United States Patent

[11] **3,542,089**

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[21] Appl. No. **744,159**
[22] Filed **July 11, 1968**
[45] Patented **Nov. 24, 1970**

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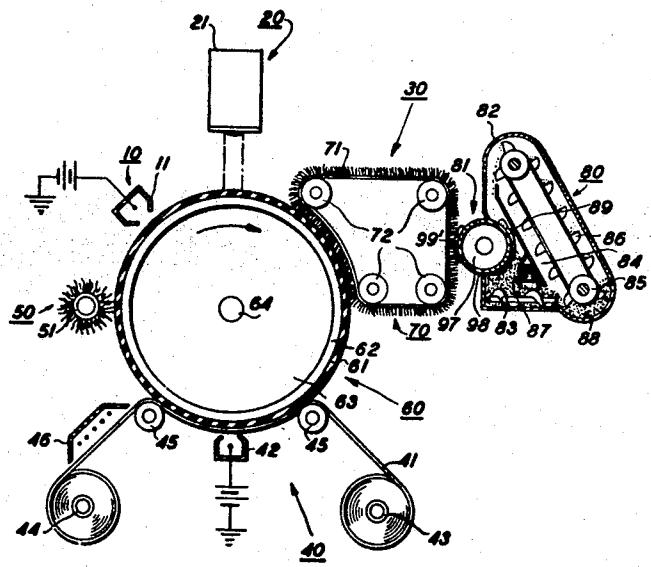
[54] **TONER DISPENSER**
4 Claims, 1 Drawing Fig.

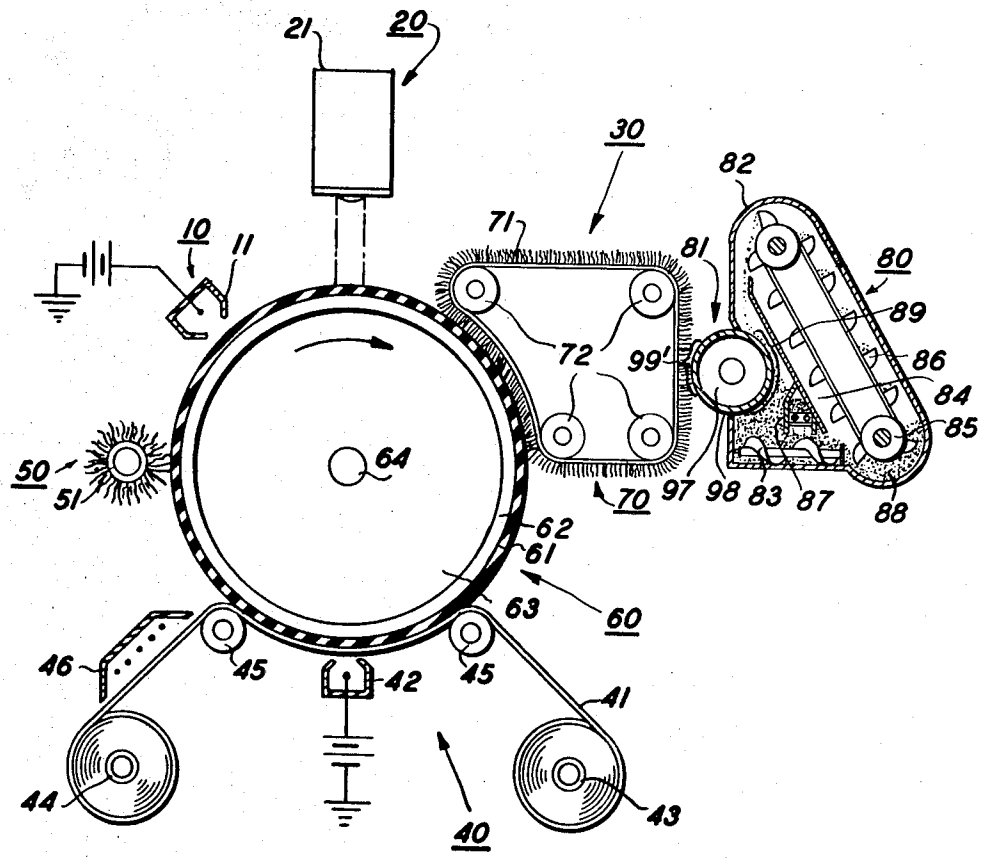
[52] **U.S. Cl.** **141/1,**
141/256; 222/226; 317/3, 317/262
[51] **Int. Cl.** **B65b 1/04,**
B65b 3/04
[50] **Field of Search** 141/1, 256;
222/Inq, 70, 226; 317/Inq, 3, 262; 353/Inq;
355/Inq, 3, 10, 15, 17; 219/Inq; 101/Inq; 117/Inq;
118/Inq; 15/Inq; 96/Inq, 1.5; 19/Inq; 346/Inq

[56] **References Cited**
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ABSTRACT: An apparatus and method for dispensing toner to a developing member including a dispenser which mechanically and/or triboelectrically strips toner particles from the carrier beads in a developer mixture and carries the toner particles to the developing member upon which they are deposited.





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TONER DISPENSER

This invention relates to developing electrostatic latent images and, in particular, to dispensing charged toner particles onto a developing member.

In xerography and related arts, an electrostatic latent image is formed on a xerographic plate. In order to make the latent image visible, marking particles such as toner are placed in contact with the xerographic plate where they are deposited in image configuration due to the pattern of electric fields on the plate. A two-component developer composed of a mixture of electrostatically attractable toner particles and a granular carrier material is commonly used to develop electrostatic images.

One method of depositing toner on a plate bearing an electrostatic latent image is by cascade development. For instance, where the xerographic plate takes the form of a drum in an automatic xerographic apparatus, such as that shown in U.S. Pat. No. 3,190,264, the cascade developing system customarily has a vertical or inclined conveyor apparatus to transport developer from a reservoir to an elevated system of chutes or guides which direct the gravitational flow of developer onto the peripheral surface of the xerographic drum. The buckets on the conveyor system are arranged parallel to the axis of the drum and have a transverse length approximately equal to the width of the drum surface. As the developer falls across the surface of the drum, the toner particles adhere to the xerographic plate according to the configuration of the latent image while the carrier beads continue downwardly and into a sump. The carrier beads are retoned and then recirculated by the conveyor.

Another manner by which toner is deposited on a xerographic plate is with the use of a fibrous developing brush. The brush can be made of any suitable material such as rabbit fur, fox fur, camel hair, dynel, (a synthetic fiber of 40 percent acrylonitrile and 60 percent vinyl chloride), or any other suitable natural or synthetic material. The fibrous members of the brush act as carriers and serve a function similar to the carrier beads in the developer mixture. A developing brush impregnated with toner particles is brought in contact with the plate bearing the latent image and the particles are deposited upon the plate in imagewise configuration thereby developing the latent image.

An undesirable aspect of developing latent images with brushlike materials is that there is not any known way of efficiently loading the developing brush with charged toner particles. One known method is to rotate the brush in a reservoir of toner thereby allowing the fibers to pick up the toner particles from the reservoir and deposit them on the plate being developed. This method has an inherent disadvantage in that as the brush continues to rotate it creates a cavity in the reservoir described by the path through which it rotates and fewer and fewer particles contact the fibers. This condition worsens as the brush continues to rotate, even when a mixing apparatus is added in order to keep the reservoir in a loose consistency.

A second method of loading a developing brush is to place a hopper of toner over the brush and feed toner from it to the brush. The hopper includes a mesh bottom which allows toner to pass onto the brush as the hopper is vibrated. This method is undesirable at high brush speeds in that at high brush speeds inadequate and uneven amounts of particles are distributed on the brush and the particles are not uniformly charged.

The present invention is intended to overcome the prior difficulties of loading a developing member by causing the charged toner particles to be placed on the developing member through the use of a dispenser. Accordingly, it is an object of the present invention to overcome the problems of loading a developing member as occurred in the prior art.

It is another object of the invention to improve developing apparatus for the development of electrostatic latent images.

It is a further object of the invention to improve dispensing apparatus for loading toner particles on a brushlike member.

It is still a further object of the invention to improve dispensing apparatus for loading charged toner particles on a developing member.

It is still a further object of the invention to improve dispensing apparatus which removes charged toner particles from carrier beads in a developer mixture.

The present invention is an apparatus and method for dispensing charged toner particles onto a developing member. Developing material consisting of a mixture of toner particles and carrier beads is placed in a collecting station. In contact with the developing material and the developing member is a dispenser which removes charged toner particles from the granular carrier beads and carries them to a dispensing station adjacent the developing member. The toner particles so carried are deposited on the developing member which, in turn, develops a plate bearing an electrostatic latent image. As the system operates and toner particles are removed from the carrier beads, the denuded carrier beads flow to the bottom of the collecting station where they are retoned with toner particles fed from a toner reservoir. An auger of some other suitable moving means carries the carrier beads which have been retoned into an area where they are collected by buckets on a conveyor which recirculates the developing mixture through the system.

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 used in conjunction with the accompanying drawing.

Referring to the attached drawing, there is shown a typical automatic xerographic machine. The principle element of the machine is photosensitive plate **60**. The plate has five distinct stations arranged about its periphery which carry out the operational steps of the xerographic process. These stations include charging station **10**, exposing station **20**, developing station **30**, transfer station **40**, and cleaning station **50**.

The plate is in the shape of a rotatable drum **63** which is driven about shaft **64** by a motor (not shown). The drum comprises a layer **62**, an electrically conductive material, which, in turn, is covered on its outer surface with layer **61**, a photoconductive insulating material such as vitreous selenium.

An electrostatic latent image is formed on the surface of the drum by passing it through charging station **10** and exposing station **20**. The charging station consists of any suitable means for placing a uniform charge on layer **61** such as corona charging device **11**.

Exposure station **20** comprises a projector **21** which projects and focuses on the drum a light pattern conforming to the image to be reproduced by the xerographic machine. The image projected onto the photosensitive layer of the drum is synchronized with the movement of the drum. The projected light pattern causes selective charge dissipation on elemental areas of layer **61**, thus forming an electrostatic latent image. Other means for forming an electrostatic latent image including means for forming images on ordinary insulating surfaces can be used and these are known in the art and may be used instead of the one shown.

After the formation of the electrostatic latent image the drum passes through developing station **30**. At the developing station, the developing system includes developing apparatus **70** and toner dispensing apparatus **80** working in combination to deposit charged toner particles on the surface of the drum in conformance with the configuration of the electrostatic latent image. In the case of the xerographic system shown in the drawing, the toner particles consist of the finely-divided particles of thermoplastic resins having colored pigments dispersed throughout such as those disclosed in U.S. Pat. No. 2,618,551. Developing station **30** will be described in more detail below.

Following the developing step the drum passes through transfer station **40** where the image is transferred to support material **41**. Transfer of the image onto the support material is aided by corona charging device **42** which applies an electro-

static charge to the support material having a polarity opposite that of the toner particles. Transfer of the developed image from the photosensitive surface to the support material takes place between guide rollers **45** which act to position the support material against the photosensitive drum at the transfer station.

Support material **41** is fed from reel **43** before transfer and is rewound on reel **44** after transfer takes place. If the support material is the permanent substrate upon which the image is to be fixed, a fixing device such as fuser **46** can be placed along the path of the support material between the point where the developed image is transferred to the support material and the point where the support material is rewound on reel **44**. The fuser is positioned to heat the toner and permanently bond it to the support material.

The final station shown in the FIG. is cleaning station **50** which comprises cylindrical brush **51** which contacts the photosensitive surface of the drum. The cleaning station is desirable to remove any residue marking particles from the photosensitive surface after transfer has taken place and before the surface begins a new cycle. The above described process and apparatus are commercially known in the art as evidenced in U.S. Pat. No. 3,117,891 and any of the many known equivalents of process or apparatus may be employed in connection with the present invention.

It is within the development station, station **30**, that the present invention is utilized. As was mentioned above, the development system at station **30** has two cooperating apparatus; developing apparatus **70** and dispensing apparatus **80**. The developing apparatus can be any type of apparatus which is able to receive charged toner particles and place them on the surface of drum **63**. In the illustration there is shown fur belt **71** which is supported and driven by rollers **72**. The outer surface of this developing member is brushlike in character having a multitude of elongated carrier members such as cloth or brush fibers extending outwardly from the belt. In general, this member may be a brushlike surface of fur or the like, cloth such as velvetlike cloth having a fibrous surface, a weblike surface having elongated members or fibers extending therefrom, or other support surface bearing a multiplicity of elongated carrier members on its surface. At the point were the belt contacts the photosensitive surface the belt's brushlike surface deposits finely-divided toner particles on the surface of the drum. The developing member can also take the shape of a rotatable brush having a multitude of elongated carrier members or fibers, the fibers being analogous to the fibers of the belt as shown in the FIG. Depending on the speed of the machine, more than one belt and/or brush can be used to carry toner to the xerographic plate.

In the alternative, developing member **71** can be any suitable material such as cloth, mylar, or other nonpile material which will convey toner to the point where they are deposited on the surface of the drum.

Dispensing apparatus **80** serves the function of dispensing or placing charged toner particles on the developing member. It can assume any suitable shape such as a roller, endless belt, etc. The dispensing apparatus is enclosed by housing **82**, except in the area where dispenser **81** is located. Developing mixture **88** consisting of carrier beads having toner adhering thereto is brought to an elevated position near the top of conveyor housing **82**. The conveyor has a multitude of scoops **86** and is supported and driven by rollers **85**. As the conveyor moves in the counterclockwise direction around its roller the scoops are brought through the developing mixture at the bottom of the housing where they are filled. The scoops bring the developing mixture to a position near the top of the housing where the developing mixture is dumped onto dispenser **81**. Partition **84** keeps all of the developer released by the scoops in the area surrounding the dispenser. At the bottom of the housing is auger **83** or a group of augers, or some similar type apparatus which mixes additional toner particles fed from toner reservoir **87** with the carrier beads. The auger then moves the mixture to the bottom of the conveyor where the mixture is recirculated.

As mentioned above the developing material is a mixture of suitable pigmented or dyed electrostatically-attractable, toner particles and a granular carrier material. In order to develop a latent image comprised of negative electrostatic charges or the areas of least positive potential, the toner particles and granular carrier bead combination should be selected so that the toner particles are triboelectrically positive relative to the granular carrier. Conversely, in order to develop a latent image comprised of positive electrostatic charges, or the areas of highest positive potential, the toner particles and granular carrier should be selected so that the toner particles are triboelectrically negative relative to the granular carrier. This triboelectric relationship between the toner particles and granular carrier depends on their relative position in the triboelectric series. In this series, the materials are arranged in such a way that each material is charged with positive triboelectric charge when contacted with any material below it in the series and with negative triboelectric charge when contacted with any material above it in a series. The relative movement of the powder and granular material causes a rubbing action between the two triboelectrically-dissimilar materials and thereby produces triboelectric charge on each.

Due to the action of the auger and the moving scoops there is created within housing **82** a circulating flow of the developing material which carries it adjacent dispenser **81**. The area where the mixture contacts the dispenser is collecting station **89**. At the collecting station the dispenser rotates thereby mechanically and/or triboelectrically stripping the charged toner particles from the carrier beads. The particles are then carried out of the housing by the dispenser to dispensing station **99** where they are deposited on developing member **71**.

The surface of dispenser **81** is made of a material **98** which is located at a position in the triboelectric series which is different than that of the toner particles. The entire dispenser can be made of material **98**, or, as shown, material **98** can comprise an outer layer around core **97**. Depending upon whether the latent electrostatic image is developed with positively or negatively toner particles, a specific material is chosen for the surface of the dispenser. As was mentioned above, any material used on the surface of the dispenser which is above the toner particles in the triboelectric series will be charged positive. Therefore, in order to triboelectrically strip negatively charged toner particles from their respective carrier beads, the material on the surfaces of the dispenser must occupy a position in the triboelectric series which is above the position occupied by the toner particles. When negatively-charged toner particles are used, silk mesh, for example, can be used on the surfaces of the dispenser. The surface material on the dispenser can be chosen depending upon the magnitude of the charge which is placed on the toner particles when mixed with the carrier beads. At a given set of operating conditions, the greater the distance between the positions of the two materials in the triboelectric table, the greater the charge resulting on the two by triboelectric action.

Since the charge already exists on the toner particles due to their mixing with the carrier beads, an electrical bias can be placed on the dispenser to enhance the attraction of the toner particles. If the particles bear a charge of negative polarity, for instance, a positive electrical bias can be placed on the surface of the dispenser to attract the toner. If this were done, a positive electrical bias of larger magnitude should be placed on the fur belt to transfer the toner from the dispenser to the belt at dispensing station **99**.

Dispenser **81** can also be used as a collecting member merely to remove toner particles from a developing mixture. In order to accomplish this simpler result, the same considerations as described above will govern the choice of material used on the surface of the collecting member.

Dispenser **81** rotates and collects charged toner particles on its surface. The clearance between housing **82** and the dispenser is sufficient to allow a layer of the toner particles on the dispenser to exit the housing. Due to the fibrous nature of developing member **71**, the charged toner particles on the dispenser are readily transferred to the developing station.

The transfer of toner from the dispenser to the developing materials can also be aided by choosing the material of the developing member so that it is triboelectrically attractive to the toner particles.

Although the various drive and control apparatus necessary to make the system operate as disclosed above are not specifically shown or discussed, it is intended that any suitable apparatus be used and that such a suitable apparatus be part of this general disclosure. For example, a unitary motor can be used to drive the cascade device, dispenser and fur belt through appropriate gear systems.

I claim:

1. An apparatus for dispensing electrostatically-attractable toner particles having a predetermined triboelectric property to a developing member having a surface made of a material having a triboelectric property different than that of the toner particles and adapted to acquire and electrostatic charge of a first magnitude due to the triboelectric action with the toner particles comprising:

a movable dispenser in contact with the surface of the developing member at a dispensing station, the surface of the dispenser comprising a material having a triboelectric property different than that of the toner particles and adapted to acquire an electrostatic charge of a second magnitude due to triboelectric action with the toner particles, said second magnitude being of less value than said first magnitude;

means for placing developing material in contact with the surface of the dispenser at a collecting station located adjacent the dispensing station, the developing material comprising a mixture of coated granular material and electrostatically-attractable toner particles, said coating and toner particles having a triboelectric relationship of opposite polarity and being attracted to one another with a force of a third magnitude, said third magnitude being of less value than said second magnitude; and

means for moving the dispenser so that at least a portion of its surface passes through the dispensing station and the collecting station.

2. The apparatus in claim 1 wherein the means to place developing material in contact with the surface of the dispenser is a conveying apparatus adapted to transport the developing material to an elevation over the dispenser and cascade the developing material over the surface of the dispenser.

3. An apparatus for removing electrostatically-attractable toner particles having a predetermined triboelectric property from a mixture of coated granular material and toner particles, the coating and toner particles having a triboelectric relationship of opposite polarity and a being attracted to one another by an electrostatic charge of a first intensity due to triboelectric action comprising:

a rotatable collecting member having a surface comprising a material having a triboelectric property different than that of the toner particles and adapted to acquire an electrostatic charge of a second magnitude due to triboelectric action with the toner particles, said second magnitude being of greater value than said first magnitude; and

means for rotating the collecting member in contact with the mixture.

4. A method of removing electrostatically-attractable toner particles having a predetermined triboelectric property from a mixture of coated granular material and toner particles, the coating and toner particles having a triboelectric relationship of opposite polarity and being attracted to one another by an electrostatic charge of a first magnitude due to triboelectric action, comprising rotating a collecting member in a reservoir of the mixture, the surface of the collecting member having a triboelectric property different than that of the toner particles and the surface acquiring an electrostatic charge of a second magnitude due to triboelectric action with the toner particles, the second magnitude being of greater value than the first magnitude.