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Suzuki et al.

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[54] **TRANSFER PRINTING APPARATUS OF ELECTROPHOTOGRAPHIC APPARATUS**

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[52] **U.S. Cl.** **355/3,** 355/64, 355/110
[51] **Int. Cl.. G03g 15/00,** G03b 27/10, G03b 27/32
[58] **Field of Search** 355/3, 64, 110

[56] **References Cited**

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[57] **ABSTRACT**

In transfer printing apparatus of electrophotographic apparatus of the type wherein a receptor sheet is urged against a photosensitive element carried by a rotary drum by means of a transfer printing roller so as to transfer print an electrostatic latent image formed on the photosensitive element onto the receptor sheet there is provided a stationary separating member between the receptor sheet and the photosensitive element. Preferably, the separating member comprises a pair of strips which are disposed at an angle with respect to the direction of movement of the receptor sheet.

2 Claims, 6 Drawing Figures

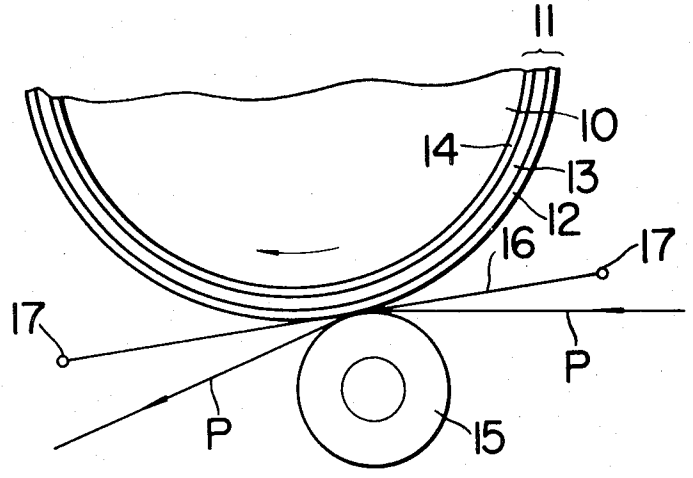


FIG. 1

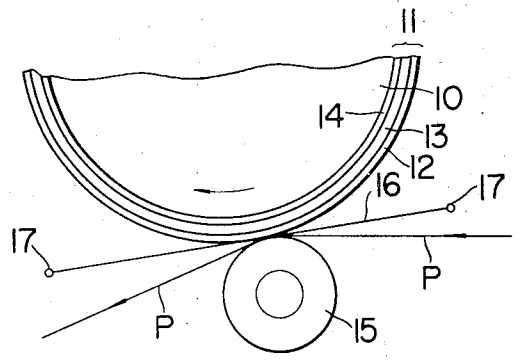


FIG. 2

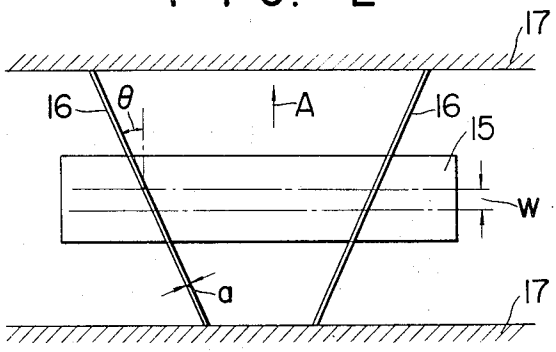


FIG. 3

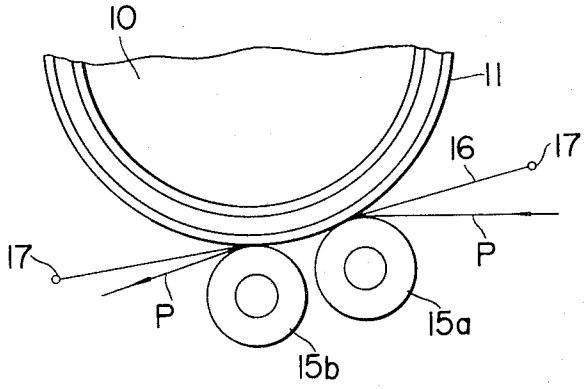


FIG. 4

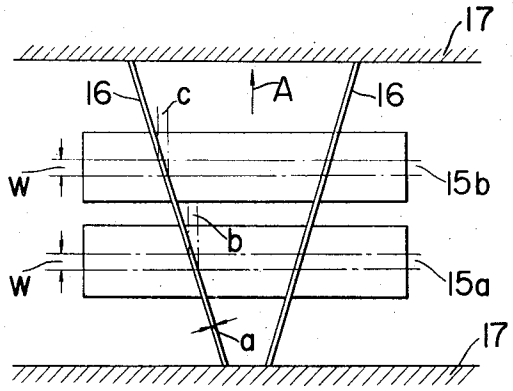


FIG. 5

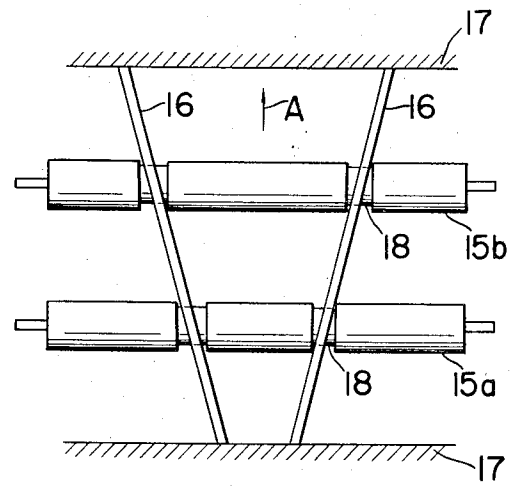
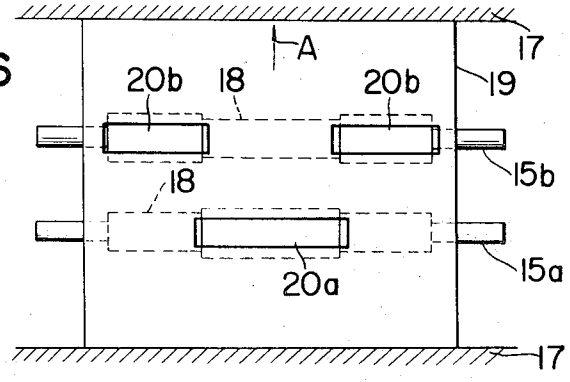


FIG. 6



TRANSFER PRINTING APPARATUS OF ELECTROPHOTOGRAPHIC APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to apparatus for separating a receptor sheet or a transfer printing paper from a photosensitive drum of an electrophotographic apparatus after an electrostatic latent image formed on the surface of the drum has been transfer printed onto the receptor sheet.

In one type of electrophotographic apparatus, an electrostatic latent image formed on the surface of a rotary photosensitive element corresponding to an original is transfer printed onto a receptor sheet by means of a transfer printing roller which acts to urge the receptor sheet against the photosensitive element and then the transfer printed latent image is developed to obtain a visible image. However, it is difficult to separate or peel off the receptor sheet from the photosensitive element because the electrostatic force of the latent image attracts the receptor sheet toward the photosensitive element.

To positively separate the receptor sheet from the photosensitive element it has been proposed various devices including (1) a device wherein a peel off member is contacted against the periphery of the rotary photosensitive element for mechanically separating the receptor sheet, (2) a device wherein the leading edge of the receptor sheet is slightly curved away from the periphery of the photosensitive element and a peel off member is disposed with its inner end slightly spaced apart from the periphery of the rotary photosensitive element so as not to damage it, (3) a device wherein after the transfer printing an air jet is applied to the leading edge of the receptor sheet to separate it from the photosensitive element, (4) a device wherein a suction drum is arranged behind the receptor sheet to separate it by suction (5) and combinations of these devices. However, with devices (1) and (2) it is impossible to transfer print the latent image along the entire length of the receptor sheet thus decreasing the effective area thereof. Devices (3) and (4) not only require the provision of a source of pressurized air but also are difficult to positively peel off the receptor sheet where the quantity of the charge of the latent image is large as in the case of a perfectly black picture.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide a new and improved apparatus for separating a receptor sheet from a photosensitive element.

Another object of this invention is to provide novel separating apparatus of simple construction which can efficiently separate a receptor sheet from a rotary photosensitive element after the electrostatic latent image has been transfer printed but does not interfere with the transfer printing.

According to this invention there is provided transfer printing apparatus of electrophotographic apparatus of the type wherein a receptor sheet is urged against a photosensitive element carried by a rotary drum by means of a transfer printing roller so as to transfer print an electrostatic latent image formed on the photosensitive element onto the receptor sheet, characterized in that a stationary supporting member is interposed between the receptor sheet and the photosensitive element.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. **1** shows a side view, partly broken away, of a photosensitive drum provided with separating apparatus embodying the invention;

FIG. **2** is a plan view of a transfer printing roller and separating members;

FIG. **3** shows a side view similar to FIG. **1** but showing a modified embodiment using two transfer printing rollers;

FIG. **4** is a plan view showing the transfer printing roller and separating members of the embodiment shown in FIG. **3**;

FIG. **5** is a plan view similar to FIG. **4** showing modified transfer printing rollers and

FIG. **6** is a plan view showing a modified separating member and modified transfer printing rollers.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. **1**, a rotary photosensitive drum **10** utilized for forming an electrostatic latent image on the periphery thereof may be any suitable construction and the latent image may be formed by any suitable method. In the illustrated example, the drum **10** carries a cylindrical photosensitive element **11** including an electrode layer **14**, a photoconductive layer **13** and a transparent highly insulative layer **12** which are bonded together into an integral cylindrical structure. Where the drum **10** is made of metal, the electrode layer **14** may be omitted. The photoconductive layer **13** may be made of any photoconductive material or phosphor manifesting persistent internal polarization, such as CdS, Zn CdS, CdS or Zn CdS activated with copper or silver, selemium, anthracene or TeSe. A latent image may be formed on the surface of the highly insulative layer **12** by applying a first electric field across the photosensitive element to deposit a charge of one polarity on the surface of the highly insulative layer thereby establishing substantially uniform persistent internal polarization in the photoconductive layer, applying a second electric field across the photosensitive element to deposit a charge of the opposite polarity on the surface of the highly insulative layer, and projecting a light image upon the photoconductive layer through the highly insulative layer concurrently with the application of the second electric field thereby forming the latent image on the surface of the highly insulative layer. Above described method is advantageous in that the latent image is not erased by later irradiation of light so that it is possible to carry out the transfer printing and developing operations in the bright. Where the photoconductive layer contains a large number of deep charge trap levels, as in the case of Zn CdS activated with silver or copper, it is desirable to irradiate the latent image with uniform light from an electric lamp for example.

In the case of the conventional xerography, the latent image is formed by applying an electric field across the photosensitive element in the dark and then projecting a light image. In this case, however, as the latent image is readily erased by light it is necessary to carry out the transfer printing and developing operations in the dark as is well known in the art.

To transfer print the latent image thus formed on the periphery of the photosensitive element onto a recep-

tor sheet P, usually an ordinary paper, there is provided a transfer printing roller **15** which is made of rubber, for example, and is urged against the periphery of the rotary photosensitive element **11** by suitable means, not shown. According to this invention, one, two or more spaced apart seperating members **16** of a fiber, string or tape of a synthetic resin such as nylon and polytetrafluoroethylene or metal foil are provided between stationary members **17,** to extend through the nip between photosensitive element **11** and transfer printing roller **15** and the receptor sheet P is fed between the separating members and the transfer printing roller. Among various materials, strips of polytetrafluoroethylene are found to be most suitable because they have flat and smooth surface so that they do not damage the photosensitive element and receptor sheet by the contact friction, and because they have small elongation, a large shear strength and a long life. Even when a conductive material such as a metal foil or sheet is used, the electrostatic latent image would not be erased so long as the contact pressure between the separating members and the photosensitive element is low. Conductive material has a large durability. As shown in FIG. **2,** the separating members are disposed at an angle θ with respect to the direction of movement of the receptor sheet P which is indicated by arrow A. Since the separating members are disposed between the rotary drum and the receptor sheet they act to separate the receptor sheet from the rotary drum after transfer printing. As the rotary drum is rotated, the separating members are contacted by the surface of the photosensitive element so that one may consider that the latent image would be erased or certain portion of the latent image would not be transfer printed. Actually, however, it was found that the latent image can be satisfactorily transfer printed where a relation $a/W < \sin\theta$ is satisfied, where W represents the contact width between the peripheries of the photosensitive element and transfer printing roller and a the width of a separating member. Moreover, since the separating members are disposed at an angle with respect to the direction of movement of the receptor sheet P it is possible to prevent the receptor sheet from crimpling. While separating members of any number may be used, the material from which the separating members are formed should be wear resistant and should not damage the surfaces of the photosensitive element and the receptor sheet. The result of experiment shows that a nylon fiber having a diameter of 0.2 mm and a tape of polytetrafluoroethylene having a thickness of 0.05 mm and a width of 3 mm are satisfactory. The separation of the receptor sheet can be enhanced where the receptor sheet P is fed into the nip and removed from the nip, both at an angle with respect to the separating members, as diagrammatically shown in FIG. **1.** Further, the separating members may be inclined in the same direction, but better results are obtained when they are inclined in the opposite directions as shown in FIG. **2.**

In the modified embodiment shown in FIGS. **3** and **4,** two parallel transfer printing rollers **15***a* and **15***b* which are spaced apart in the direction of movement A of the receptor sheet are provided to increase the effective area of the contact width W. With this arrangement, there is no fear of mis-transfer printing even when the width a of the separating members **16** is large. More particularly, as shown in FIG. **4,** when the latent image is transfer printed by transfer printing roller **15***b*, the portions of the latent image corresponding to widths c may not be effectively transfer printed by the interference of the separating members **16.** However, these portions are not interferred by the separating members **16** while the latent image is transfer printed by the other transfer printing roller **15***a*.

In another embodiment shown in FIG. **5,** the transfer printing rollers **15***a* and **15***b* are provided with reduced diameter portions **18** which receive separating members **16** so as not urge them against the periphery of the photosensitive element.

In the modification shown in FIG. **6,** the separating member **19** takes the form of a web of a synthetic resin. In this case, transfer printing roller **15***b* is formed with a reduced diameter portion **18** at the middle section thereof, whereas the other transfer printing roller **15***a* is provided with reduced diamter portions **18** on the opposite end sections. The separating member **19** is provided with windows **20***b* and **20***a* at the larger diameter protions of the transfer printing rollers **15***b* and **15***a*, respectively. Windows **20***a* and **20***b* are staggered in the lateral direction with respect to the direction of movement of the receptor sheet. Thus, the entire width of the receptor sheet interposed between the transfer printing rollers and the separating member is urged against the periphery of the photosensitive element to effect efficient transfer printing of the latent image.

According to the embodiments shown in FIGS. **5** and **6,** since the separating member is not urged against the periphery of the photosensitive element by the provision of reduced diameter portions **18** there is no fear of damaging by friction the surface of the photosensitive element and the latent image which has been transfer printed on the surface of the receptor sheet.

While the invention has been shown and described in connection with a particular method of forming an electrostatic latent image, it will be clear that the latent image can be formed by any method and by utilizing any one of many known photosensitive elements. If desired, suitable voltage may be applied between the rotary drum and the transfer roller to enhance transfer printing.

We claim:

1. In apparatus for transfer printing of electrophotographic images comprising a rotary drum provided with a photosensitive element on which an electrostatic image is to be formed, a receptor sheet and a transfer printing roller for urging said receptor sheet against the surface of said photosensitive element to transfer print said latent image onto said receptor sheet, the improvement which comprises a stationary separating member made of a sheet material having a width at least equal to the width of said receptor sheet interposed between said receptor sheet and said photosensitive element, said transfer printing roller being formed with a large diameter section and said separating member being provided with a window to receive said large diameter section.

2. The transfer printing apparatus according to claim **1** wherein there are provided a plurality of parallel transfer printing rollers which are spaced apart in the direction of movement of said receptor sheet and are provided with a large diameter portion and a reduced diameter portion, the large diameter portions of adjacent transfer rollers being staggered with respect to the direction of movement of said receptor sheet.

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