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Fukushima et al.

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[54] **APPARATUS FOR FORMING WHITE FRAME IN ELECTROPHOTOGRAPHY**

[76] Inventors: **Osammu Fukushima; Seiji Matsumoto; Masamichi Sato,** all of No. 105, Oaza Mizonuma, Asaka, Japan

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[21] Appl. No.: **336,748**

Related U.S. Application Data

[62] Division of Ser. No. 104,979, Jan. 8, 1971, abandoned.

[52] **U.S. Cl.** ..... **355/3 R,** 355/7, 355/17, 96/1 R

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

[58] **Field of Search** 355/3, 7, 17

[56] **References Cited**

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Primary Examiner—Richard M. Sheen

Attorney, Agent, or Firm—Gerald J. Ferguson, Jr.

[57] **ABSTRACT**

Electrophotographic apparatus having an exposure device for producing a white frame border about an electrostatic latent image. The apparatus comprises a plurality of internal channel members surrounding the exposure light source which open downwardly onto the copy sheet. The channel members contain a plurality of light sources for projecting light onto the perimetric portions of the copy sheet in partially overlapping relation to the electrostatic latent image for completely dissipating the charge about the electrostatic latent image so that no black border appears about the electrostatic latent image after toner development.

5 Claims, 6 Drawing Figures

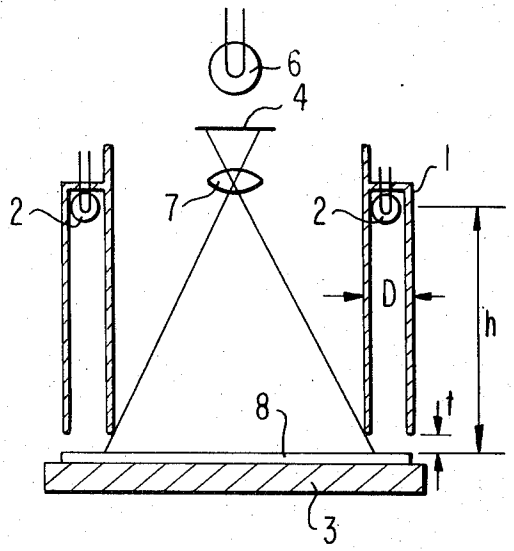


FIG. 1

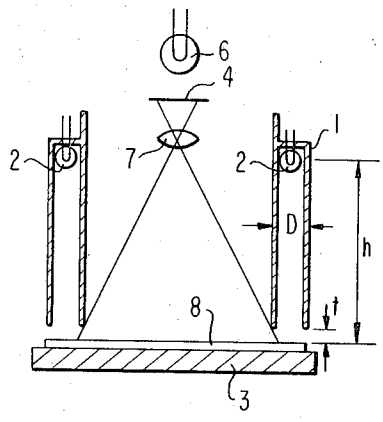


FIG. 2

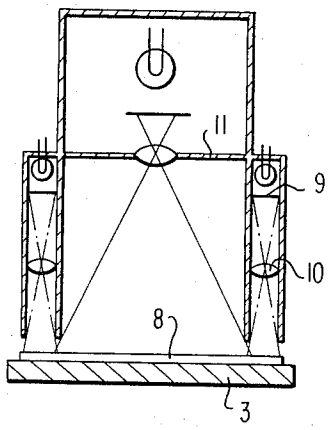


FIG. 3

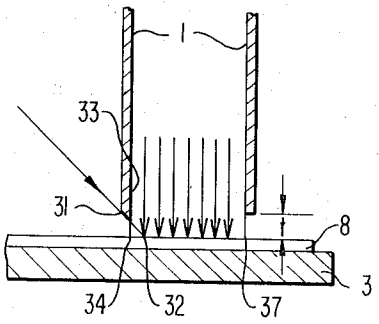


FIG. 4

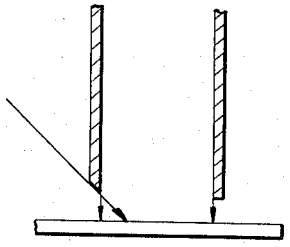


FIG. 5

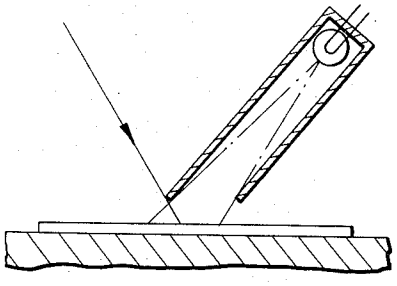
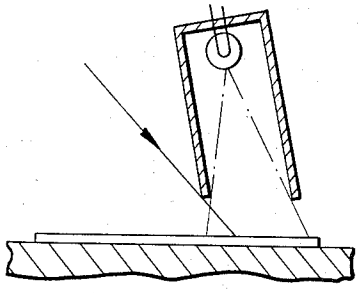


FIG. 6



APPARATUS FOR FORMING WHITE FRAME IN ELECTROPHOTOGRAPHY

RELATED APPLICATION

This is a division of an application Ser. No. 104,979 filed Jan. 8, 1971, now abandoned.

BRIEF SUMMARY OF THE INVENTION

This invention relates to a device for forming a white frame having no toner deposited thereon on the perimetric portion bounding the image without exerting any adverse effect upon the image on the sensitive layer.

BRIEF EXPLANATION OF THE DRAWING

FIG. 1 and FIG. 2 are longitudinally sectioned side views of the devices for working the present invention and FIG. 3 through FIG. 6 are longitudinally sectioned side views of the important parts thereof.

DETAILED DESCRIPTION OF THE INVENTION

In obtaining an electrophotographic image, there is generally followed a procedure whereby an electrophotographic sensitive layer is formed on a base having suitable electroconductivity, electrically charged uniformly such as by means of corona discharge so as to have photosensitivity conferred thereon, exposed to light from a given image so as to have an electrostatic latent image formed in conformity with the image on the electric charge distributed thereon, and caused to be approached by fine colored particles carrying electric charge (hereinafter referred to as "toner") so as to permit the toner to adhere selectively on the electrostatic latent image, converting the latent image into a visible image. In conferring electric charge on the sensitive layer by means of uniform electric charging, however, it has been customary heretofore to effect the charging on a large area more than sufficient for covering a generally used surface, namely, on an area wider than the area containing therein the surface exposed to the image. After the step of exposure to the image, therefore, it often happens that the perimetric portion bounding the image plane remains unexposed to light and therefore retains the electric charge unreleased. Particularly where there is involved the use of a printing frame, the perimetric portion bounding the image plane is covered by the printing frame and therefore is suffered to remain unexposed to light. When such sensitive layer is developed with a developing agent containing a toner charged to the opposite sign to that of the polarity of the electric charge for forming the electrostatic latent image (namely, the polarity of the electric charge to be conferred uniformly) (hereinafter, the treatment will be referred to as "attraction development"), since the toner is deposited in proportion to the amount of electric charge remaining on the sensitive layer, the toner is also deposited on the perimetric portion of image and consequently produces color thereon. Since the perimetric portion of image has not undergone discharging at all, it is developed to the highest density in all the area of the sensitive layer, making the reproduced image unsightly. Further, since unnecessary development is effected on the perimetric portion, the toner is wasted heavily. Therefore, the difference in toner density of developing agent becomes large before and after a large number of developments. As a result, there is involved a shortcoming that a heavy change occurs in the density of electrophotographic images as the treatment of development is repeated.

This invention relates to a device for forming a white frame having no toner deposited thereon on the perimetric portion bounding the image without exerting any adverse effect upon the image on the sensitive layer. And, this device has overcome those shortcomings mentioned above.

Now, the present invention is described with reference to the drawing. In FIG. **1**, **1** denotes a light-shielding frame having a cross section of the shape of ⊓ with an opening in the direction of the sensitive layer, **2** a light source disposed on the upper end of the light-shielding frame **1**, **3** a base for mounting a sensitive paper, **4** a transparent original, **6** a light source for projection, **7** a projection lens system, and **8** a sensitive paper mounted on the aforementioned mounting base **3**. The photosensitive surface of the sensitive paper **8** is spaced by an opening "t" from the lower end of the light-shielding frame **1**. In this device, the transparent original **4** is projected and formed on the sensitive paper **8** by means of the light source for projection **6** and the projection lens system **7** so as to form an electrostatic latent image and, at the same time, the frame-shaped perimetric portion bounding the formed image is exposed to light from the light source **2** held within the light-shielding frame **1** until the electric charge on the sensitive paper **8** in that portion is eliminated completely. The light from the light source **2** within the light-shielding frame **1** falls on the sensitive paper almost at right angles. The portion of light from the light source for porjection which advances diagonally through the opening "t" at the lower end of the light-shielding frame **1** reaches the frame-shaped portion exposed by means of the light-shielding frame **1**. Consequently, no unexposed portion occurs between the image area and the frame-shaped portion thus exposed. Upon development, therefore, a black line having the thickness corresponding to the thickness of the board forming the light-shield frame **1** will not appear between the white frame and the image area.

A description is made of the portion close to the lower end of the light-shielding frame **1** with reference to FIG. **3**. The light for the formation of image has its boundary formed by the outer edge **31** at the lower end of the light-shielding frame **1** and, with respect to the sensitive paper, the boundary is formed at the point **32** below the light-shielding frame **1**. The boundary **34** which is formed by the inner edge **33** at the lower end of the light-shielding frame **1** lies inside the image area. The light projected in the shape of a frame by means of the light-shielding frame **1** and the light projected for the formation of image overlaps each other below the light-shielding frame **1**, enabling the electric charge on the sensitive paper **8** to be eliminated without reference to the magnitude of the light for the formation of image. As a consequence, there is obtained a clean white frame. The opening "t" is determined by taking this relationship into account. In order that the light emitted inside the light-shielding frame **1** may not exert any adverse effect on the image area and that the white frame may be obtained in a clear contrast, the value of "t" is desired to be as small as possible. However, the opening must be such that the sensitive paper **8**, when suffered to rise, will not come into contact with the lower end of the light-shielding frame **1**. The opening is desired not to exceed 20 mm. The value of "t" for which

the aforementioned effect can be achieved becomes small according as the board forming the light-shielding frame **1** decreases in thickness. So far as the distance "h" from the light source **2** to the sensitive paper **8** is so fixed as to satisfy $h = 20t$, possible fading in the white frame does not pose any problem practically. The light source **2** may comprise a number of electric bulbs disposed at suitable intervals, a slender light source like a fluorescent lamp or a light-conducting tube such as of fiber optics. In this device, no specific time is required for the formation of the white frame when the light source **2** within the light-shielding frame **1** and the light source **6** for image projection are so synchronized as to permit the exposure for formation of the white frame to be effected simultaneously with the exposure to the image or when the light source **2** is kept on at all times inside the light-shielding frame provided with a shutter and the shutter is opened at the same time the light source **6** for the projection of image is lit on.

FIG. **2** illustrates a device for providing a fixed magnification, which device has a diffusing plate **9** and a cylindrical lens **10** directly below the light source **2** in the device shown in FIG. **1.** This device serves to uniformize the light projected for the formation of white frame and enhance the quantity of light utilized therefor. Further, a light-shielding plate **10** is disposed above the light-shielding frame **1** so as to permit the device to be utilized where not perfectly dark room is available.

In the device to be used for the present invention, it is desirable for the prevention of scattering of light emanating from the light source **2** to have the interior surface of the light-shielding frame **1** finished with a black delustered paint having high absorbing property, for example. The lower end of the light-shielding frame **1** is desired to be formed with a material having relatively high resistance so that it may not destroy the latent image even when the sensitive paper **8** is suffered to rise from the base and come into contact therewith.

FIG. **4** illustrates an example wherein the lower end of the light-shielding frame **1** is cut diagonally along the direction in which the light for the formation of image advances.

FIG. **5** and FIG. **6** illustrate examples wherein the light-shielding frame is inclined with reference to the surface of the sensitive paper.

As has been described, this invention covers a method for forming a white frame, whereby the light-shielding frame is placed at a distance from the surface of the sensitive paper so that when the light for projection of the image and the light from the light source within the light-shielding frame are emitted, these lights overlap at the portion where the white frame is formed in the perimetric portion bounding the image area and consequently there is produced a clear white frame.

What is claimed is:

1. An electrophotographic apparatus comprising: means for projecting a light image from an original sheet onto a copy sheet having an uniformly electrically charged photoconductive layer to form an electrostatic latent image thereon; means for fixedly supporting a copy sheet having an uniformly electrically charged photoconductive layer to form an electrostatic latent image thereon; means for fixedly supporting a copy sheet having an uniformly electrically charged photoconductive layer in a fixed position in alignment with said projection means during formation of the electrostatic latent image; and exposure means for forming a white frame border about the electrostatic latent image, said exposure means comprising frame forming means adjacent said projection means for projecting light onto a perimetric portion of the charged photoconductive layer in partially overlapping relation to the electrostatic latent image while the copy sheet remains at said fixed position for completely dissipating the charge about the electrostatic latent image so that no black border appears about the electrostatic latent image after the image is toner developed.

2. Apparatus as in claim **1** where said frame forming means comprises a plurality of internal channel members opening downwardly onto the charged photoconductive layer, said channel members surrounding said projection means with the opening thereof disposed adjacent portions of the charged photoconductive layer and a plurality of light sources respectively disposed within said channel members.

3. Apparatus as in claim **2** where the distance between the openings in said channel members and the charged photoconductive layer is not more than 20 millimeters.

4. Apparatus as in claim **3** where each said channel member includes means for directing the light therefrom substantially perpendicularly onto the charged photoconductive layer.

5. Apparatus as in claim **1** wherein said projection means and said frame forming means simultaneously project the light image and the frame forming light on the uniformly charged photoconductive layer.

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