

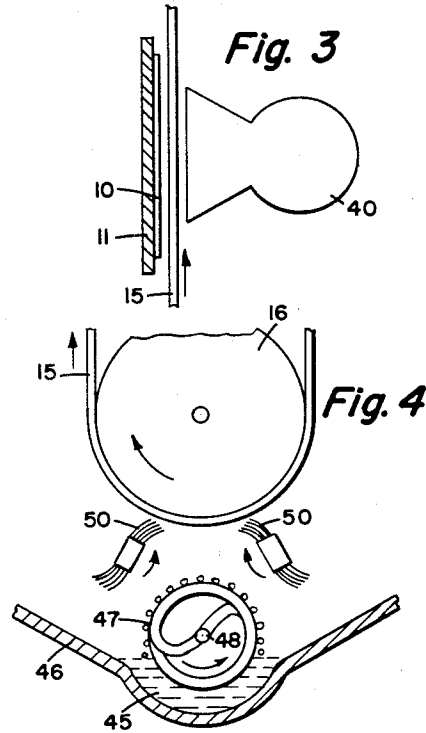
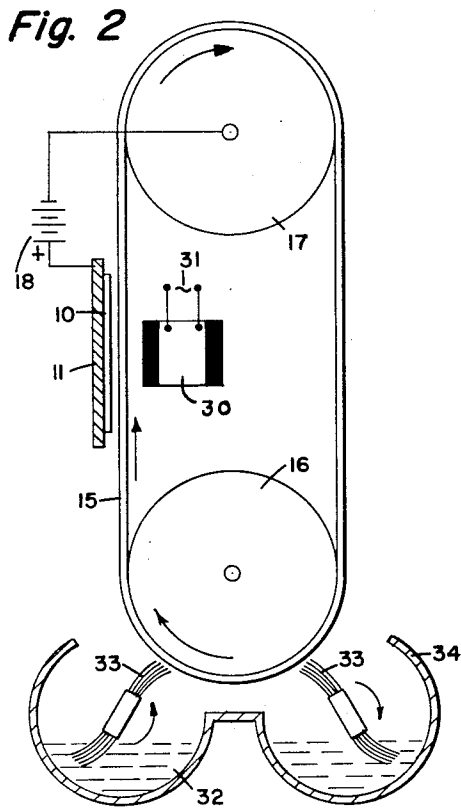
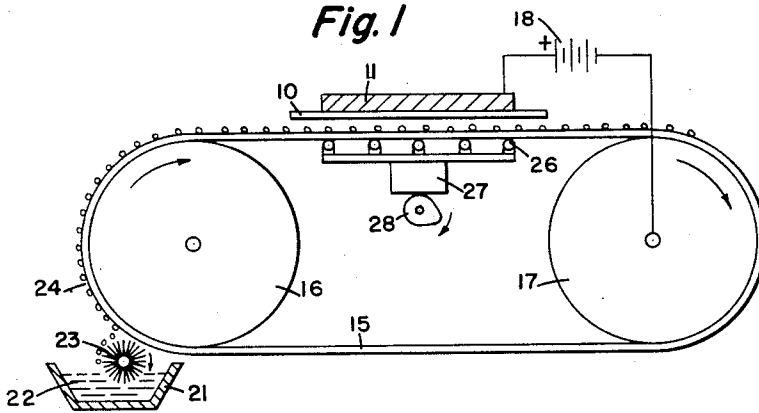
July 7, 1964

W. C. YORK

3,140,199

VIBRATING BELT POWDER CLOUD GENERATOR FOR XEROGRAPHY

Filed April 28, 1961



WILLIAM C. YORK
INVENTOR.

BY *R. Frank Smith*
F. M. Emerson Holmes

ATTORNEYS

1

3,140,199

VIBRATING BELT POWDER CLOUD GENERATOR FOR XEROGRAPHY

William C. York, Rochester, N.Y., assignor to Eastman Kodak Company, Rochester, N.Y., a corporation of New Jersey

Filed Apr. 28, 1961, Ser. No. 106,202
7 Claims. (Cl. 118—637)

This invention relates to xerographic developing equipment and particularly to apparatus for applying xerographic toner to an imagewise electrostatically charged surface.

Many systems and types of apparatus have been developed for applying toner to electrostatic images on the surfaces of photoconductors which have been exposed to light. There is in all of these the problem of producing uniformity of development, adequate density in the charged areas, zero density in the background or uncharged areas and freedom from dust and dirt.

The object of the present invention is to overcome all such difficulties. Triboelectric toner powders are commonly used in xerographic processes since they become charged merely by agitation or rubbing and this charge is utilized in the toning or developing step. The present invention utilizes the triboelectric charge for two other purposes. The present invention employs a belt conveyor and the triboelectricity is used to make the powder adhere to the belt uniformly for conveyance to the developing station. Secondly this triboelectric charge creates an adherence of the toner to the belt which must be overcome (primarily by agitation as discussed below) if the field created by the imagewise charge on the photoconductive surface is to be effective in forming an image. These opposing effects insure uniformity so that toner does not tend to transfer to the background area of the image.

However, this triboelectric adherence of the toner to the belt might introduce non-uniformity since some toner particles would be in direct contact with the belt and others would be spaced slightly therefrom. Any lack of uniformity thus created is overcome, according to the present invention by mechanical vibration or agitation of the belt right at the developing station. This mechanical agitation may be provided by rollers contacting the back of the belt, where such rollers are caused to vibrate rapidly by a high speed rotating cam. A horn emitting sound or ultrasonics impinging against the back of the belt constitute another form of belt vibrator. In preferred embodiments of the invention the belt contains a ferromagnetic material such as a layer of iron or may consist of iron. In this case the vibration is provided simply by an electromagnet connected to an A.C. source.

The belt with the toner powder may pass through the developing and vibrating station at any angle such as horizontally or preferably vertically. The toner is applied to the belt by a system including one or more brushes and means for agitating or stirring the toner powder in the supply bin. The brush itself may act as the toner agitating means or the toner may be kicked up by one member such as a rotating helix and transferred to a brush which in turn transfers it to the belt so that the toner on the belt is fully triboelectrically charged and held to the belt solely by this charge. Brushes and rotating helices for application of toner particles from a bin to a surface are known.

Two special modifications of the toner applicator warrant mention although they are not essential to the present invention. In one case a friable cake of toner is ground or scrubbed by an abrasive drum which grinds off toner particles and applies them to the conveyor belt. In the other case, the conveyor belt itself is abrasive and

2

grinds off the toner from the friable cake and carries it to the developing station. Either system works well with the conveyor belt required by the present invention.

The essential feature of the invention is the mechanical vibration of the belt at the developing station, sufficient to overcome the triboelectric attraction between the toner and the belt. It should be noted that the toner is moved to the developing station without the use of air pressure, which is one of the commonest causes of dust, since the air pressure tends to spread toner unduly throughout any developing machine. Other advantages and the principle of the invention will be fully understood from the following description when read in connection with the accompanying drawing in which:

FIG. 1 schematically illustrates one preferred embodiment of the invention.

FIG. 2 similarly illustrates another preferred embodiment of the invention.

FIG. 3 illustrates an alternative form of mechanical vibration and,

FIG. 4 illustrates a preferred form of toner applicator.

In FIG. 1 a xerographic sheet 10 which has been charged and exposed so as to have an electrostatic image on the surface thereof is held by means (not shown) against a metal plate 11. A belt 15 of metal or plastic is moved by rotating drums 16 and 17 immediately below the xerographic sheet 10 and carries toner particles 24 to the developing station at which the sheet 10 is located. The choice between metal and plastic affects the type of development. So called "solid area" development without edge effects occurs when the belt is conducting or is insulating and backed by a conductor. "Fringe" development (more pronounced at the edges of image areas) occurs when the belt is insulating and not backed by a conductor.

The toner is applied from a bin 21 containing loose particles 22 of toner, by means of a rotating brush 23 to the surface of the belt 15 which moves above the brush 23. The brush 23 tends to stir the powder 22 so as to create triboelectric charges and due to these charges only, the powder adheres to the belt 15. Two devices are here used to insure transfer of the toner particles 24 to the charged area of the image 10. One of these is an electrostatic bias between the belt and the backing plate 11, which bias is provided by a source of potential indicated schematically at 18. This first feature is optional and the bias when used may be of either polarity depending upon the toner polarity and upon whether the toner is to be deposited in the charged or uncharged areas of electrostatic image. The triboelectric adherence of the powder to the belt 15 is overcome or reduced to a small uniform amount of attraction by means of transverse rods or rollers 26 contacting the back of the belt 15 at the development station. These rollers 26 are supported at their edges by a mount 27 which moves rapidly up and down by the operation of a cam 28 which is rotated rapidly by means of a motor (not shown). This simple mechanism gives excellent prints with clean highlights and with a minimum of dust and smoke.

The slightly more sophisticated apparatus shown in FIG. 2 has been found to give even greater uniformity with a minimum of variations and a minimum of maintenance difficulties over long periods of time. In the arrangement shown in FIG. 2 the belt 15 is of fairly stiff but still flexible sheet iron. The vibration at the toning station is provided simply by an electromagnet 30 powered from an A.C. source indicated schematically at 31. This causes the belt to vibrate and reduce or overcome the triboelectric attraction of the powder to the belt. A uniformly controlled amount of powder transfers to the desired areas of the xerographic sheet 10. In this FIG. 2, the toner particles 32 are agitated by relatively soft

3

brushes 33 which rotate deep into the toner particles and carry toner to the bottom of the belt 15. The container 34 for the toner consists of two, more or less cylindrical, sections shaped to insure a high degree of agitation of the toner as the brushes are rotated. The distance of the brushes 33 from the belt 15 is adjusted to give the desired thickness of toner particles on the belt 15.

FIG. 3 schematically illustrates the use of a mechanically operated horn 40 driven by a motor not shown, which horn causes fairly intense sound waves to impinge across the back of the belt 15 at the toning station. Actually all of the forms of the invention tend to create some sound and it is preferable to have some sound insulation in the housing of the machine, but the intensity of the sound need not be very high and the 60 cycle hum produced by the arrangement shown in FIG. 2, for example, is not objectionable. Even lower frequencies are employed in the arrangement shown in FIG. 1 so that the only audible sound is the noise set up by the mechanical moving parts rather than the intended frequencies of this motion itself.

In FIG. 4 the bin of toner particles 45 is cylindrically shaped with extended sides to catch any falling toner particles. The toner in the bin is continuously agitated by rotating a helix or spring shaped member 47 about its axis 48. Sometimes the helical member is made with a reverse pitch at the center and is turned so that the toner tends to be driven from the ends to the center of the cylindrical bin. This metal helix 47 does pick up some particles primarily by the triboelectric charge and these particles are transferred by rotating brushes 50 to the surface of the belt 15. The two stages of application of the toner each of which requires triboelectric charge, insures that the particles applied to the belt 15 and hence conveyed to the toner station are only those so charged.

Having thus described various preferred embodiments of my invention I wish to point out that it is not limited thereto but includes modifications thereof within the scope of the appended claims.

I claim:

1. In a xerographic developing machine, a toner applicator comprising means for supporting an electrostatically

4

charged layer to be developed, a flat belt with a section thereof in an area close to and parallel to said layer when so supported, means remote from said area for triboelectrically loading said belt with toner powder, means for moving said belt for carrying triboelectrically held toner powder to said area close to said layer and means positioned adjacent to said area and on the opposite side of said belt from said layer for vibrating said section of said belt in said area.

2. An applicator according to claim 1 in which said belt is metal.

3. An applicator according to claim 1 in which said electrostatically charged layer is supported in a substantially vertical plane.

4. An applicator according to claim 1 in which the means for triboelectrically loading said belt consists of a bin of toner powder, means for agitating the powder in said bin and brushes transferring toner powder from the bin to the belt.

5. An applicator according to claim 1 in which said belt contains iron and in which said vibrating means includes A.C. operated electromagnets.

6. An applicator according to claim 1 in which said vibrating means consists of a source of sound for impinging sound waves on the side of said belt away from said electrostatically charged layer.

7. An applicator according to claim 1 in which said vibrating means consists of mechanically vibrating rods contacting the surface of said belt facing away from said electrostatically charged layer.

References Cited in the file of this patent

UNITED STATES PATENTS

2,276,328	Melton et al. -----	Mar. 17, 1942
2,376,343	Carlton -----	May 22, 1945
2,748,746	Wommelsdorf -----	June 5, 1956
2,829,025	Clemens et al. -----	Apr. 1, 1958
2,895,847	Mayo -----	July 21, 1959
2,901,374	Gundlach -----	Aug. 25, 1959
2,902,974	Greaves -----	Sept. 8, 1959
2,910,963	Herman -----	Nov. 3, 1959
3,013,890	Bixby -----	Dec. 19, 1961