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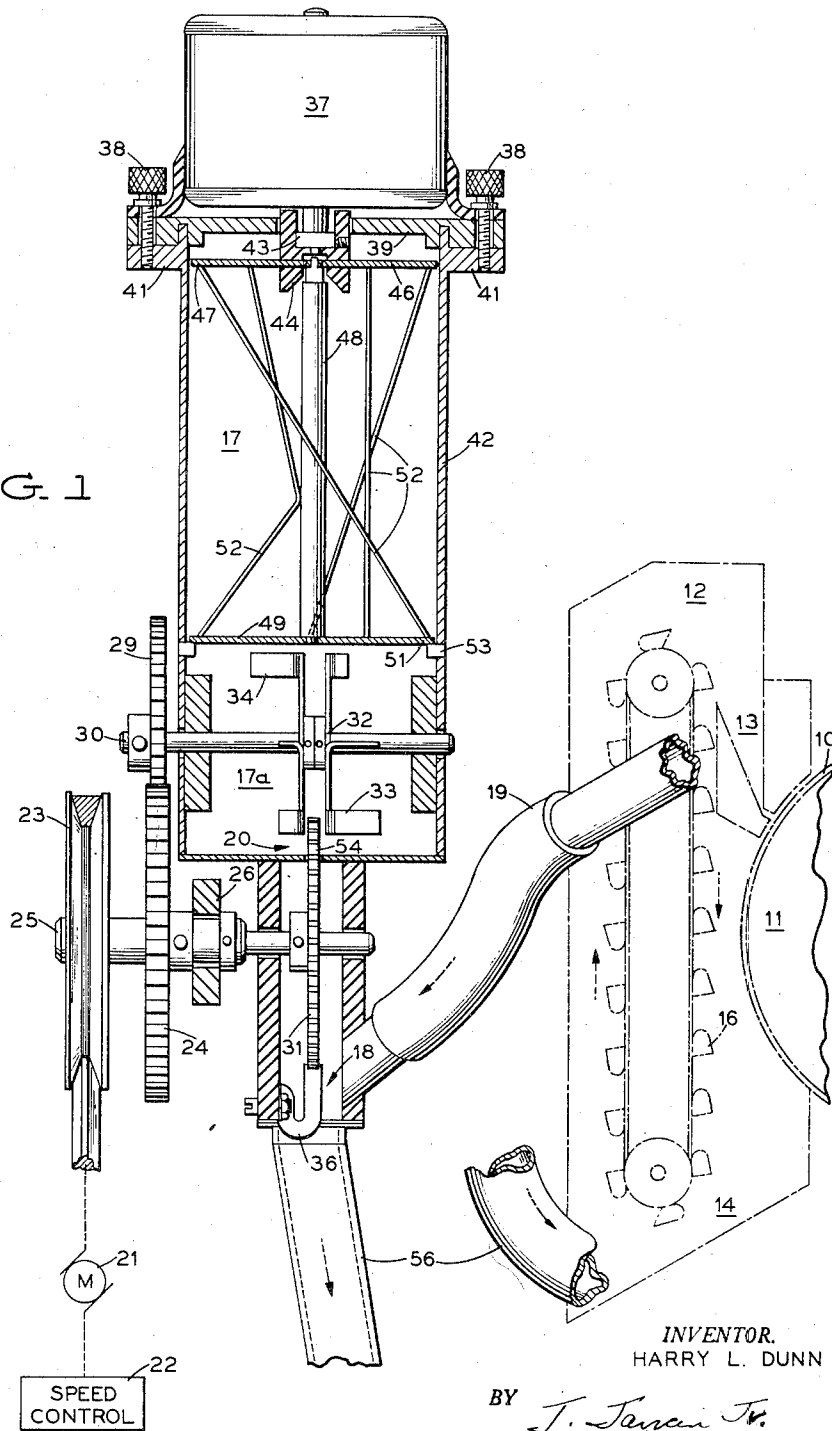
2,779,306

ELECTROSCOPIC TONER METERING DEVICE

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2 Sheets-Sheet 1

FIG. 1



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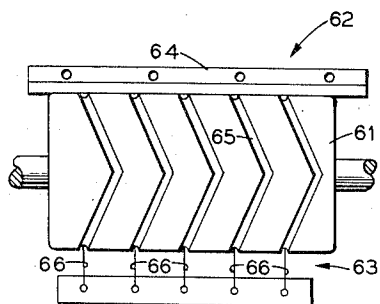
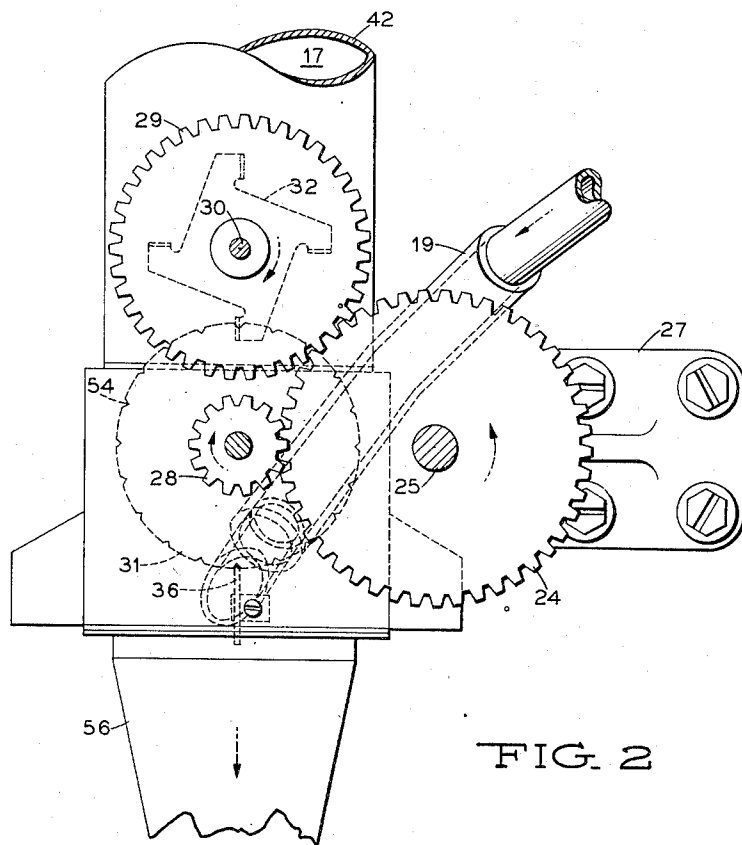
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ELECTROSCOPIC TONER METERING DEVICE

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4 Claims. (Cl. 118—303)

This invention relates to a device for dispensing metered quantities of electroscopic toner and the like, and has for its broad object the provision of means associated with a xerographic printer, whereby good quality xerographic printing may be effected.

Another primary object of this invention is to provide a device for metering accurate quantities of electroscopic toner to xerographic developer being used in a xerographic printer.

In line with the foregoing, another object of this invention is to provide a continuously operating variable quantity electroscopic toner dispensing device.

A still another object of this invention is to provide a device for dispensing electroscopic toner to xerographic developer by flushing metered quantities of toner from the toner outlet port of this device with the xerographic developer.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of examples, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a front elevation, with parts in section, of the electroscopic toner dispensing device.

Fig. 2 is a side elevation of a portion of the dispensing device.

Fig. 3 is a view of a toner metering wheel having herringbone type grooves on the surface thereof.

As is brought out in some detail in Walkup Patent No. 2,618,551 and Wise Patent No. 2,618,552, both of which issued on November 18, 1952, electroscopic toner is, in general, a finely-divided resinous powder capable of being attracted to and held by electrical charges stored on the surface of xerographic plates or so-called electroplates. The electroscopic toner is combined with a granular carrier material consisting of a core such as glass or steel beads, for example, covered with, and encased in, a suitable covering which imparts the necessary triboelectric properties (the electrification by contact of two materials having different electron affinities) to the granular carrier material, to form xerographic developer. This xerographic developer may be used in a printing machine of the type shown and described in Schaffert Patent No. 2,576,047 which issued on November 20, 1951, by cascading the developer from an upper hopper over the electroplate on the xerographic printer drum, to a lower xerographic developer reservoir. The granular carrier material in the xerographic developer does not adhere to either the charged or the uncharged areas of the cylindrical electroplate on the xerographic printer drum, whereas the electroscopic toner particles which are carried by the afore-mentioned carrier material, are attracted to and retained by electrically charged electroplate areas. A bucket conveyor similar to the one shown in Fig. 2 of the Bower Patent No. 2,375,191, issued on May 8, 1945, may be used with the afore-mentioned Schaffert patent

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printer for carrying xerographic developer from the reservoir to the hopper in order to keep an adequate supply of developer in the hopper.

It should be apparent at this time that as a xerographic printing operation continues, the quantity of electroscopic toner in the xerographic developer is decreased because it is the toner which goes to make up the imprint on the xerographically printed record. Inasmuch as it is the toner which goes to make up the printed record, it should also be apparent that to maintain an imprint of good quality it is necessary to replenish the supply of electroscopic toner as it is decreased. It might be well to point out at this time that the balance between the quantity of electroscopic toner and the carrier in the xerographic developer must be carefully maintained lest an insufficient quantity of toner cause a light imprint and an overabundance of toner cause a dark imprint with streaked background. It has also been found by actual tests that the rate of addition of electroscopic toner with respect to a given quantity of carrier must be increased as the xerographic developer is used. There are several reasons for this fact; one being that the carrier acquires a toner film which reduces the developer efficiency.

Those persons familiar with this phase of the graphic arts, i. e., xerographic printing, are aware that electroscopic toner is extremely difficult to handle because it is a tacky substance, and because the toner particles per se are extremely small, i. e., approximately 2 to 20 microns in diameter. As a result, electroscopic toner is not only hard to handle generally, it is extremely difficult to dispense in accurately metered quantities.

General description

The relationship between the electroscopic toner dispensing device and a drum type xerographic printer is shown diagrammatically in Fig. 1. Incremental areas of the electroplate 10 on the rotatable xerographic drum 11, are moved through an electrostatic latent image developing station 12 having an upper hopper 13 and a lower reservoir 14 for xerographic developer. A sufficient amount of developer is maintained in hopper 13 by the action of a bucket conveyor 16 which carries the developer upwardly from reservoir 14 to hopper 13. Developer is then caused to cascade from a suitable opening in hopper 13 over the surface of electroplate 10. Electroscopic toner in the cascading developer is caused to adhere to the charged areas of the electroplate, whereas excess toner and all of the carrier in the xerographic developer continues to cascade downwardly into the reservoir 14.

Toner which is to be added to the xerographic developer, is initially placed into chamber 17 (Fig. 1), wherefrom it is metered to a toner outlet port 18. In order to avoid having any, if not most, of the electroscopic toner remain in outlet port 18 so as to obstruct toner passage, xerographic developer from hopper 13 is fed via a connecting tube 19 back to outlet port 18 in order to flush away any toner accumulation at the outlet port. The toner so removed, i. e., by the flushing action, along with the developer from reservoir 13 doing the flushing, is directed to the reservoir 14 via a feed-back tube 56. It should also be mentioned here that the triboelectric affinity of the carrier for the new toner probably aids in carrying away the toner from outlet port 18.

Mechanical description

Referring to Fig. 1, an electric motor 21 having any suitable, conventional speed control apparatus 22 is operatively connected to a dispensing device drive pulley 23 via a belt. The pulley 23 and a drive gear 24 are each fixedly attached to a common shaft 25 for simultaneous rotation. This shaft is journaled in a supporting

flange 26 which is a part of the frame structure 27 (see also Fig. 2). As is shown, the drive gear 24 engages a pair of driven gears 28 and 29 each of which is used to drive a toner metering wheel 31 and a toner agitator 32, respectively. Thus, as the drive gear 24 is driven in a counterclockwise direction, the toner metering wheel 31 and agitator 32 are each driven in a clockwise direction.

The toner agitator 32 includes a plurality of paddles such as paddles 33 and 34, for example, which agitate the electroscopic toner particles in the lower section 17a of chamber 17 so as to assure the presence of a sufficient quantity of toner in the vicinity of upper portion of toner adding wheel 31, or at the toner inlet port 20. As is shown, the common shaft 30 to which driven gear 29 and agitator 32 are connected for rotation, is suitably journaled in the toner dispensing device frame structure. It should be brought out here for the sake of future reference that the expression "toner compartment" includes the toner inlet and outlet ports 20 and 18, respectively, and in fact covers all of the toner containing vessel above the outlet port 18.

The toner metering wheel 31 has a series of peripheral notches 54 (Fig. 2) for carrying the electroscopic toner from the toner inlet port in chamber 17a down and around to the resiliently, flexible scraping element 36 which is used to remove the toner being carried in each of the notches 54 in the metering wheel so that the toner may either drop into, or be flicked to, the toner outlet port 18. One end of element 36 is supported by the device frame structure, whereas the other end lies against the periphery of the wheel 31 over the toner carrying notches 54.

As mentioned previously, toner is initially placed into chamber 17 (Fig. 1). This is done manually by removing an electric motor assembly 37 which is normally held in place by a couple of thumb screws 38 each of which passes through a respective slot in a chamber top 39 for a screw type engagement with the threaded portions of a couple of corresponding ears 41. The circular chamber top 39 has an annular groove therein so that the top may be slipped onto the upper portion of the chamber wall 42.

A motor driven shaft attached collar 43 has fixedly attached thereto a bi-furcated drive element 44 which is arranged to straddle a rod 46 connected at each end to an upper cylindrical ring 47. In addition, this rod 46 is fixed to a toner mixer shaft 48 which, in turn, is fixed at the other end to a similar rod 49 connected at each end to a lower cylindrical ring 51, similar in all respects to the afore-mentioned ring 47. A plurality of irregularly shaped ribs 52 are spaced between, and connected to, different points on the cylindrical rings 47 and 51 in the manner shown in Fig. 1. The bottom ring 51 rests on a circular ledge 53 which actually supports the entire toner mixer assembly including ribs 52. Thus, when the motor in assembly 37 is operated, the bi-furcated element 44 causes the mixer assembly including ribs 52 and rings 46 and 51, to rotate on ledge 53. This rotating action tends to keep the quantity of electroscopic toner in chamber 17 broken up, and also provides for an adequate quantity of toner to be loosened for the feeding action by agitator 32. As mentioned previously, the rotating toner agitator 32 with its paddle wheels 33 and 34 causes a sufficient quantity of toner to be maintained in the proximity of the upper portion of toner metering wheel 31, i. e., the toner inlet port 20.

Each of the peripheral notches 54 (see also Fig. 2) carry toner from the toner inlet port 20 down and around to the resilient element 36 as mentioned previously. The toner carried in each of the notches 54 either drops downwardly into the outlet port 18 or may be flicked by the spring action of element 36 to the outlet port 18. In view of the inherently tacky property and small particle size of electroscopic toner, there is a tendency for this substance to accumulate at the outlet port to an extent

whereby the passage to tube 56 may be completely closed. This is prevented by the aforementioned flushing action due to the feedback of xerographic developer from hopper 13 to reservoir 14 via the tubes 19 and 56, and outlet port 18. That is, the developer cleanses the outlet port of any toner particles which might tend to remain in the vicinity of outlet port 18.

Should it be necessary to either increase or decrease the rate of electroscopic toner being metered to outlet port 18, the speed control apparatus 22 may be governed accordingly so that the toner metering wheel 31 may be driven either more slowly or more rapidly.

It has been found that the toner carrying notches in the toner metering wheel need not necessarily be normal, or even substantially so, to the direction of peripheral movement of the wheel through the toner at the toner inlet port. In fact, annular grooves cut along the surface of the wheel so as to be concentric to the wheel shaft have afforded successful operations. A toner metering wheel having herringbone type grooves on the surface thereof, is shown in Fig. 3. This wheel 61 is caused to rotate between a toner inlet port and a toner outlet port each identified by the reference numerals 62 and 63, respectively. A wiper blade 64 is used at the inlet port 62 so that only the toner within the grooves 65 is carried away from the inlet port. A plurality of toner removing elements 66, such as flexible wires for example, one for each associated groove 65, is used to effect the removal of the toner in each groove 65 to the toner outlet port 63.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. A xerographic image developing station having a developer hopper, a developer reservoir, and means for conveying xerographic developer from said reservoir at the bottom of said station to said hopper at the top thereof, in combination with, an electroscopic toner adding apparatus for dispensing said toner in metered quantities comprising a toner compartment having a toner inlet port and a toner outlet port; a rotatable toner metering wheel positioned within said compartment for rotation between said inlet and said outlet ports, said wheel having toner-holding notches arranged along the periphery thereof; a resiliently flexible element, one end of which is supported by said compartment and the other end of which lies against the periphery of said toner metering wheel over said toner-holding notches, said wheel acting to flex said element in an arc corresponding to the circumference of said wheel; drive means for rotating said wheel whereby said toner-holding notches carry said toner from said inlet port to said other end of said flexible element lying against the periphery of said wheel so as to cause said toner to be removed from said toner-holding notches to said outlet port; a first tube connected at one end to said hopper and at the other end to said compartment for effecting a flow of said developer from said hopper to said outlet port; and a second tube connected at one end to said compartment and at the other end to said reservoir so that the mixture of said developer and the metered quantities of said toner are flushed away from said outlet port to said reservoir by the action of said developer.

2. In an apparatus for dispensing finely-divided electroscopic toner in metered quantities to a xerographic image developing station, the combination of a toner compartment having a toner inlet port and a toner outlet port; a rotatable toner mixer having irregularly arranged ribs positioned for rotation within said compartment; a rotatable toner metering wheel positioned for rotation within

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said compartment between said inlet and said outlet ports, said toner metering wheel having toner-holding notches along the periphery thereof; a resiliently flexible element, one end of which is supported by said compartment and the other end of which lies against the periphery of said toner metering wheel over said toner-holding notches, said toner metering wheel acting to flex said element in an arc corresponding to the circumference of said toner wheel; a rotatable toner agitator positioned for rotation within said compartment adjacent said inlet port and intermediate the planes of rotation of said toner mixer and said toner metering wheel; means for rotating said toner mixer and said toner agitator so as to cause said toner to tumble and move towards said toner inlet port; and drive means for rotating said toner metering wheel so that said toner is carried by said toner-holding notches to said other end of said flexible element which removes said toner from said notches and into said toner outlet port.

3. An apparatus according to claim 2 additionally comprising speed control means for controlling the rotational

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speed of said drive means so that the quantity of said toner metered to said toner outlet port may be governed accordingly.

4. An apparatus according to claim 2 additionally comprising a developer chamber, and means including a tube between said developer chamber and said compartment for feeding said developer from said developer chamber to said outlet port whereby the metered quantity of said toner is flushed away from said outlet port by the action of said developer.

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