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[54] **METHOD AND APPARATUS FOR ENCLOSING A LAMP**

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[73] Assignee: **Xerox Corporation**, Stamford, Conn.

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[52] **U.S. Cl.** ..... **355/3**, 317/262 A

[51] **Int. Cl.** **G03g 15/00**

[58] **Field of Search** ..... 355/3, 17, 15, 10; 118/637; 317/2, 262 A

[56] **References Cited**

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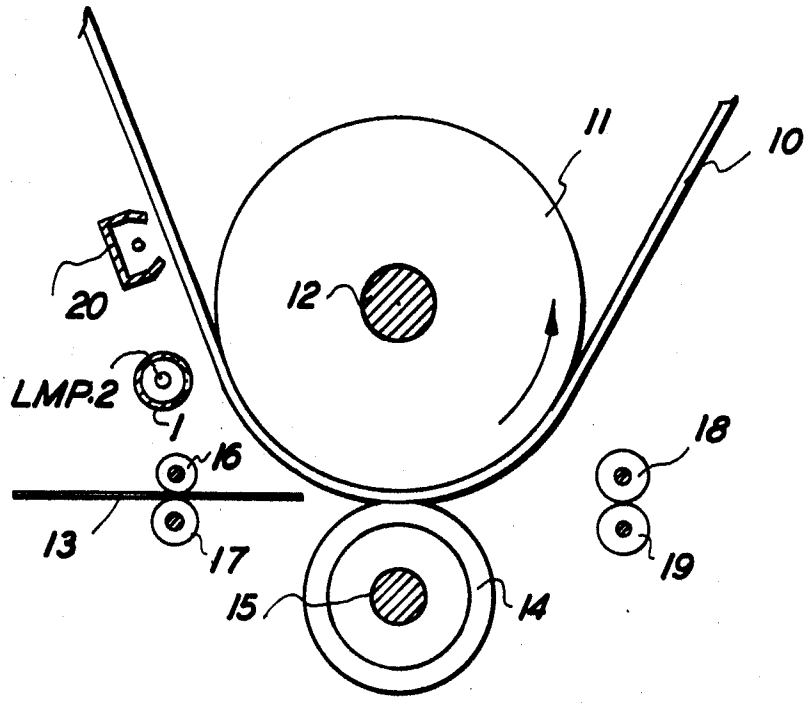
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[57] **ABSTRACT**

Method and apparatus for keeping a light source in an electrophotographic machine free from contaminating deposits of electroscopic toner material in which the light source is enclosed within an electrically chargeable closure member to physically isolate the light source from the toner material, and the closure member is charged to a polarity. The transparent portion of the closure member may be either a dielectric material or glass coated with a transparent conductive layer to form an electric field to repel the toner material away from the closure member and the light source.

4 Claims, 5 Drawing Figures



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SHEET 1 OF 2

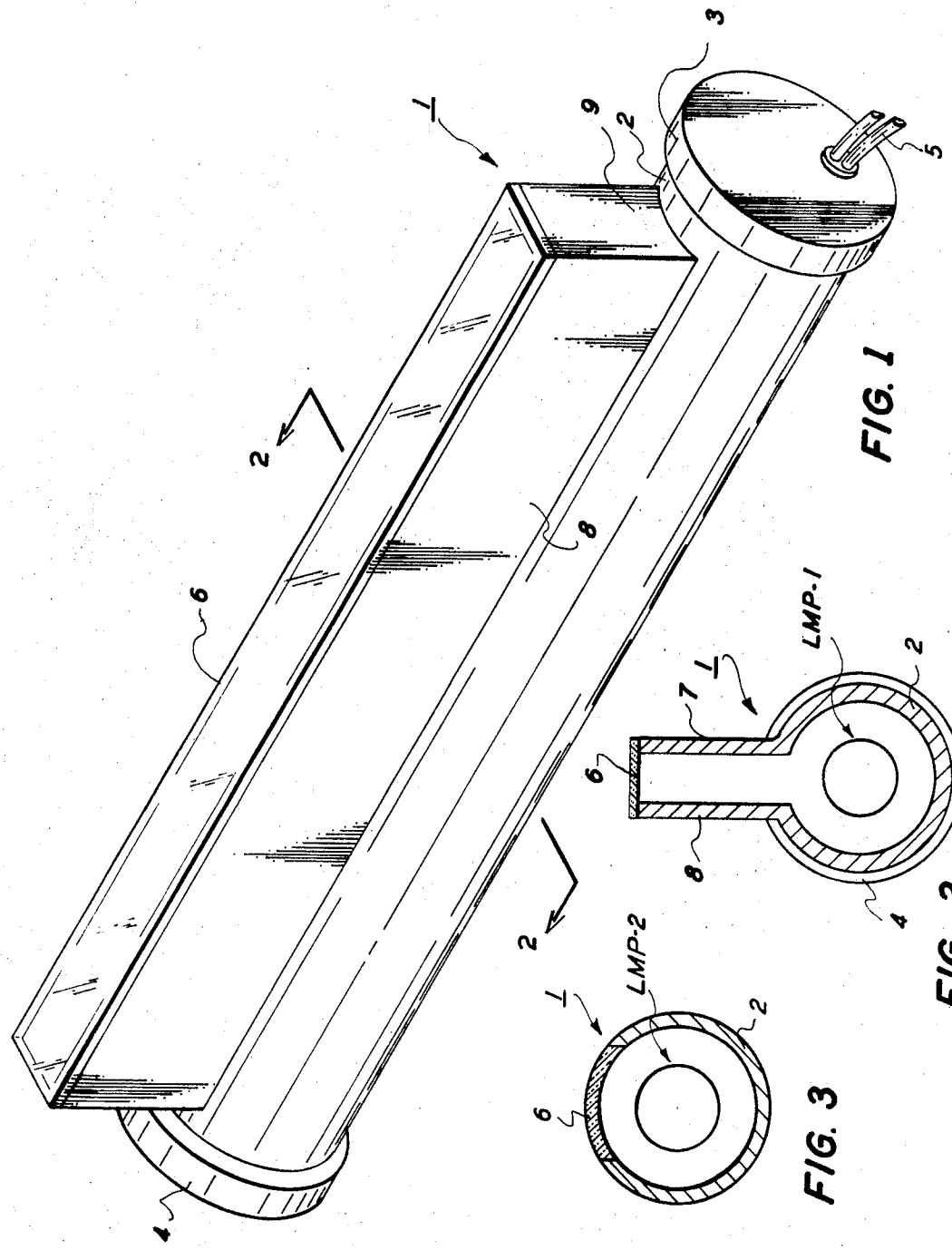


FIG. 1

FIG. 2

FIG. 3

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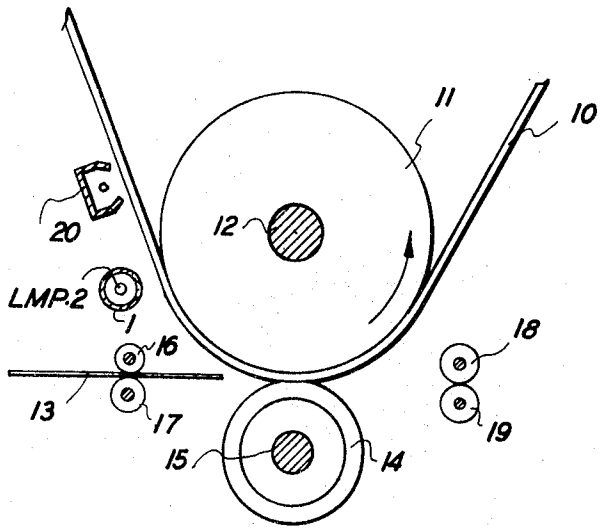


FIG. 4

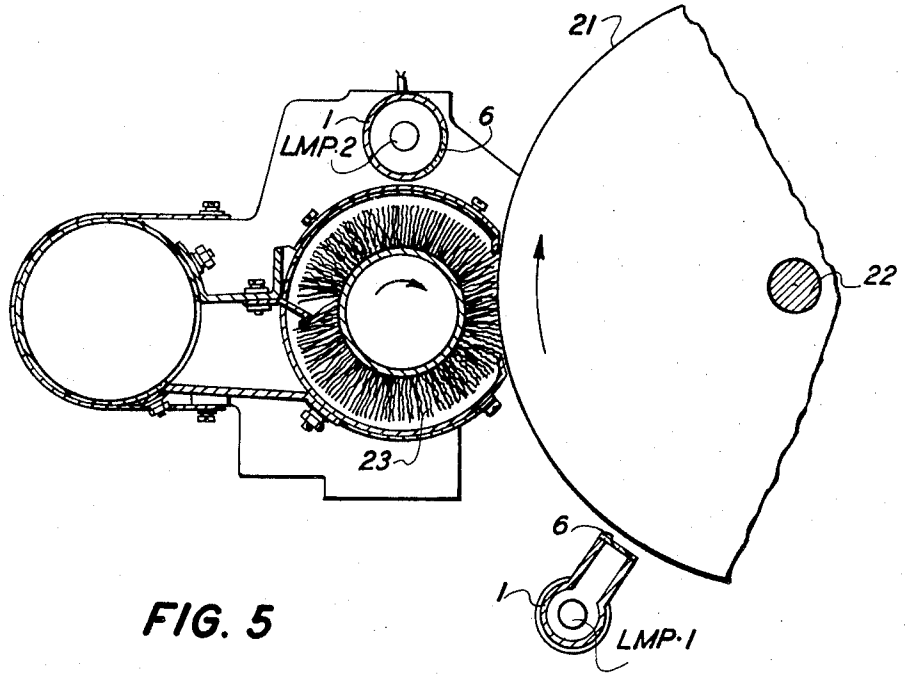


FIG. 5

METHOD AND APPARATUS FOR ENCLOSING A LAMP

BACKGROUND OF THE INVENTION

This invention relates generally to electrophotography and more particularly to method and apparatus for keeping a light source in an electrophotographic machine free from contaminating deposits of electroscopic toner material.

In electrophotographic or xerographic machines such as those illustrated in U.S. Pat. Nos. 3,062,110, 3,278,972 and 3,432,232, for example, light sources are not only utilized for illuminating the images to be copied, but are also utilized for flood illuminating the photoreceptive surface to dissipate or later the electrostatic charge thereon.

In such xerographic machines, a xerographic plate which includes a photoconductive surface on a conductive backing is advanced past a series of processing stations. At the charging station, a uniform electrostatic charge is deposited onto the photoconductive surface of the xerographic plate. At the exposure station, a light or radiation pattern of copy to be reproduced is projected onto the photoreceptive surface to dissipate the charge thereon in the exposed areas, and thereby form a latent electrostatic image of the copy to be reproduced. At the developing station, developer material including toner particles which are triboelectrically charged to a polarity which is generally opposite to the polarity of the electrostatic latent image on the photoreceptive surface are cascaded over the photoreceptive surface. As the developer material is thus cascaded over the photoreceptive surface, toner particles are attracted to and adhere to the electrostatic latent image to form a xerographic powdered image in the configuration of the copy being reproduced. At the transfer station, the xerographic powder image is electrostatically transferred from the photoreceptive surface to a transfer material or a support surface such as paper. At the cleaning station, the photoreceptive surface is cleaned by brushing, for example, to remove residual toner particles which may remain thereon after image transfer.

In each of the electrophotographic or xerographic machines described in the patents referred to above, the photoreceptive surfaces are flood illuminated prior to the charging step to effect a substantially complete discharge of any residual electrostatic charge remaining on the photoreceptor. In many applications it may also be desirable to provide flood illumination of the photoreceptive surface at other steps in the process, for example, prior to the transfer step or prior to the cleaning step.

However, after operation of such xerographic machines over extended periods of time, the internal components have been found to accumulate small deposits of loose toner material. As a result of the physical characteristics of the toner material employed in such machines, this problem has nevertheless persisted, notwithstanding numerous attempts to eliminate loose toner material within the machine.

While the operation of some components within the machine remains substantially unaffected by the accumulation of deposits of loose toner material, other components such as lamps, for example, are substantially affected if deposits of toner material are permitted to accumulate. As should be apparent, toner material if allowed to accumulate on lamps in xerographic machines substantially substracts from the illumination output of the lamps. Such lamps, therefore, require periodic cleaning to insure maximum illumination output. However, the cleaning of such lamps may itself present a somewhat difficult problem since the heat generated by the lamps may produce at least a partial melting of the toner material on the lamp envelope. It is therefore highly desirable to eliminate the periodic cleaning of the lamps in xerographic machines by preventing toner material from accumulating on the lamps.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to prevent the accumulation of contaminating deposits of toner material on a light source in a xerographic machine.

It is another object of the present invention to provide method and apparatus for keeping a light source in an electrophotographic or xerographic machine free from contaminating deposits of electroscopic toner material.

It is still another object of the present invention to provide an arrangement for eliminating unwanted toner deposits from a light source in a xerographic machine.

These and other objects of the invention are attained by enclosing the light source in a xerographic machine within an electrically chargeable closure member to physically isolate the light source from the toner material and electrically charging the closure member to a polarity to form an electric field to repel the toner material away from the closure member and the light source.

Other objects of the invention will become readily apparent to those skilled in the art in view of the following detailed disclosure and description thereof, especially when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is one embodiment of a lamp closure member as contemplated by the present invention.

FIG. 2 is a cross sectional view of the closure member of FIG. 1 taken along the lines 2—2.

FIG. 3 is a cross sectional view of a second embodiment of a lamp closure member as contemplated by the present invention.

FIG. 4 is a schematic illustration of a portion of a xerographic system incorporating the embodiment of closure member illustrated in FIG. 3.

FIG. 5 is a schematic illustration of a portion of a xerographic system incorporating the embodiments of closure members illustrated in both FIGS. 2 and 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The method and apparatus as contemplated by the present invention may best be understood by referring first to FIGS. 1–3 of the drawings. As illustrated therein, a light source typically adaptable for use in xerographic or electrophotographic machines and generally designated LMP comprises an elongated tubular envelope surrounding the active elements of the light source. While the present invention is particularly adaptable for use in conjunction with light sources of the fluorescent type, the invention is also equally

adaptable for use with other types of light sources such as incandescent, vapor, etc.

According to the present invention, the light source in a xerographic machine is kept free from contaminating deposits of electroscopic toner material by enclosing the light source within an electrically chargeable closure member **1** to physically isolate the light source from the toner material. In the embodiment of closure member illustrated in FIGS. **1** and **2**, the closure member comprises an elongated tubular member **2** which surrounds the light source LMP and extends along the length thereof. The elongated tubular member **2** may be sealed at either end thereof by means of end caps **3** and **4** which include suitable mounting means to support the light source LMP internally of the closure member **1**. Suitable means **5** may also be provided in one or more of the end caps **3** or **4** to electrically connect the light source to a power supply suitable for energizing the particular light source LMP employed.

In the embodiment as illustrated in FIG. **3**, closure member **1** also includes a substantially transparent window member **6** extending along the light source LMP which permits radiation energy from the light source to be emitted through the closure member. The embodiment as illustrated in FIGS. **1** and **2** also includes a substantially transparent window member **6** to permit radiation energy to be emitted by the light source through the closure member. However, in the embodiment of FIGS. **1** and **2** the window member **6** encloses the end of an elongated passageway formed by side walls **7** and **8** and end walls **9**.

With the light source LMP suitably enclosed in closure member **1** to physically isolate the light source from contaminating deposits of the electroscopic toner material, the closure member **1** may be electrically charged to a polarity to form an electric field to repel the toner material away from the closure member and the light source. While electrostatic charging is the preferred method of obtaining a repelling field forming charge on the closure member **1**, it should be readily understood and appreciated that the closure member **1** may also be electrically biased to a suitable electrical potential to produce an appropriate electric field about closure member **1** which similarly serves to repel the triboelectrically charged toner particles away from closure member **1** and light source LMP.

Where an electric field is formed about closure member **1** by applying a suitable electrical bias, closure member **1** or the window portion **6** thereof may comprise any suitable material which exhibits the characteristics of being both substantially optically transparent and electrically conductive. One suitable material which may be used is NESA glass which is a glass which is coated with conductive tin oxide on the surface thereof. Thus in applications where toner material having a triboelectric charge of a negative polarity is employed for example, a suitable negative bias may be applied to the window **6** of closure member **1** to form a field to repel the negatively charged toner particles away from the light source LMP and closure member **1**. While it is presently contemplated that only the window **6** be biased with the appropriate electrical potential, it is also possible to provide an electrical bias to the entire portion of closure member **1** to repel the charged toner particles.

In applications wherein the electrical field is formed about closure member **1** by electrostatic charging means, closure member **1** or window portion **6** thereof may comprise any suitable dielectric material which is substantially optically transparent. Typical dielectric materials include glass as well as plastics such as cellulose acetate, cellulose triacetate, cellulose acetate butyrate, ethyl cellulose, polymethyl methacrylate, fluoroplastics, polyethylenes polyamides, polypropylenes, polyesters and polystyrenes. Polyesters such as Mylar which is a trade name of E. I. duPont de Nemours & Co., Inc. has been found to work particularly well in this application. Thus, the window **6** of closure member **1** may be electrostatically charged to a polarity the same as the triboelectric charge of the particular toner material employed. For example, in applications wherein toner material having a triboelectric charge of a negative polarity is employed, the window **6** will be electrostatically charged to a negative polarity to form an electric field to repel the negatively charged toner particles away from the light source LMP and closure member **1**. While it is presently contemplated that only the window **6** be electrostatically charged to the appropriate polarity, it is also possible to have the entire portion of closure member **1** comprised of a dielectric material and electrostatically charge the entire portion of closure member **1** to repel the charged toner particles. The electrostatic charging of dielectric window **6** may be accomplished by means of corona discharge devices, by induction charging or by combinations of both.

In FIG. **4** of the drawings there is schematically illustrated a portion of a xerographic system employing the lamps and enclosure arrangement as contemplated by the present invention. As shown therein a photoreceptor **10** in the form of a web or endless belt is advanced over a roller member **11** supported on shaft **12**. In this arrangement xerographic images on a photoreceptor **10** are transferred to a support surface such as copy sheet **13** at the transfer station under the influence of an electrical field formed between transfer roller **14** and photoreceptor **10**. Transfer roller **14** is suitably mounted for rotation with photoreceptor **10** about shaft **15** permitting a sheet **13** to be advanced by roller pairs **16–17** and **18–19** through the nip formed between transfer roller **14** and photoreceptor **10**. The electrical field for effecting transfer of the xerographic images to the support material is formed by applying a suitable electrical bias to the roller member **14**.

Prior to transfer of the xerographic images on photoreceptor **10**, photoreceptor **10** is subjected to a corona discharge member **20** to neutralize the charge on the photoreceptor **10**. Subsequent to neutralizing the charge on photoreceptor **10**, the photoreceptor **10** is subjected to a lamp LMP enclosed in closure member **1** as contemplated by the present invention to further discharge the photoreceptor **10** and to enhance transfer of the xerographic images to the support sheet **13** at the transfer station. In this arrangement the proximity of corona discharge member **20** to closure member **1** is sufficient to produce an electrostatic charge on the dielectric portion of closure member **1** while at the same time serving the primary function of neutralizing the charge on the photoreceptor **10**. Thus as closure member **1** is electrostatically charged, toner particles will be repelled by the resulting electric field away from closure member **1** and light source LMP thus keeping closure member **1** and light source therein free from contaminating deposits of the toner material.

In FIG. 5 of the drawings there is also schematically illustrated a portion of a xerographic system employing the lamp and enclosure arrangement as contemplated by the present invention. In this system, lamp arrangements are utilized both prior to cleaning of the photoreceptive surface and also subsequent to the cleaning operation. As shown in FIG. 5, a photoreceptor 21 in the form of a cylindrical drum is rotated about a shaft 22 to pass the cleaning station at which the photoreceptive surface is rapidly brushed by a rotating brush member 23 to remove toner particles from the drum surface which may remain after the transfer operation. Prior to the cleaning station, the photoreceptive surface is subjected to flood illumination from light source LMP–1 enclosed in the embodiment of closure member 1 described in connection with FIG. 2. In this arrangement a charge is induced on the dielectric window 6 by the charged photoreceptor 21 as it is rotated past window 6. As window 6 is thus charged, toner particles will be repelled by the resulting electric field away from closure member 1 and light source LMP–1 thus keeping closure member 1 and light source LMP–1 therein free from contaminating deposits of the toner material.

Subsequent to the cleaning station, the photoreceptive surface is also subjected to flood illumination from light source LMP–2 enclosed in the embodiment of closure member 1 described in connection with FIG. 3. In this arrangement a suitable electrical bias is applied to the substantially transparent electrically conductive window portion of closure member 1 to create an electric field to repel toner particles away from closure member 1 and light source LMP–2 thus keeping closure member and light source LMP–2 therein free from contaminating deposits of the toner material.

From the foregoing description it will therefore be appreciated that the present invention provides both effective and reliable method and apparatus for keeping a light source in a xerographic or electrophotographic machine free from contaminating deposits of toner material.

While the present invention has been described with reference to preferred arrangements, it will be generally understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the true spirit and scope of the invention.

What is claimed is:

1. Apparatus for keeping a non-image forming light source used to floor a photosensitive member in an electrophotographic machine with radiation to which it is sensitive free from contaminating deposits of triboelectrically charged toner material comprising

an enclosure member for supporting said light source therein to physically isolate said light source from said toner material with the walls of the enclosure, said enclosure member including at least a portion thereof which is substantially transparent to the radiation emitted by said light source and

means for electrically charging at least the transparent portion of said enclosure member to form an electrostatic field to repel said toner material away from said charged portion of said enclosure member and said light source whereby at least said transparent portion of the enclosure member is kept free of contaminating toner material.

2. The apparatus of claim 1 wherein said transparent portion of said enclosure includes glass coated with a transparent conductive layer capable of being coupled to an electrical energy source for charging the transparent portion appropriately to form the electric field to repel the contaminating toner material.

3. The apparatus of claim 1 wherein said transparent portion of said enclosure member includes a dielectric material capable of retaining electrostatic charge on its surface to form said electric field for repelling the contaminating toner material.

4. The apparatus of claim 3 wherein said electrophotographic machine includes a corona discharge device arranged to deposit electrostatic charge on the surface of the photosensitive member and simultaneously deposit charge on the dielectric portion of said enclosure.

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