United States Patent [19]

Andrako

[11] **3,898,956**

[45] **Aug. 12, 1975**

[54] **TONER REPLENISHER**

[75] Inventor: **Thomas E. Andrako,** Maple Heights, Ohio

[73] Assignee: **Addressograph-Multigraph Corporation,** Cleveland, Ohio

[22] Filed: **Nov. 16, 1973**

[21] Appl. No.: **416,610**

[52] **U.S. Cl.** **118/637;** 118/7; 222/DIG. 1

[51] **Int. Cl.²** **G03G 15/08**

[58] **Field of Search** 118/7, 637, 308; 222/DIG. 1, 161, 342

[56] **References Cited**

UNITED STATES PATENTS

2,715,585	8/1955	Schwartz et al.	118/637
2,910,964	11/1959	Stavrakis et al.	118/637
3,320,879	5/1967	Edwards et al.	222/DIG. 1
3,367,307	2/1968	Lawes et al.	118/7 X
3,374,768	3/1968	Lawes et al.	118/637
3,396,872	8/1968	Wheeler	118/308 X
3,669,072	6/1972	Reynolds et al.	118/637
3,827,394	8/1974	Takahashi et al.	118/637

Primary Examiner—Mervin Stein
Assistant Examiner—Douglas Salser
Attorney, Agent, or Firm—Ray S. Pyle

[57] **ABSTRACT**

A method and apparatus for supplying make-up toner particles to a toner mix in an electrostatic image printing machine. Pure toner is supplied to a hopper and the hopper has a gravity dispensing opening with a rotary brush serving as a door. The brush picks up toner particles in the mat thereof and a doctor blade flicks the bristle mat as the brush turns, to cause a flying cloud of toner particles which settle downwardly into a subjacent mixing chamber.

2 Claims, 4 Drawing Figures

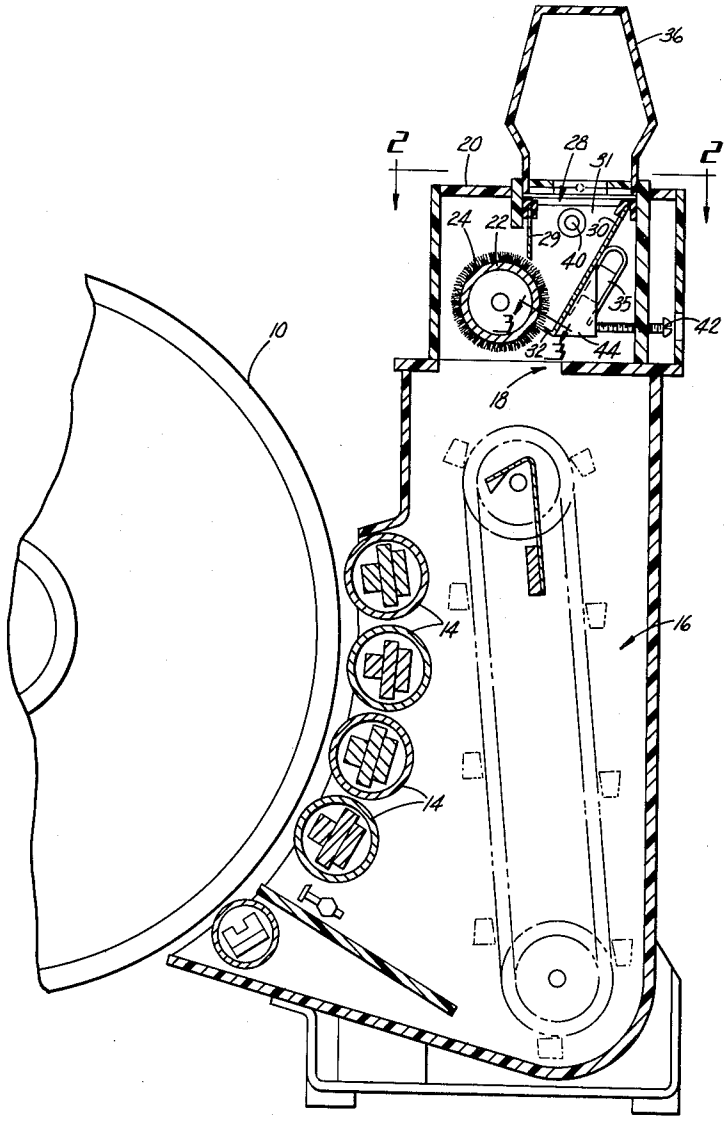
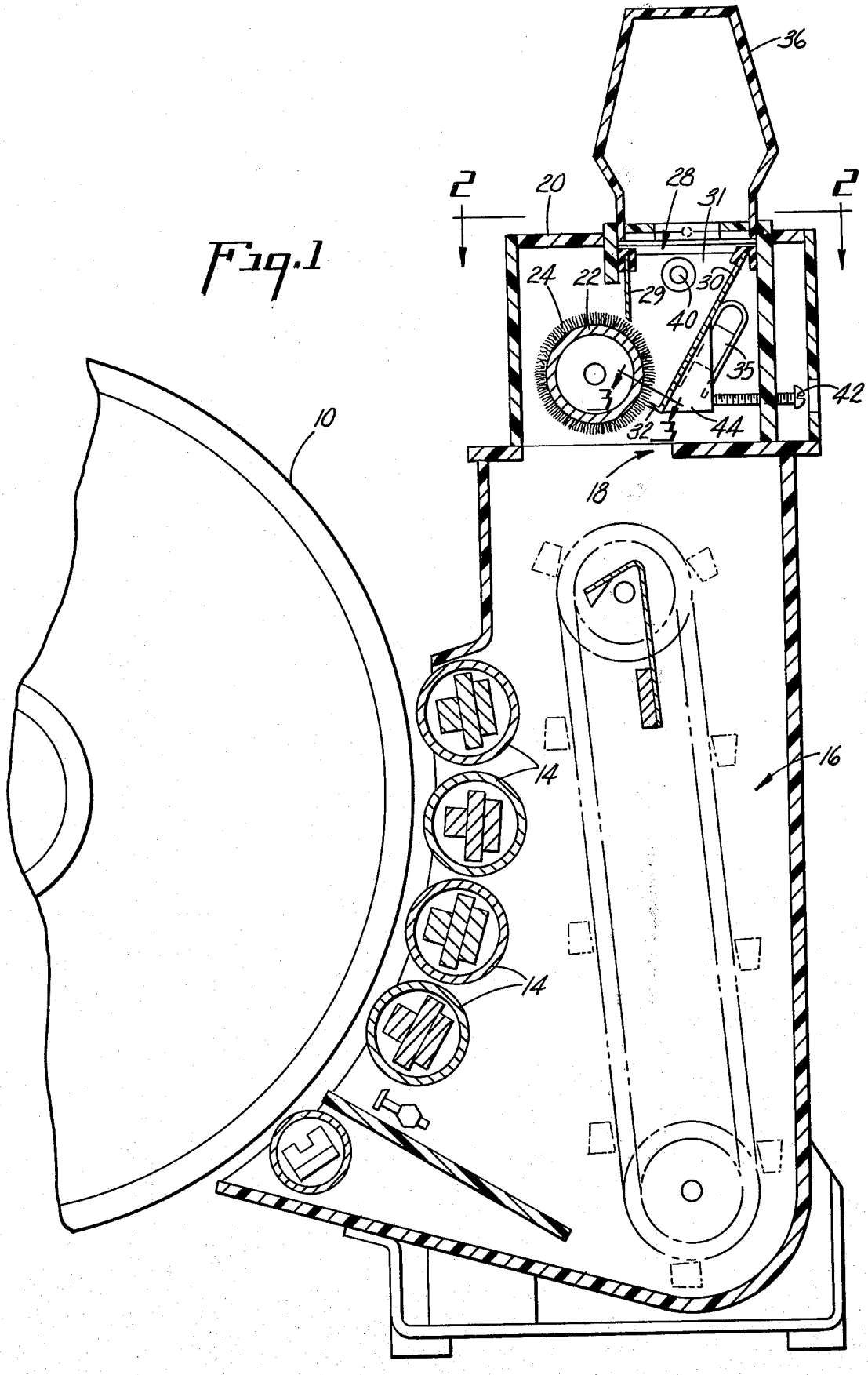


Fig. 1



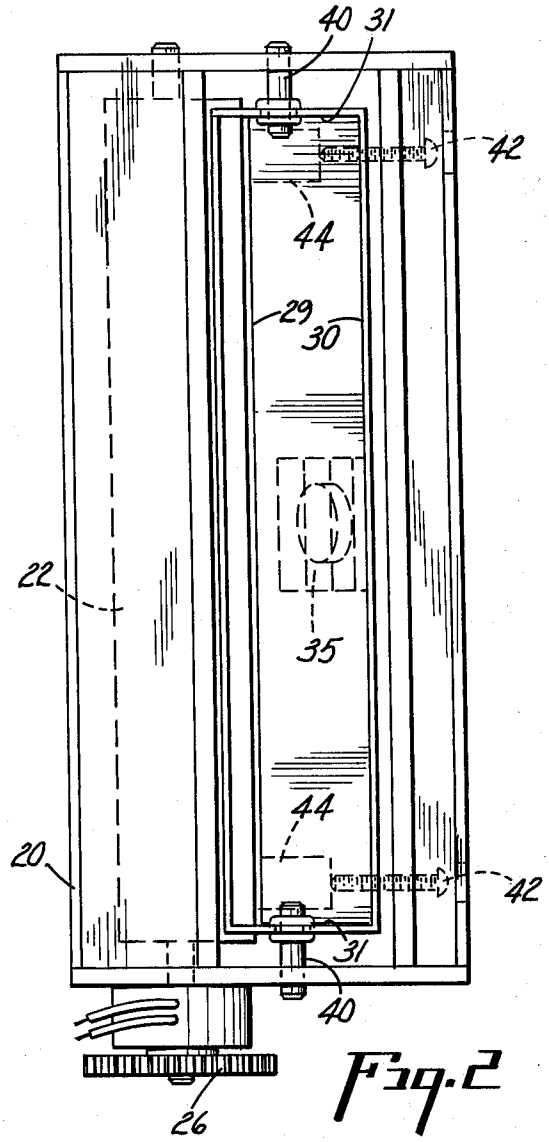


Fig. 2

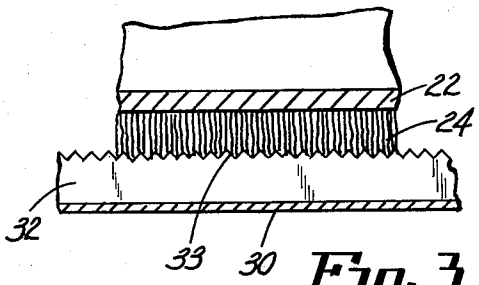


Fig. 3

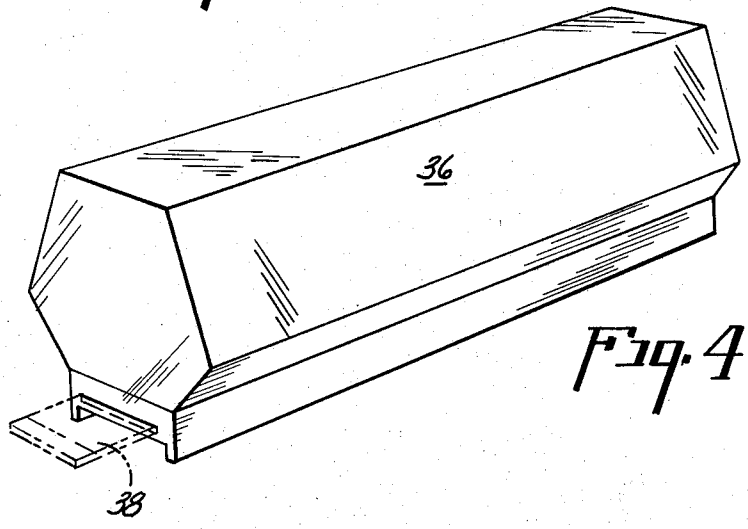


Fig. 4

TONER REPLENISHER

BACKGROUND OF THE INVENTION

The original method of adding toner particles to a depleted toner mix was simply to open up the compartment and pour a quantity of the pure particle matter into the mixing chamber and then allow mixing to take place for a period of time to bring about a homogeneous mix.

Such addition methods produced enough toner air pollution and contamination of worker's hands that it was objectionable. Accordingly, mechanical addition devices of many and varied types have been developed for both dry and liquid addition. An example is illustrated and numbered, although not described, in U.S. Pat. No. 3,697,050. In the prior art reference a sponge roller blocks the exit opening of a hopper and the surface of the sponge roller is able to drag enough of the toner material along with its surface to a scraping blade that the toner can be scraped off into a mixing chamber.

SUMMARY OF THE INVENTION

The purpose to be accomplished by this invention is the uniform dispersion of a controlled amount of toner material into a mixing chamber avoiding all lump or batch injection and producing a flying cloud which causes an acceleration of incorporation uniformly into a depleted toner mix.

DESCRIPTION OF THE FIGURES OF THE DRAWING

FIG. **1** is a mechanical schematic of an automatic xerographic reproducing machine utilizing the present invention.

FIG. **2** is a top view of the dispensing unit of this invention taken along the line **2—2** of FIG. **1.**

FIG. **3** is a fragmentary section of a doctor blade and brush interface taken substantially along the line **3—3** of FIG. **1.**

FIG. **4** is a perspective illustration of a cartridge to supply toner material to the system, and is shown in section in FIG. **1.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

The electrostatic copy art is so thoroughly known that no effort is made to illustrate a complete working machine. There are many issued patents and technical journals which completely illustrate such systems if reference is needed. As in all electrostatic systems of the type under consideration, a light image of an original to be reproduced is projected onto the sensitized surface of a drum **10,** whether that drum has a metal photoconductive surface for later transfer of an image, or is a drum support for a paper plate having a photoconductive insulating surface. It is immaterial to this invention which type surface is used. An electrostatic latent image is formed on that surface. Thereafter, the latent image is developed with an oppositely charged developing material comprising carrier beads and smaller toner particles triboelectrically adhering thereto to form a powder image, corresponding to the latent image on the drum surface. The powder image is then electrostatically fused either directly upon the surface where created, or transferred to a carrier upon which it is to be permanently affixed.

The electrostatically attractable developing material commonly used in magnetic brush developing apparatus comprises a pigmented resinous powder referred to here as "toner" and a "carrier" of larger beads removed in the trioelectric series from the toner so that a triboelectric charge is generated between the toner powder and the granular carrier. The carrier is magnetizable and also provides mechanical control for the formation of the brush bristles by virtue of magnetic fields so that the toner can be readily handled and brought into contact with the exposed surface. The toner is then attracted to the electrostatic latent image from the carrier bristles to produce a visible powder image on an insulating surface.

A series of magnetic rollers form the magnetic mix into a brush-like formation following the magnetic path of magnets placed within the roller **14,** in a well known manner described in U.S. Pat. No. 3,697,050 and shown in further developed form in co-pending application Ser. No. 337,340, titled QUALITY CONTROL OF ELECTROSTATIC IMAGE DEVELOPER MIX.

In applicant's co-pending application, it is stated that as the developer mix is depleted, a fine dust of replacement toner without magnetic material is caused to cascade from a supply source and become mixed into the entire system as the toner floats and falls down into the cascading material being dumped from mixer buckets shown in phantom outline in FIG. **1** of the drawings.

The purpose of this invention is to supply the toner particles as a fine dust cloud into an area **16,** which may be termed a mixing chamber. A mix of non-consumable carrier members, such as glass particles or magnetic iron particles, and consumable toner particles are mixed in chamber **16.** After the toner mix is carried by the magnetic brushes in the illustrated embodiment, or otherwise depleted of its toner particle supply, the spent mix is deposited back into the mixing chamber and caused to be mixed with the supply of toner particles in the chamber in order to carry the toner particles from the chamber back to the area where it is needed. Eventually the toner particles are carried out of the chamber to the extent that they must be re-supplied. This point in time is possible to be determined by observation of the output of the machine, but modern equipment provides monitoring devices which can determine when the additional toner supply is needed.

This invention is directed to the improvement in toner particle supply and it comprises generally a housing **20** which is seated on the top of the mixing chamber **16** over a supply entrance **18** in the chamber.

A brush of circular cross-section, which is preferably a cylindrical brush, is mounted in the housing **20** adjacent to the entrance opening **18.** Brush **22** has a bristle mat **24** at its exterior surface, and the brush is driven in a rotary direction by means of an electric power train which feeds into the drive gear **26** shown best in FIG. **2.** The balance of the power train is conventional and need not be illustrated for the purpose of understanding this invention. However, it should be noted that such power train preferably is one which can be started and stopped at will and controlled in response to some chamber monitoring device which indicates when sufficient toner supply is present or absent from mixing chamber **16.**

A supply hopper **28** has an opening located with respect to gravity in a position which will allow toner placed in the hopper to be expelled from the hopper

through that opening. The opening is defined by short front walls **29** and sloping rear wall **30.** Walls **29** and **30** are formed by end walls **31.** The hopper is then located so that the brush **22** acts as a rotating door for the opening between the terminal edge of walls **29** and **30** in the supply hopper. In this respect the rotating brush is much like prior art sponge roller referred to above.

This invention differs markedly from the prior art, however, in that not only is the brush one with a bristle mat **24,** but the sloping rear wall **30** of the hopper terminates in a doctor blade formation indicated by the reference character 32. Doctor blade **32** extends partially into the mat of the bristle mat **24** to cause the bristles to bend and then snap back after the bristle passes the blade when the brush **22** is rotated.

The doctor blade **32** is shown as an integral part of the sloping rear wall **30,** although obviously could be a separate structure if so desired.

In order to facilitate the formation of a uniform supply of cloud-like toner material it has been found that the doctor blade action is enhanced by providing the doctor blade **32** with serrated teeth **33** as shown best in FIG. 3 of the drawings. Thus the bristle mat not only is bent back from the forward direction of roller movement but the bristles are caused to separate laterally and snap back in a compound action. Such snapping action of a stiff bristle mat brush will cause the toner particles clinging to the brush bristle to fly free and form a cloud atmosphere on the exterior of the hopper and directly above the opening **18.** Hence, the cloud descends in a light mist into the mixing chamber **16** and provides an even distribution of the product throughout the chamber. The mixing action is thus greatly facilitated.

Further enhancement of the cloud formation is provided by means of a vibrator **35** mounted to the sloping rear wall **30.** As the back wall vibrates it will prevent any bridging of toner material in the hopper and thus cause an even flow of the material to the brush. However, it is very important that this vibration action enhances the flicking action of the bristle mat and hence a better dispersing of the toner particles from the bristles of the roller.

A supply cassette **36** is designed to fit the top of the housing **20** over the top entrance of the hopper **28.** A drawer slide **38** is withdrawn to open the bottom of the cassette after the cassette is installed. Therefore, all of the toner material is confined within closed walls to prevent air pollution and operator contamination.

In order to prevent the vibration of vibrator **35** from being transmitted to unwanted portions of the apparatus, the hopper **28** is mounted on support pins **40** by means of rubber grommets at each end wall **31,** and proper adjustment of the hopper and the brush is obtained by means of adjustment screws **42** which contact adjustment blocks **44.**

What is claimed is:

1. In a toner system for electrostatic image development employing a mix of non-consumable carrier members and consumable toner particles, the system including a mixing chamber wherein spent mix is deposited and caused to be resupplied with toner particles clinging thereto, said chamber having a supply entrance opening above the mixing area;

the improvement in toner particle supply, comprising:

a housing seated on said chamber over said supply entrance opening;

a brush of circular cross-section mounted in said housing adjacent said entrance opening, said brush having a bristle mat surface, and means for rotating said brush about its central axis;

a supply hopper located to expel toner from said hopper through said opening by gravity, said hopper mounted adjacent said brush with said brush as the sole closure blocking the opening;

the hopper opening is rectangular, defined by a vertical front hopper wall and a sloping rear hopper wall terminating at a location substantially directly below said front wall, and end walls;

a doctor blade formed by a serrated edge formation of said rear wall termination on the side of said opening from which the mat of said brush exits, said blade extending partially into said mat to cause the bristles to bend and then snap back after passing the blades; and

a vibrator means for vibrating said rear wall to shake toner down to said brush and to actuate the particle dispensing action of said brush;

whereby, the bristles pick up toner particles from a hopper supply, and flick the particles free in a descending cloud to said mixing chamber.

2. In a toner system for electrostatic image development employing a mix of non-consumable carrier members and consumable toner particles, the system including a mixing chamber wherein spent mix is deposited and caused to be resupplied with toner particles clinging thereto, said chamber having a supply entrance opening above the mixing area;

the improvement in toner particle supply, comprising:

a housing seated on said chamber over said supply entrance opening;

a brush of circular cross-section mounted in said housing adjacent said entrance opening, said brush having a bristle mat surface, and means for rotating said brush about its central axis;

a supply hopper having an opening located to expel toner from said hopper through said opening by gravity, said hopper mounted adjacent said brush with said brush as the sole closure blocking the opening;

a doctor blade at said hopper opening on the side of said opening from which the mat of said brush exits, said blade extending partially into said mat to cause the bristles to bend and then snap back after passing the blade; and

a vibrator mounted to act upon said doctor blade to accelerate the particle dispensing action;

whereby, the bristles pick up toner particles from a hopper supply, and flick the particles free in a descending cloud to said mixing chamber.

* * * * *