**, each of which is secured to a suitable frame element of the apparatus and connected to an electrical circuit, not shown.

The original or copy to be reproduced is inserted by the operator between a small pivoted start or idler roller **14** and the first driven roller **13**. The operator must push the paper between the rolls until the original is restrained by guide **15**. When the cycle is initiated, a cam **77** on the drum shaft causes the start or idler roller **14** to press the paper against the driven roller **13**. The leading edge of the original is driven across the scanning area and enters the nip of the second set of rollers or feed out rollers **17** and **18**. After the original enters the feed out rollers, the start or idler roller **14** raises and the trailing edge of the guide **15** comes in contact with the original to press it against gate **16** which acts as a backup plate.

The feed rollers of the document scanning mechanism are driven at a uniform speed to move a document to be scanned across the illuminated gate **16** in synchronism with the movement of the xerographic drum whereby a flowing image of the document is projected in proper registration upon the xerographic drum. To effect synchronous movement between the feed rollers and the xerographic drum, the same shaft used to drive the drum is also used to drive the rollers; that is, the shaft **56** is provided with a second worm **63** which engages the worm gear **64** fixed to the end of shaft **65** carrying the feed-out roller **17**. Equal lineal speed of the document feed roller **13** and and the feed-out roller **17** is affected by means of a gear **66** secured to shaft **65** which drives gear **67** fixed to the end of shaft **68** supporting the document feed roller **13** for rotation therewith, through idler gear **69** journaled on axle **71** fixed to the frame plates **60**. Axle **71** also has the gate **16** secured thereon.

Shaft **65** and **68** carrying feed-out roller **17** and document feed roller **13**, respectively, are suitably journaled in parallel relation to each other in the frame plates **60** attached to base plate **51** at the front of the machine.

To intermittently effect feeding of a document to be scanned, the idler roller **14** is journaled in one end of arms **72** which are secured at their opposite ends to a document feed control shaft **73** journaled in the frame plates **60**.

The document feed control shaft is periodically oscillated to bring the idler roller **14** into or out of feeding contact with the feed roller **13** or a document sandwiched therebetween, by lever arm **74** connected by link **75** to the cam follower lever **76** having a follower **84** riding on cam **77** secured to the drum shaft **53**. Cam follower lever **76** is pivotably secured intermediate its ends by a shoulder pin **214** to support **215**.

As the cam follower **76** rises on the cam **77**, the idler roller **14** is forced, against the biasing action of the coil spring **78**, out of feeding contact with the driven feed roller **13**, whereas on the fall of the cam follower, the coil spring will resiliently bias the idler roller into feeding contact with the driven feed roller.

Idler feed-out roller **18** is mounted on shaft **79** movably mounted in slots **81** formed at an angle of approximately 45 degrees from the vertical in the frame plates **60**, whereby the feed-out roller **18** is forced by gravity into peripheral contact with the feed-out roller **17**.

*Development System*

In order to effect development of the electrostatic latent image on the cylindrical xerographic plate, the developing system shown includes a developer apparatus **28** which coacts with the cylindrical xerographic plate or drum to form a development zone wherein the charged and exposed surface of the drum is developed to form a powder image of the copy.

For this purpose a developer housing is mounted adjacent to the xerographic drum to form the development zone. Mounted within the developer housing is a driven bucket-type conveyor used to carry the developer material previously supplied to the developer housing to the upper portion of the developer housing from where the developer material is cascaded over a hopper chute onto the drum. As the developer material cascades over the drum toner particles of the developer material adhere electrostatically to the previously formed electrostatic latent image areas on the drum, the remaining developer material falling off the peripheral surface of the drum onto the bottom of the developer housing. Toner particles consumed during the development operation to from the visible powder images are replenished by a toner dispenser **29** mounted within the developer housing.

Specifically, the developer assembly, generally designated **28**, includes a box-like developer housing having side walls **101** and **102** supporting an outer cover **103** attached thereto, these elements forming in the lower portion thereof a reservoir for developer material. As shown in FIGS. 4 and 5 the side walls are formed with a concave edge portion in conformity with the shape of a xerographic drum to permit the developer housing to be positioned closely adjacent to the xerographic drum, seals **104** being attached to the concave edge portions of the side walls to ride against the peripheral surface of the drum **10**.

A suitable bucket-type conveyor is used to convey developer material from the reservoir portion of the developer housing to the upper portion of the developer housing from where it is cascaded over the xerographic drum. In the embodiment disclosed the bucket-type conveyor consists of a series of parallel spaced buckets **105** secured as by rivets to a pair of endless conveyor belts **106** wrapped around the pins **107** of the conveyor drive pulleys **108** secured to drive shaft **111** and driven shaft **112**, respectively, to rotate therewith.

The drive shaft **111** of the conveyor is journaled in bearings **109** mounted on the side walls of the developer housing with its left-hand end, as seen in FIG. 4, to which gear **113** is attached extending beyond side wall **101** into gear box **110** fastened to the side wall **101**. Gear **113**, on the drive shaft is driven by worm **114** fixed on vertical shaft **115** suitably journaled in the gear box **110**.

Shaft **115** is connected operatively to motor **62** by belt **117**, which runs on pulley **116** and compound pulley **118** fixedly mounted on shaft **115** and on the shaft of the motor **62**, respectively.

The driven shaft **112** of the conveyor is also journaled in a pair of bearings **109** mounted on the side walls of the developer housing, with the axis of driven shaft **112** positioned in spaced parallel relation to the axis of drive shaft **111**. The driven shaft has fixed on one end thereof a circular drive disc **119** which acts as a vertical turntable on which the driven wheel for actuating the toner dispenser **29** rotates as described hereinafter.

To deflect the developing material and to spread this material across the face of the drum as the developing material is emptied out of the conveyor buckets by gravity,

there is provided, as seen in FIG. 1, a flanged hopper chute **121** secured to the side walls of the developing housing. As the xerographic drum rotates, developing material tumbled over the flanged hopper chute onto the drum will cascade over the drum and eventually fall off or be thrown off the surface of the xerographic drum to fall into the reservoir portion of the developer housing.

For supporting the developer housing in a position adjacent to the xerographic drum there is secured to the side walls of the developer housing suitable supports **122** which are mounted on the base plate.

Referring now to the subject matter of the invention, as the developing mixture is cascaded over the xerographic drum, toner particles are electrostatically pulled away from the carrier component of the developer material and deposited on the drum to form xerographic powder images, while the partially denuded carrier particles pass off the drum into the reservoir. As toner powder images are formed, additional toner particles must be supplied to the developing mixture in proportion to the amount of toner deposited on the drum. To supply additional toner particles to the developer mixture, a toner dispenser **29**, of the type disclosed in the previously referred to Hunt application Serial No. 776,976, is used to accurately meter toner to the developer mixture.

The toner dispenser consists of a hopper or container **131** for the toner particles to be dispensed. Although the hopper or container may be made in any size or shape, the hopper shown is formed as a rectangular open-ended box having vertical side walls **132** and end walls **133**.

The bottom of the hopper is partially closed by dispensing plate or platform **134** positioned in spaced vertical relation below the lower edges of the walls of the hopper. The dispensing plate or platform, which is as wide as the hopper, has upturned end portions by means of which the dispensing plate is suitably attached to the end walls of the hopper. The dispensing plate or platform combines with the walls of the hopper to provide a reservoir having narrow elongated outlet slots or passages **135** for the flow of toner particles.

To effect substantially uniform flow of toner particles through the outlets or passages there is provided a metering element, having a dispensing grid; positioned for reciprocating motion in the space between the dispensing plate and the lower edges of the walls of the hopper. The metering element, as shown, consists of an open-ended box **136** having end walls and side walls larger than the walls of the hopper, the dispensing grid, in the embodiment shown, being formed of a continuous strand of wire **137** laced from one side wall to the other for the full length of the box.

Springs **138**, depending normally in a vertical position from spacers **193** secured to the end walls of the hopper, are attached at their lower ends to the end walls of the metering element to support the latter for substantially reciprocating movement in relation to the toner hopper. Actually, the path of motion of the metering element describes a slight arc, but since the radius of this arc, as determined by the length of each spring working as if pivoted about the line at which it is attached to the spacers, is so large as compared to the length of travel of the metering element, it can be considered that the metering element moves in substantially a straight line.

The rate at which toner is consumed in the developing operation depends both on the amount of developer material cascaded onto the drum for development of the electrostatic latent image and on the area of the electrostatic latent image to be developed. The rate at which developer material is cascaded onto the drum, for a given size of developer buckets, depends on the speed of operation of the developer conveyor which is usually fixed at a given rate dependent upon the speed of rotation of the xerographic drum. To correlate the dispensing rate of the toner dispenser with respect to the speed of operation of the developer conveyor, the toner dispenser is driven by a drive transmission of the type wherein rotation is imparted from a drive disc to a driven disc as a consequence of frictional engagement between the periphery of one disc and the face of the other disc and wherein an eccentric linkage is driven by the driven disc to actuate the metering element of the toner dispenser. The position of the driven disc on the drive disc may be varied by an operator to increase or decrease the toner dispensing rate, as required, to compensate for the variations in the electrostatic latent image areas being developed.

The driven disc **141**, having a peripheral surface of rubber or like material is rotatably mounted on shaft **142** fixed to the lower end of control lever **143**. The driven disc is rotated by frictional contact with drive disc **119** to rotate cam **144**. Cam **144** is formed either integrally with the wheel as shown, or as a separate element attached thereto. Both the driven disc **141** and the cam **144** are retained on shaft **142** by means of a retaining ring **149** positioned in a suitable groove formed in the shaft. Cam follower arm **145**, pivotally mounted on the control lever **143**, is oscillated upon rotation of the cam **144** to effect a forward stroke of the plunger **146**. Plunger **146** is movably mounted in apertures formed in the lower cross member of a frame, **147**, fastened to the side wall **101** of the developer housing, and in the guide **148** connected to the left-hand spring **138** as seen in FIG. 4.

One end of the plunger **146** butts against the cam follower arm and its other end butts against the left-hand spring **138** so that the forward stroke of the plunger is effected by movement of the cam follower arm in one direction and the return stroke of the plunger is effected by the biasing action of the springs **138** as they return to their normal vertical position. This biasing action also forces the follower portion of the cam follower arm **145** against the cam **144**.

A control lever **143** carrying the driven disc **141** rotatably mounted on shaft **142** is fixed on rod **151** journaled in the cross members of the frame **147** to permit the driven disc to be moved edgewise parallel to the face of drive disc **119** to enable the speed of rotation imparted to the driven disc **141** and therefore cam **144** to be changed. Movement of control lever **143** is effected by means of a lever **152** secured at one end to the rod **151** and secured at its opposite end to the lower screw element of turnbuckle **153** secured to bracket **154** attached to the gear box **110**. With this arrangement, the position at which the driven disc contacts the face of the drive disc may be varied while the machine is in operation to increase or decrease the rotational speed of the driven disc with corresponding increase or decrease in the number of strokes per unit of time of the metering element of the toner dispenser.

As shown in FIG. 5, the toner dispenser is movably supported within the developer housing and is inserted therein through an opening **161** formed in the side wall **102**. A cover **162** of a size larger than the opening **161** in the side wall is attached by side extension plates **163** formed thereon to the toner dispenser for supporting it within the developer housing. The cover **162**, forced against the side wall **102** by fasteners **163** adjustably mounted on the side wall, prevents the toner dispenser from moving axially within the developer housing. A handle **164** is secured to the cover **162** to permit the toner dispenser to be withdrawn from the developer housing when desired.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

What is claimed is:

1. In a developing apparatus for developing an electrostatic latent image formed on a xerographic drum

wherein the developing apparatus includes a developer housing having a sump portion for developer material, a bucket-type conveyor mounted within the developer housing, a drive connected to the conveyor to operate the conveyor at a predetermined speed to convey a developer material to the upper portion of the developer housing where it is cascaded onto the drum, and wherein a toner dispenser is positioned within the developer housing, the toner dispenser including a metering element to dispense metered quantities of toner to the developer material;

the improvement comprising a variable speed drive connected between the conveyor and the metering element of the toner dispenser whereby to vary the rate at which toner is dispensed to the developer material,

the variable speed drive including a circular drive disc rotated at constant speed about an axis by said bucket-type conveyor drive,

a driven wheel,

a cam connected to said driven wheel for rotation therewith,

a control lever pivotally connected to said developer housing,

said driven wheel and said cam being rotatably supported by said control lever to rotate about an axis at right angles to the axis of said circular drive disc with the peripheral surface of said driven wheel in frictional contact with said drive disc,

said control lever permitting the position of said driven wheel on said circular drive disc to be varied with respect to the axis of rotation of said circular drive disc to vary the rotative speed of said driven wheel and therefore said cam with respect to the speed of said circular drive disc,

and cam follower means operatively connected at one end to said cam and at its other end to said toner dispenser for effecting operation of said toner dispenser.

2. In a developing apparatus for developing an electrostatic latent image formed on a xerographic drum wherein the developing apparatus includes a developer housing having a sump portion for developer material, a bucket-type conveyor mounted within the developer housing, a drive connected to the conveyor to operate the conveyor at a predetermined speed to convey a developer material to the upper portion of the developer housing where it is cascaded onto the drum, and wherein a toner dispenser is positioned within the developer housing, the toner dispenser including a metering element to dispense metered quantities of toner to the developer material;

the improvement including a drive disc rotated by said conveyor drive,

a driven disc,

a control lever rotatably supporting said driven disc, said control lever being pivotally connected to the developer housing and positioned with respect to the drive disc whereby the peripheral surface of said driven disc is in frictional driven engagement with the face of said drive disc,

adjusting means connected to said control lever to pivot the control lever to move the driven disc in a path substantially parallel to the face of said drive disc,

and means operatively connecting the metering element of the toner dispenser to said driven disc whereby said metering element is actuated by said driven disc.

3. In a developing apparatus for developing an electrostatic latent image formed on a xerographic drum wherein the developing apparatus includes a developer housing having a lower sump portion for developer material,

a conveyor mounted within the developer housing,

a drive connected to the conveyor to operate the conveyor at a predetermined speed to convey developer material to the upper portion of the developer housing to be discharged from the conveyor onto the xerographic drum, and wherein a toner dispenser is mounted on the developer housing, the toner dispenser including a metering element to dispense metered quantities of toner to the developer material;

the improvement comprising a variable speed drive connected between the conveyor and the metering element of the toner dispenser whereby to vary the rate at which toner is metered to the developing material,

the variable speed drive including a drive disc rotated at constant speed with respect to said conveyor by said conveyor drive,

a driven disc,

mounting means rotatably mounting said driven disc with the periphery of said driven disc in frictional engagement with the face of said drive disc and for edgewise swinging movement in a path parallel to the face of said drive disc about an axis parallel to the axis of rotation of said drive disc to enable the speed of rotation imparted to said driven disc to be changed,

a cam operatively connected to said driven disc for rotation therewith,

and cam follower means operatively connected at one end to said cam and at its other end to the metering element of the toner dispenser for effecting operation of said toner dispenser as said cam follower is actuated by said cam.

4. In a developing apparatus for developing an electrostatic latent image formed on a xerographic drum wherein the developing apparatus includes a developer housing having a lower sump portion for developer material,

a conveyor mounted within the developer housing,

a drive connected to the conveyor to operate the conveyor at a predetermined speed to convey developer material to the upper portion of the developer housing to be discharged from the conveyor onto the xerographic drum, and wherein a toner dispenser is mounted on the developer housing, the toner dispenser including a metering element to dispense additional toner to the developer material;

the improvement comprising a variable speed drive connected between the conveyor and the metering element of the toner dispenser whereby to vary the rate at which toner is metered to the developing material,

the variable speed drive including a drive disc rotated by said conveyor drive,

a driven disc,

a control lever rotatably supporting said driven disc with the periphery of said driven disc in frictional engagement with the face of said drive disc whereby said driven disc is rotated by said drive disc,

said control lever being mounted on said developer housing for pivotable movement about an axis parallel to the axis of rotation of said drive disc whereby said driven disc is adapted for movement in a path parallel to the face of said drive disc to enable the speed of rotation imparted by said drive disc to said driven disc to be changed,

and cam means operatively connecting said driven disc to the metering element of the toner dispenser whereby said metering element is actuated in accordance with the rotative speed of said driven disc.

5. In a developing apparatus for developing an electrostatic latent image formed on a xerographic drum wherein the developing apparatus includes a developer housing having a lower sump portion for developer material,

a conveyor mounted with the developer housing,

a drive connected to the conveyor to operate the conveyor at a predetermined speed to convey developer

material to the upper portion of the developer housing to be discharged from the conveyor onto the xerographic material, and wherein a toner dispenser is mounted on the developer housing, the toner dispenser including a movable metering element to dispense additional toner to the developer material;

the improvement comprising a variable speed drive connected between the conveyor and the metering element of the toner dispenser whereby to vary the rate at which toner is metered to the developing material,

the variable speed drive including a drive disc rotated by said conveyor drive,

a control lever pivotally connected to the developer housing,

a driven disc rotatably mounted on said control lever, said control lever supporting the driven disc for movement in a path parallel to the face of said drive disc about an axis parallel to the axis of rotation of said drive disc with the periphery of said driven disc in frictional engagement with the face of said drive disc to enable the speed of rotation imparted to said driven disc to be changed,



a cam operatively connected to said driven disc for rotation therewith,

and a cam follower pivotably mounted on said control lever and operatively connected at one end to said cam and at its other end to the metering element of the toner dispenser for effecting operation of said metering element as said cam follower is actuated by said cam.

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