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Dennie

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[54] **REPRODUCTION MACHINE WITH MEANS FOR SOLIDIFYING THE RECLAIM TONER**

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[52] **U.S. Cl.** **118/637;** 118/600; 355/15

[51] **Int. Cl.²** **G03G 21/00**

[58] **Field of Search** 118/637, 312, 600, 602, 118/603; 355/15

[56] **References Cited**

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3,793,986	2/1974	Latone	118/637
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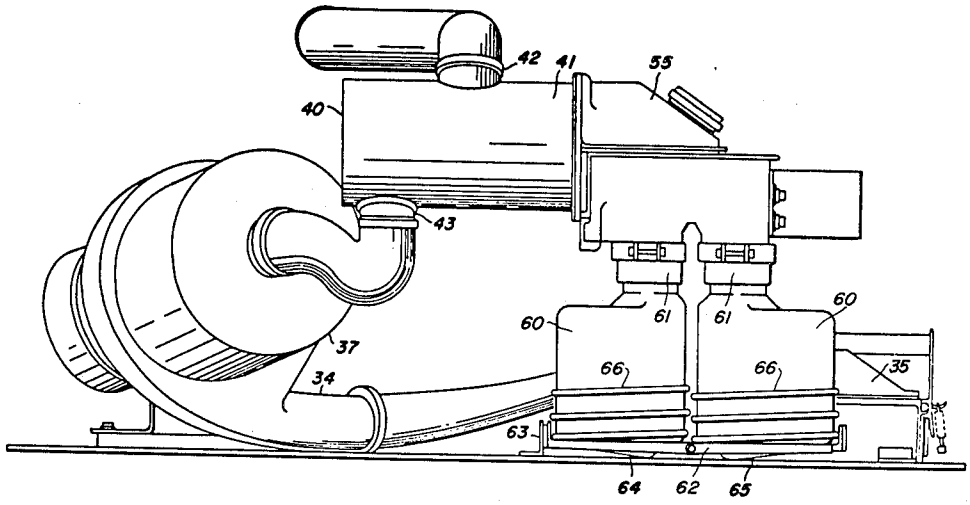
[57] **ABSTRACT**

An electrostatic reproduction machine has an improved toner reclaiming system in which the reclaimed toner is solidified as it is collected, preferably by heating the bottles in which the toner is collected.

3 Claims, 2 Drawing Figures



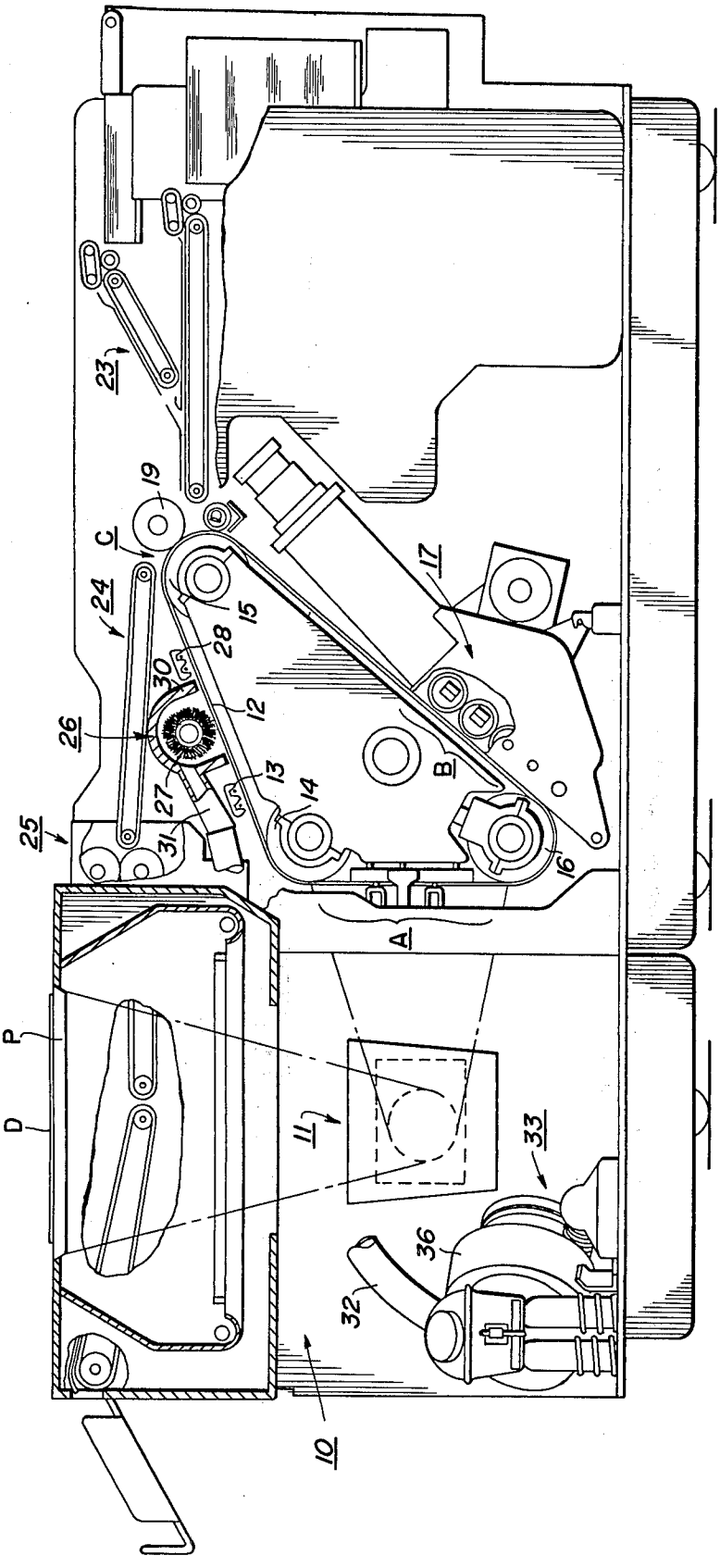


FIG. 1

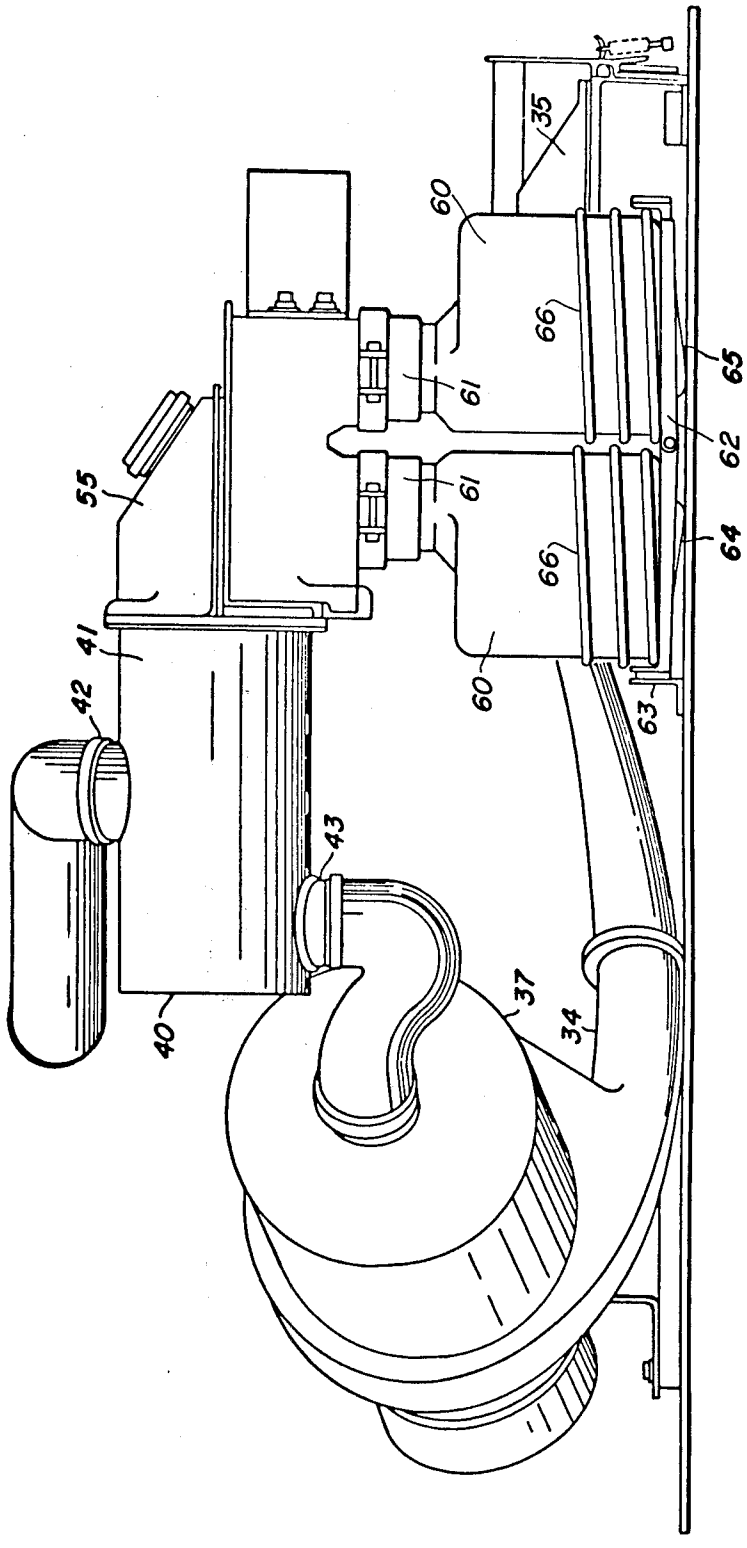


FIG. 2

REPRODUCTION MACHINE WITH MEANS FOR SOLIDIFYING THE RECLAIM TONER

BACKGROUND OF THE INVENTION

This invention relates to a toner particle reclaiming system, but more particularly, it relates to a reclaiming system in which the toner is reclaimed as a solid block.

In the practice of xerography as described in U.S. Pat. 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 selectively dissipate 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 electrostatic latent image may then be developed by contacting it with a finely divided electrostatically attractable developing material, such as a resinous powder. The powder is held in the image areas by the electrostatic fields on the layer. Where the field is greatest, the greatest amount of material is deposited; and where the field is least, little or no material is deposited. Thus, a viewable 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 support surface and suitably fused to thereby form a permanent print.

Present day electrostatic reproduction machines are adapted to produce copies of between 10 and 60 sheet of copy per minute and are capable of effecting solid area development. Enormous amounts of developing material are consumed during reproducing operations requiring multiple copies and to a large extent a relatively large amount of some of this material is lost or diverted, requiring frequent additions of new material to the development system for the machines.

In copending U.S. application Ser. No. 152,136, filed on June 11, 1971, now U.S. Pat. No. 3,793,986, by Salvatore Latone and assigned to Xerox Corporation, the assignee of the present invention, a toner reclaiming system is disclosed wherein residual developer material, removed from an electrostatic insulating surface, is deposited in receptacles and thus is provided for reuse. Briefly, the system operates by causing a flow of air to carry developer particles from a brush cleaning device in an electrostatic printing machine to a particle separation apparatus wherein the particles are separated from the air flow and conveyed to a collection manifold and thence to recovery containers. The small amount of particles remaining in the air flow are removed by a final filter element through which the air passes. It has been recognized that the developer material contained in the recovery containers should be periodically discharged therefrom and returned to the electrostatic reproduction machine. Although using reclaimed toner is viable in some applications, in others it is undesirable and should be discouraged. This is because contaminants are added to the toner as it passes through the process steps of the reproduction machine. These contaminants include cleaning brush fibers, paper lint, silicone oil used in the machine, etc. Also it is believed that the toner particle size distribution in the reclaimed toner may not be the same as in the original toner supply, and that this may create other problems e.g., photoreceptor filming.

SUMMARY OF THE INVENTION

The present invention is directed to a toner reclaiming system in which the reclaimed toner is solidified, preferably by heating the reclaimed toner as it is collected in a collection bottle. The reclaimed toner may also be solidified, however, by adding a toner solvent or placticizer to the collection bottle which will solidify the toner as it is deposited in the bottle, or by lining the bottle with a material which will react with the toner so as to solidify the toner.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic sectional view of an electrostatic reproduction machine incorporating the present invention therein with the processing components in section to better illustrate the environment for the present invention;

FIG. 2 is a schematic view of a toner reclaiming system for the reproduction machine including the means for heating the reclaimed toner as the toner is collected.

DETAILED DESCRIPTION OF THE INVENTION

For a general understanding of an electrostatic reproduction machine in which the present invention may be incorporated, reference is made to FIG. 1 in which some of the various system components for the machine are schematically illustrated, and to FIG. 2 wherein the complete reclaiming system is shown. Like component parts are identified by like reference numerals throughout. As in all electrostatic systems such as a xerographic machine of the type illustrated, a light image of an original to be reproduced is projected on the sensitized surface of a xerographic plate to form an electrostatic latent image thereon. Thereafter, the latent image is developed with an oppositely charged developing material comprising developer particles known as toner particles to form a xerographic powder image corresponding to the latent image on the plate surface. The powder image is then electrostatically transferred to a support surface to which it may be fixed by a fusing device whereby the powder image is caused to adhere permanently to the support surface.

The electrostatically attractable developing material commonly used in image developing apparatus comprises a pigmented resinous powder referred to here as "toner" and a "carrier" of larger granular beads formed with steel cores coated with a material removed in the triboelectric series from the toner so that a triboelectric charge is generated between the toner powder and the granular carrier, and the toner is then attracted to the electrostatic latent image from the carrier to produce a visible powder image on the electrostatic insulating surface.

In the illustrated machine, an original D to be copied is placed upon a transparent support platen P fixedly arranged in an illumination assembly generally indicated by the reference numeral **10**. While upon the platen, an illumination system flashes light rays upon the original thereby producing image rays corresponding to the informational areas on the original. The image rays are projected by means of an optical system **11** to an exposure station A for exposing the photosensitive surface of a moving xerographic plate in the form

of a flexible photoconductive belt **12.** In moving in the direction indicated by the arrow, prior to reaching the exposure station A, that portion of the belt being exposed is uniformly charged by a corona discharge device **13** located at a belt run extending between a supporting roller **14** and a drive roller **15.** The exposure station extends between the roller **14** and a third support roller **16.**

The exposure of the belt surface to the light image selectively dissipates the electrostatic charge on the surface of the photoconductive layer in the areas struck by light, thereby forming an electrostatic latent image in image configuration corresponding to the light image projected from the original on the supporting platen. As the belt surface continues its movement, the electrostatic image passes around the roller **16** and through a developing station B located at a third run of the belt and in which there is positioned a developing apparatus generally indicated by the reference numeral **17.**

The developing apparatus **17** may comprise a plurality of conventional magnetic brushes which carry developing material to the adjacent surface of the upwardly moving inclined photoconductive belt **12,** in order to provide development of the electrostatic image. As the developing material is applied to the electrophotographic belt, toner particles in the development material are attracted electrostatically to the belt surface to form powder images.

The developed electrostatic image is transported by the belt **12** to a transfer station C located at a point of tangency on the belt as it moves around the drive roller **15** where a sheet of copy material is moved at a speed in synchronism with the moving belt in order to accomplish transfer of the developed image. There is provided at this station a transfer roller **19** which is arranged on the frame of the machine for contacting the non-transfer side of each sheet of copy material as the same is brought into transfer engagement with the belt **12.** The roller **19** is electrically biased with sufficient voltage so that a developed image on the belt **12** may be electrostatically transferred to the adjacent side of a sheet of material as the same is brought into contact therewith.

There is also provided a sheet transport mechanism adapted to transport sheets of material seriatim from a suitable handling mechanism generally indicated by the reference numeral **23** to the developed image on the belt as the same is carried around the roller **15.** A programming device operatively connected to the mechanism **23,** and the aforementioned illumination system is effective to present a developed image at the transfer station C in time sequence with the arrival of a sheet of material.

After the sheet is stripped from the belt **12,** it is conveyed by a conveying system **24** into a fuser assembly indicated generally by the reference numeral **25** wherein the developed and transferred xerographic powder image on the sheet material is permanently affixed thereto. After fusing, the finished copy is discharged from the apparatus at a suitable point for collection externally of the apparatus.

The excess toner particles remaining as residue on the developed images, as well as those particles not otherwise transferred therefrom are carried by the belt **12** to a cleaning apparatus **26** positioned on the run of the belt between rollers **14** and **15** adjacent the charging device **13.** The cleaning device comprises a rotating brush **27,** corona discharge device **28** for neutralizing charges remaining on the non-transferred toner particles and a housing **30** for supporting the brush **27** and into which the toner particles are brought to be subsequently conveyed away from the vicinity of the belt under the influence of an air stream. For this purpose, the housing **30** is in communication with the input end **31** of a duct **32** which is connected to a pumping apparatus and toner reclaiming system, generally indicated by the reference numeral **33,** for removing the toner laden air from the housing **30** on a continuous basis during machine operation.

The toner reclaiming system is in the form of an air conveying system including the duct **32,** an output duct **34** (clearly illustrated in FIG. **2**) having a filtering device **35** as the output end for the system, and pumping apparatus such as motor-driven blower or fan means **36** interposed between and in operational fluid communication with the ducts **32, 34.** The blower means may be of the conventional type having an impeller (not shown) mounted for rotation within a blower housing **37** having its input end connected to the duct **32** and its output end connected to the duct **34.** The operation of the blower means is such as to move air from the chamber within the brush housing **30,** through the duct **32,** through a separating means, through the blower housing **37,** through the duct **34** and finally through a final filter element **35** and out into the surrounding atmosphere.

Positioned in the duct **32,** between its input end **31** and the blower means **36,** and operating as part of the air conveying system is separating means **40** which is utilized to separate the toner particles from the air flowing through the system. As observed from FIG. **2,** the separating means **40** includes a housing **41** formed with an input fitting **42,** and an output fitting **43,** the latter fitting connecting the housing **41** to the input side of the blower housing **37.** The separating means **40** may be of any type which is adapted to separate particles from air flow and to permit the continued flow of the "clean" air while moving the particles to a collecting point. It is preferred that the separator be of the centrifugal type which is constructed so that particle-laden air is set in a whirling motion to drive the particles against walls by centrifugal forces.

The toner-free air flows through the housing **41** between walls within the housing, out of the housing by way of the fitting **43** and into the blower housing **37.** The entire movement of air being produced by the blower means and after being directed therethrough completes its path through the duct **34** and to the filtering element **35** which is utilized in order to precipitate the remaining toner particles which may remain in the flow of air after leaving the separating means **40.**

The separated toner particles are directed out of housing **41** and collect in a manifold **55** which may be suitably attached to the housing **41** as another separated chamber therein. Bellow means **61,** capable of expandable and compressible deformation, are provided for supporting the recovery containers **60** in suspended relation beneath manifold **55.** The recovery containers, which may comprise one or more suitable vessels adapted to be heated and to receive the separated toner particles. Generally, the depositing of toner particles in the containers will be fairly even; that is, the containers will receive particles in substantially equal amounts. A more complete description of the toner reclaiming system, and the manner in which the system operates is set forth in U.S. Pat. No. 3,793,986.

The containers **60** are seated upon a movable platform generally indicated by reference numeral **62.** The platform is coupled to the frame of the electrostatic reproduction machine by conventional means **63** and is comprised of first and second portions **64** and **65,** each portion being adapted to receive an equal number of containers. For the assumed example wherein the total number of containers **60** is equal to four, it is appreciated that each portion **64** and **65** receives two containers. The platform portions **64** and **65** are mounted for movement; when moved a predetermined amount in accordance with the weight of toner contained therein, a switch is activated to interrupt the operation of the electrostatic reproduction machine. For further details as to how this is accomplished, reference is made to U.S. Pat. No. 3,838,922.

As the reclaimed toner is deposited in the bottles **60,** the latter are being heated by electrical heating coils **66** so as to solidify the toner as it is collected, the coils **66** being connected to a suitable source of power. Since the toner is being solidified as it is collected, each of the bottles **60** is thus able to hold a larger amount of toner than would be the case if the toner were collected in its particulate form. Consequently, the machine can run for longer periods of time without having to change the bottles. Changing bottles less frequently also reduces the chances for a reclaim leak, and therefore there is less danger of a final filter failure. In addition, the system for sensing a full bottle of solidified toner would have increased amplitude over that for sensing a full bottle of particulate toner due to the increase in weight differential between an empty and a full bottle; in other words, the sensing system would not have to be as sensitive for solidified toner as for particulate toner since the weight differential for the former is greater.

While the invention has been described with reference to the structure disclosed, it is not confined to the details set forth, but is intended to cover such modifications or changes as may come within the scope of the following claims.

What is claimed is:

1. An improved electrostatic reproduction machine having a photoconductive surface upon which is formed an electrostatic latent image, developing apparatus for applying developing material comprising toner to the latent image to develop the same, a cleaning mechanism for removing toner from the photoconductive surface after development of the latent image, a reclaim container, and means for conveying toner from the cleaning apparatus to the reclaim container, the improvement comprising:

means for solidifying toner as the latter is being collected in the reclaim container.

2. An improved electrostatic reproduction machine as set forth in claim **1,** wherein the solidifying means comprises means for heating the reclaim container.

3. An improved electrostatic reproduction machine as set forth in claim **2,** wherein the heating means comprises electrical heating coils surrounding the reclaim container.

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