United States Patent [19]

Okamoto et al.

[11] **3,851,230**

[45] **Nov. 26, 1974**

[54] **ELECTROSTATIC TRANSFER-PRINTING SHEET STRIPPING DEVICE**

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[22] Filed: **May 18, 1973**

[21] Appl. No.: **361,646**

[30] **Foreign Application Priority Data**

June 9, 1972 Japan 47-68643

[52] **U.S. Cl.** ..... **317/262 A**, 317/2 R, 355/3

[51] **Int. Cl.** **G03g 13/18**

[58] **Field of Search** ..... 317/2 R, 262 A; 271/51, 271/DIG. 2; 355/3; 250/324–326

[56] **References Cited**

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Attorney, Agent, or Firm—Cooper, Dunham, Clark, Griffin & Moran

[57] **ABSTRACT**

A device wherein a transfer-printing sheet electrostatically adhering to the photosensitive surface of a photoreceptor after an electrostatic latent image has been formed thereon by transfer-printing from the photoreceptor is subjected to optical illumination to remove the residual charge from the photosensitive surface so as to permit the transfer-printing sheet to be easily peeled off the photoreceptor.

10 Claims, 3 Drawing Figures

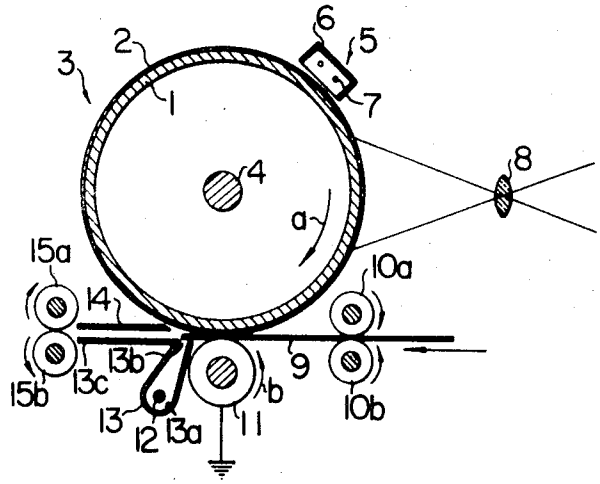


FIG. 1

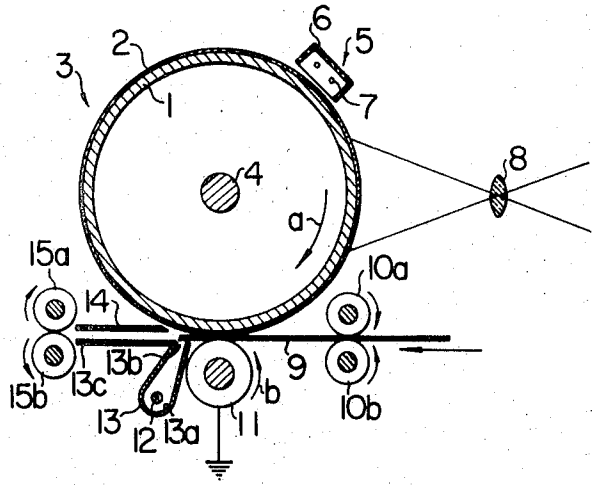


FIG. 2

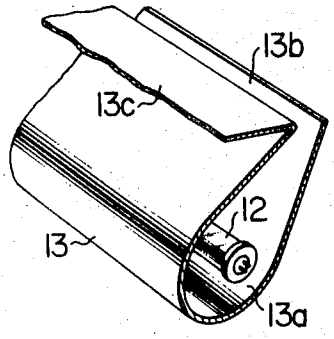
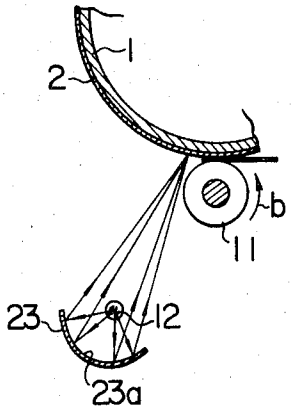


FIG. 3



ELECTROSTATIC TRANSFER-PRINTING SHEET STRIPPING DEVICE

BACKGROUND OF THE INVENTIOn

This invention relates to electrostatic transfer printing sheet stripping devices, and more particularly to such a device adapted for use with electrophotographic copying apparatus of the transfer-printing type.

In electrophotography of the transfer-printing type, a transfer-printing sheet is brought into pressing engagement with an electrophotographic photoreceptor, such for example as a photosensitive drum or photosensitive belt on which an electrostatic latent image is formed, to form in turn an electrostatic latent image on the transfer-printing sheet by transfer-printing from the photoreceptor. A developing agent containing toner particles is then supplied to the electrostatic latent image on the transfer-printing sheet to develop it into a visible toner image.

Difficulty is experienced in separating the transfer-printing sheet from the photoreceptor after they have been brought into pressing engagement with each other to form an electrostatic latent image on the transfer-printing sheet, because the transfer-printing sheet is electrostatically attracted to the photoreceptor on which the electrostatic latent image is formed.

In order to obviate this problem, several attempts have been made to facilitate stripping of the transfer-printing sheet from the photoreceptor. These include: the flowing of a stream of compressed air against the leading end portion of the transfer-printing sheet and the photoreceptor; utilizing negative or subatmospheric pressure to peel off the leading end portion of the transfer-printing sheet from the photoreceptor; giving a push as by a lever to the leading end portion of the transfer-printing sheet from inside the photoreceptor in drum form; flipping up the transfer-printing sheet by means of a separator extending through a cutout formed in the photoreceptor in drum form; and using a photoreceptor in drum form having an axial length smaller than the width of the transfer-printing sheet so that the marginal portion or portions of the photoreceptor extending outwardly from the outer periphery of the photosensitive drum may be moved upwardly as by a guide plate to peel off the transfer-printing sheet from the photosensitive drum.

These stripping means all have disadvantages. Means using compressed air is large in size and cumbersome. The use of a lever to push the leading end portion of the transfer-printing sheet from inside the photosensitive drum or the use of a separator extending through the cutout formed in the drum makes it necessary to increase the size of the drum more than is necessary and complicates the construction of the drum. In addition, problems arise as to how to operate such separator means with proper timing and with reliability in performance. The use of a photosensitive drum having a smaller axial length than the width of the transfer-printing sheet may result in the image formed on the transfer printing sheet being defective.

SUMMARY OF THE INVENTION

This invention involves an electrostatis transfer-printing sheet stripping device, simple in construction and high in efficiency, in which a transfer-printing sheet electrostatically adhering to the photosensitive surface of a photoreceptor, after an electrostatic latent image has been formed thereon by transfer-printing from the photoreceptor, is subjected to optical illumination to remove the residual charge from the photosensitive surface so as to permit the transfer-printing sheet to be easily peeled off from the photoreceptor.

According to the invention, there is provided a device which permits a transfer-printing sheet positively to be peeled off from a photoreceptor without using a bulky apparatus and complex mechanism. If the photosensitive surface of the photoreceptor is continuously exposed to optical illumination according to the invention, it is possible to remove the residual charge on the photosensitive drum. This is conducive to prevention of deterioration of the photoreceptor due to discharge breakdown.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of the electrostatic transfer-printing sheet stripping device comprising one embodiment of this invention;

FIG. **2** is a perspective view, on an enlarged scale, of the essential portions of the stripping device shown in FIG. **1**; and

FIG. **3** is a sectional view of the electrostatic transfer-printing sheet stripping device comprising another embodiment of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

The invention will be described with reference to embodiments shown in the drawings wherein the photoreceptor is a photosensitive drum.

First, the transfer-printing operation in electrophotography wherein the photosensitive drum moves in revolving motion will be described functionally. As shown in FIG. **1**, the photoreceptor of an electrophotographic copying apparatus of the transfer-printing type comprises an annular supporter **1**, and a photoconductive material layer or a photosensitive surface **2** formed on the outer surface of the supporter **1** which make up a photosensitive drum **3** rotating in the direction of an arrow *a* so that the transfer-printing operation may be performed continuously by the photosensitive surface **2**.

The photosensitive drum **3**, which is supported for rotation by a shaft **4**, is rotated at a constant rate from a synchronous motor (not shown). When the photosensitive drum **3** rotates, the photosensitive surface **2** is uniformly charged by a charging device **5** which is disposed in the charging station along the path of movement of the periphery of the drum **3** and comprises one or more corona discharge electrodes **7** energized by a high voltage power source and enclosed by shield means **6**. The charging device **5** extends across the width of the periphery of the drum **3**. In this station, an electrostatic charge is uniformly applied to the photoconductive material layer of the photosensitive drum **3**.

Disposed next to the charging device **5** along the path of movement of the periphery of the drum **3** is an exposing device disposed in the exposing station where an optical system **8**, for example is disposed to expose the photoconductive layer or photosensitive surface **2** of the drum **3** to an optical image of an original to be duplicated. By exposure to the optical image, the electric charge carried by portions of the photosensitive surface which are exposed is removed to form an electrostatic

latent image thereon. The photosensitive surface **2** of the drum **3** has a potential ranging from about 1000 volts to 10 volts when the electrostatic latent image is formed thereon.

The transfer-printing device is disposed next to the exposing device along the path of movement of the periphery of the drum **3**, in the transfer-printing position at which an electrostatic latent image is formed on a transfer-printing sheet **9** by transfer-printing from the photosensitive surface **2** of the drum **3.** That is, the electrostatic latent image formed on the photosensitive surface of the drum is transferred to the photosensitive sheet **9** which may be made of paper or any other suitable material. The transfer-printing sheet **9** is automatically fed by a pair of sheet feed rollers **10**a and **10**b and brought into contact with the electrostatic latent image on the photosensitive surface **2** of the drum **3.** The transfer-printing sheet **9** is maintained in contact with the electrostatic latent image and pressed at its back by a transfer-printing roller **11** so that transfer-printing of the electrostatic latent image may be effected.

The transfer-printing roller **11,** which is rotated in the direction of an arrow *b* by a drive mechanism (not shown) is adapted to bear against the transfer-printing sheet **9** when the transfer-printing is effected. An electrically conductive roller may be used as the transfer-printing roller **11** and a bias voltage may be impressed thereon to promote transfer-printing of the electrostatic latent image. A transfer-printing aid in the form of a transfer-printing belt may be used in place of the transfer-printing roller **11.**

The transfer-printing sheet **9** on which the electrostatic latent image has been formed by transfer-printing from the photosensitive surface **2** of the drum **3** is then peeled off the drum **3** by the stripping device according to the invention and delivered to a developing device (not shown).

The stripping device according to the invention is disposed next to the transfer-printing device and comprises a light source **12** and a reflector **13** for directing light rays in the visible region against the transfer-printing sheet and the photosensitive surface **2** of the drum **3** on which the electrostatic latent image still remains.

The light source **12** comprises a cylindrical lamp as shown in FIG. **2,** and is enclosed by the reflector **13** which is formed on its inner surface with a reflecting surface **13**a. The light rays emanating from the light source **12** are reflected and converged by the reflector **13** as they move upwardly and directed toward the photosensitive drum surface adjacent the transfer-printing position. The reflector **13** is made by bending a plate into a shape which is substantially in the form of a letter U in cross-section, and has an opening **13**b in its upper end which is about **5** millimeters in width.

The reflector **13** is disposed such that its upper opening **13**b is in spaced juxtaposed relationship to the back of the transfer-printing sheet **9** which has been brought into pressing engagement with the photosensitive surface **2** of the drum **3.** One of two edges forming the upper opening **13**b which is disposed remote from the transfer-printing roller **11** has an extension **13**c which is disposed horizontally to serve as a guide for delivering the transfer-printing sheet **9** to the developing device after transfer-printing is effected. A guide plate **14** is disposed in spaced juxtaposed relationship to the extension **13***c* to define therebetween a transfer-printing sheet passage.

In operation, light rays for stripping the transferprinting sheet **9** are directed against the leading end portion of the transfer-printing sheet after transfer-printing is effected. More specifically, if the light source **12** is turned on when it is desired to perform a stripping operation, the light rays emanating therefrom will be reflected by the reflector **13** and radiated through the opening **13***b*. The transfer-printing sheet **9** and the photosensitive surface **2** of the drum **3** are exposed to the light rays, so that the residual charge on the photosensitive surface **2** is removed. The transfer-printing efficiency is about 1/10 when the electrostatic latent image formed on the photosensitive surface **2** of the drum **3** is transferred to the transfer-printing sheet by the pressure applied by the transfer-printing roller **11.** Thus more or less electrostatic charge remains on the photosensitive surface **2** of the drum **3** after transfer-printing is effected, and the transfer-printing sheet **9** sticks to the photosensitive surface **2** by electrostatic adhesion.

However, by exposing the transfer-printing sheet and the photosensitive surface of the drum to light rays as aforementioned, it is possible to remove the residual charge from the photosensitive surface and peel off the transfer-printing sheet from the photosensitive surface of the drum so that the transfer-printing sheet may move in its travel toward the developing device.

Since the transfer-printing sheet **9** is made of an insulator, the charge carried thereon is not removed even if it is exposed to light rays.

From the foregoing description, it will be appreciated that the transfer-printing sheet adhering to the photosensitive surface of the drum can be readily and positively peeled off therefrom. The transfer-printing sheet released from engagement with the drum is delivered by a pair of conveyor rollers **15***a* and **15***b* to the developing device.

The opening **13***b* of the reflector **13** is narrowed in order to make the light rays converge and to prevent the leading end of the stripped transfer-printing sheet from finding its way through the opening **13***b* into the reflector **13.** When the opening **13***b* is increased in width, strings or wires may be trained in the opening **13***b* in the direction of movement of the transfer-printing sheet.

FIG. **3** shows another embodiment in which light rays of high intensity are directed to the stripping position. In this embodiment, a reflector **23** has a reflecting surface **23***a* of the shape whhich corresponds to one-half portion of an ellipse cut along its major axis. The lgiht source **12** is arranged such that it is disposed in a first focusing position of the reflector **23,** and a second focusing position of the reflector **23** corresponds to the stripping position at the leading end portion of the transfer-printing sheet **9.** By this arrangement, light rays reflected by the reflector **23** converge at the second focusing position of the reflector **23** so that stripping light of high intensity can be directed to the stripping position.

When it is desired to illuminate the stripping position with parallel light rays, a parabolic mirror may be used as the reflector **23.**

From the foregoing description, it will be appreciated that the stripping device according to the invention readily permits the transfer-printing sheet to be peeled

off from the photosensitive surface of the photosensitive drum after an electrostatic latent image is formed on the transfer-printing sheet by transfer printing from the photosensitive surface through illuminating the back of the transfer-printing sheet by throwing optical light on to the stripping position near the transfer-printing position in which the transfer-printing sheet is brought into pressing engagement with the photosensitive surface of the drum.

If the transfer-printing sheet **9** is a sheet of paper having its surface treated with a dielectric material, the device according to the invention can achieve better results.

What is claimed is:

1. An electrostatic transfer-printing device of the type comprising:

a. a photoreceptor having a photosensitive surface on which an electrostatic latent image is formed for transfer to a transfer-printing sheet;

wherein the improvement comprises:

b. means for bringing one surface of a transfer-printing sheet into pressing engagement with the photosensitive surface at a transfer-printing position and for applying a voltage to the other surface of said sheet, of opposite polarity from that of the electrostatic latent image charge, to transfer said image onto said transfer-printing sheet by transfer-printing from the photosensitive surface; and

c. illumination means for throwing visible light rays onto the photosenitive surface adjacent the transfer-printing position after the transfer-printing sheet is brought into pressing contact with the photosensitive surface of the photoreceptor to illuminate the transfer-printing sheet on which the electrostatic latent image has been formed and the photosensitive surface of the photoreceptor on which there is a residual charge so as to remove said residual charge sufficiently to release said transfer-printing sheet from said photosensitive surface.

2. A device as in claim **1** wherein said illumination means comprises a light source and a reflector for directing said light rays onto said photosensitive surface.

3. A device as in claim **2** wherein said reflector has a reflecting surface of the shape which corresponds to onehalf portion of an ellipse cut along its major axis.

4. A device as in claim **3** wherein the edge of said reflector remote from the transfer-printing position has an extension thereon for guiding said transfer-printing sheet after release.

5. A device as in claim **1** including guide means for guiding said transfer printing sheet after illumination by said illuminating means.

6. A method for stripping a transfer-printing sheet from the photosensitive surface of a photoreceptor against which it has been pressed to transfer-print a latent electrostatic image on one surface thereof comprising the steps of applying a voltage of opposite polarity to that of the latent electrostatic image charge to the other surface of said sheet during the pressing and shining visible light rays onto the photosensitive surface of said photoreceptor adjacent the transfer-printing position after the transfer printing to illuminate the transfer-printing sheet on which the electrostatic latent image has been formed and the photosensitive surface of the photoreceptor on which there is a residual charge so as to remove said residual charge sufficiently to release said transfer-printing sheet from said photosensitive surface.

7. A method as in claim **6** wherein said light rays are shone by means of a light source and further comprising the step of disposing a reflector about said light source for directing and concentrating said light rays onto said photosensitive surface.

8. A method as in claim **7** wherein said reflector is formed by the step of bending a flat plate into a shape which is substantially in the form of a letter u in cross section and has a narrowed upper opening.

9. A method as in claim **6** wherein the transfer printing sheet is made of paper and its surface is treated with a dielectric material.

10. A method as in claim **6** including the step of providing a guide way for the transfer printing sheet after shining the light rays thereon.

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