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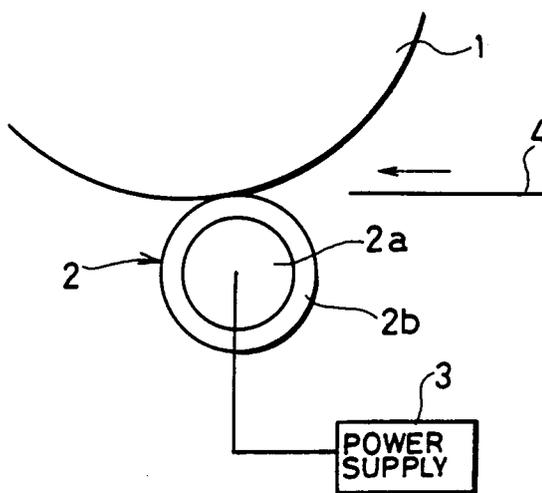
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54 Transfer device.

57 A transfer device transfers a toner image formed on a photoreceptor (1) onto a transfer sheet (4) by pressing it onto the photoreceptor (1) and applying thereto a voltage. The transfer device, provided so that it can be pressed onto the photoreceptor (1), includes a transfer roller (2) for pressing the transfer sheet (4) onto the photoreceptor (1). An electrically conductive elastic layer, (2b) including closed cells and open cells, is formed on the surface of the transfer roller (2).

FIG. 1



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FIELD OF THE INVENTION

The present invention relates to a transfer device provided in an image forming apparatus such as a copying machine, a printer, etc.

BACKGROUND OF THE INVENTION

The conventional transfer devices, which are provided, for example, in printers are arranged such that a transfer roller is pressed onto an image recording medium, and a toner on the image recording medium is transferred onto a transfer sheet when it passes through a contact portion between them by applying a voltage onto the image recording medium from the transfer roller. In such transfer devices, an elastic layer including electrically conductive material such as a carbon is provided on the surface of the transfer roller.

The elastic layer is made of, for example, a silicone rubber. The silicone rubber is elastic because of the cells formed in an inner portion.

However, as shown in Fig. 5, the cell formed in an elastic layer 102b of the conventional transfer roller is a so-called open cell 102c wherein many cells range. Therefore, when a pressure is applied onto the elastic layer 102b by pressing the transfer roller onto the image recording medium, the open cell 102c is squeezed. Thus, the portion of the elastic layer 102b, where the open cell 102c exists, is depressed. For the above reason, the elastic layer 102b formed on the surface of the transfer roller becomes uneven (see Fig. 5). This creates the problem of missing characters in the transferred image.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a transfer device which permits a reduction of missing characters in a transferred image by preventing the elastic layer from being uneven when contacting.

In order to achieve the above object, a transfer device in accordance with the present invention for transferring a toner image formed on an image recording medium onto a transfer sheet by applying a voltage to the image recording medium, is characterized by being provided with a transfer roller means having an electrically conductive elastic layer formed on a surface thereof, the elastic layer including closed cells and open cells.

With the above arrangement of the transfer device, the surface of the elastic layer of the transfer roller means can be made smooth when the transfer roller means is pressed onto the image recording medium for transferring an image. This permits a significant reduction of the missing char-

acters in the transferred image. As a result, a stable image can be obtained.

For a fuller understanding of the nature and advantages of the invention, reference should be made to the ensuing detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 through 4 show an embodiment of the present invention.

Fig. 1 is an explanatory view showing a contact condition between a transfer roller and a photoreceptor.

Fig. 2 is a partially enlarged view showing a condition of the elastic layer when a transfer roller is pressed onto a photoreceptor.

Fig. 3 is a partially enlarged view showing a condition of the elastic layer when a transfer roller is not pressed onto a photoreceptor.

Fig. 4 is a graph showing the relationship between the percentage of closed cells and the number of missing characters.

Fig. 5 which shows a conventional example is a partially enlarged view showing the condition of an elastic layer when a transfer roller is pressed onto a photoreceptor.

DESCRIPTION OF THE EMBODIMENTS

The following description will discuss an embodiment of the present invention with reference to Figs. 1 through 4.

A transfer device of the present embodiment is provided in an image forming apparatus such as a copying machine, a printer, etc. As shown in Fig. 1, the image forming apparatus is provided with a photoreceptor 1 (image recording medium) for forming a toner image. The photoreceptor 1 includes a cylindrical substrate made of an electrically conductive material such as an aluminum, and a dielectric photosensitive layer formed on a surface of the substrate.

A transfer roller 2 (transfer roller means) is provided on the photoreceptor 1 so as to be capable of contacting the surface of the photoreceptor 1 at a predetermined nip width. The transfer roller 2 includes a cylindrical transfer roller base 2a made of an electrically conductive material, and an elastic layer 2b such as a silicon rubber including carbon formed on the surface thereof. Further, a shaft for rotatably supporting the transfer roller 2 is provided at a central portion of the transfer roller 2. Here, the shaft is set parallel to a rotation shaft of the photoreceptor 1.

A power supply 3 (power supply means) is connected to a transfer roller base 2a of the transfer roller 2. The power supply 3 is provided for

applying a voltage onto the transfer roller base 2a. Thus, when a transfer sheet 4 passes through a contact portion between the transfer roller 2 and the photoreceptor 1, the toner image formed on the photoreceptor 1 is transferred onto the transfer sheet 4 by applying a voltage from the power supply 3 onto the surface of the photoreceptor 1 through the contact portion.

On the other hand, the elastic layer 2b of the transfer roller 2 includes cells in its inner portion. The cells are composed of closed cells 2c wherein each cell is independent and open cells wherein many cells range. In this arrangement, the surface of the transfer roller 2 can be made smooth when contacting as shown in Fig. 2. Additionally, in order to obtain a still smoother surface of the transfer roller 2, the percentage of the closed cells 2c is preferably set higher than the percentage of the open cells.

In order to investigate the relationship between the percentage of the closed cells 2c and the number of missing characters, an experiment was conducted.

First, three kinds of electrically conductive silicon rubbers (hardness of JISA 35°) including carbon which respectively include closed cells 2c in the ratio of 20%, 50%, and 80% (volume percentage) were prepared. Here, the diameter of the closed cells 2c in the silicon rubber was set in the range of 100 - 200 μm. To determine the percentage of the independent cells, the following method was adopted: First, silicon rubber was sunk in water. Then, by weighting the volume of the absorbed water, the volume of the independent cells was figured out so as to calculate the percentage of the closed cells. Using the above three kinds of silicon rubbers, three kinds of electrically conductive elastic layers 2b were respectively formed on the three kinds of transfer rollers 2 respectively designed for the above three kinds of silicon rubbers.

Thereafter, 500 grams of load was added for each shaft so as to set the load added to the transfer rollers weighted one kilogram for both shafts. Further, applied pressure per unit area was set 0.23 kilograms/cm².

As a result of conducting the experiment under the above three conditions, the respective numbers of missing characters (portions) when the same image was transferred are shown in Fig. 4. As is clear from the figure, as the percentage of the closed cells 2c increases, the number of missing character decreases. Especially when the percentage of the closed cells 2c was set above 50%, compared with the conventional transfer roller which includes only the open cells, the number of missing characters was reduced to less than a half. Thus, the above experiment proved that the trans-

fer roller having the elastic layer 2b including the closed cells 2c was fairly effective for reducing the missing characters.

Furthermore, when the percentage of the closed cell 2c was set above 80%, the number of missing characters was still reduced as is clear from Fig. 4. Thus, the percentage of the closed cells 2c in the elastic layer 2b is preferably set above 80%.

As described, the transfer device of the present invention is characterized in that it can be pressed onto the photoreceptor 1, and also in that the electrically conductive elastic layer 2b including the closed cells 2c and the open cells is formed on the surface of the transfer roller 2 for pressing the transfer sheet onto the photoreceptor 1.

With the above arrangement of the transfer device, the surface of the elastic layer 2b of the transfer roller 2 can be made smooth when the transfer roller 2 is pressed onto the photoreceptor 1 for transferring an image. This permits a significant reduction of the missing characters in the transferred image. As a result, a stable image can be obtained.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

Claims

1. A transfer device for transferring a toner image formed on an image recording medium onto a transfer sheet by pressing it onto the image recording medium and applying thereto a voltage, comprising:
 - transfer roller means provided so that it can be pressed onto the image recording medium for pressing the transfer sheet onto the image recording medium; and
 - electrically conductive elastic layer, including closed cells and open cells, formed on a surface of said transfer roller means.
2. The transfer device as set forth in claim 1, wherein said elastic layer is made of a silicon rubber including carbon.
3. The transfer device as set forth in claim 1, wherein said elastic layer is arranged such that a percentage of the closed cells is higher than a percentage of the open cells.
4. The transfer device as set forth in claim 1, wherein said elastic layer is arranged such that

a percentage of the closed cells is above 80%.

5. The transfer device as set forth in claim 1, wherein a diameter of the closed cells of said elastic layer is set in a range of 100 - 200 μm . 5
6. A transfer device for transferring a toner image formed on an image recording medium onto a transfer sheet by pressing it onto the image recording medium and applying thereto a voltage, comprising: 10
transfer roller means, provided so that it can be pressed onto the image recording medium, for pressing the transfer sheet onto the image recording medium, wherein said transfer roller means includes a transfer roller base made of an electrically conductive material and an electrically conductive elastic layer, including closed cells and open cells, formed on a surface of said transfer roller base. 15 20
7. The transfer device as set forth in claim 6 further comprising: 25
power supply means for applying a voltage onto said transfer roller base. 25

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FIG. 1

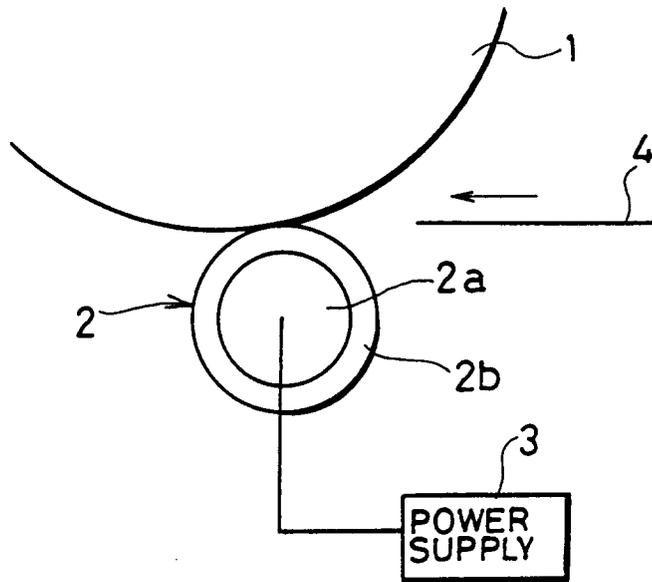


FIG. 2

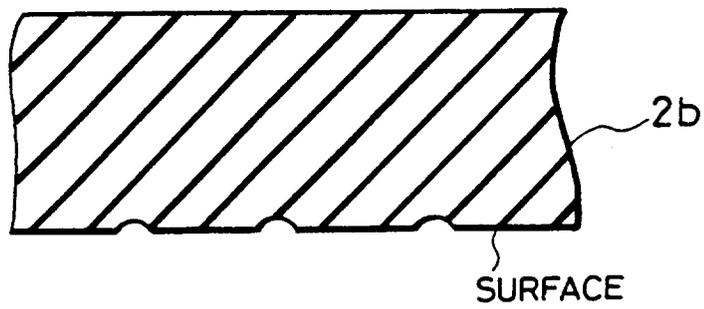


FIG. 3

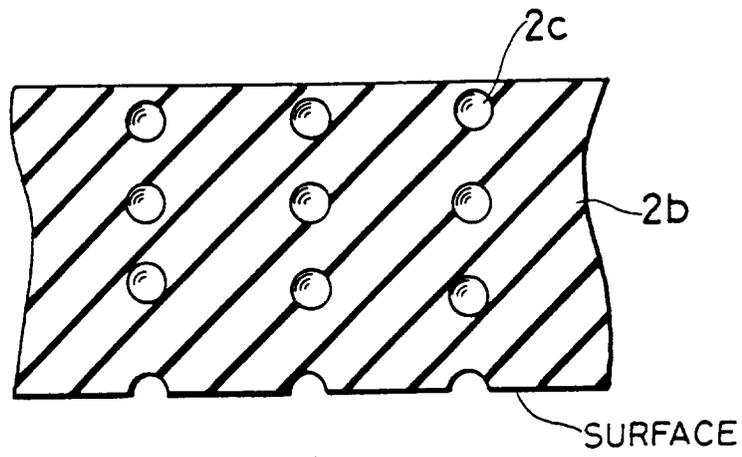


FIG. 4

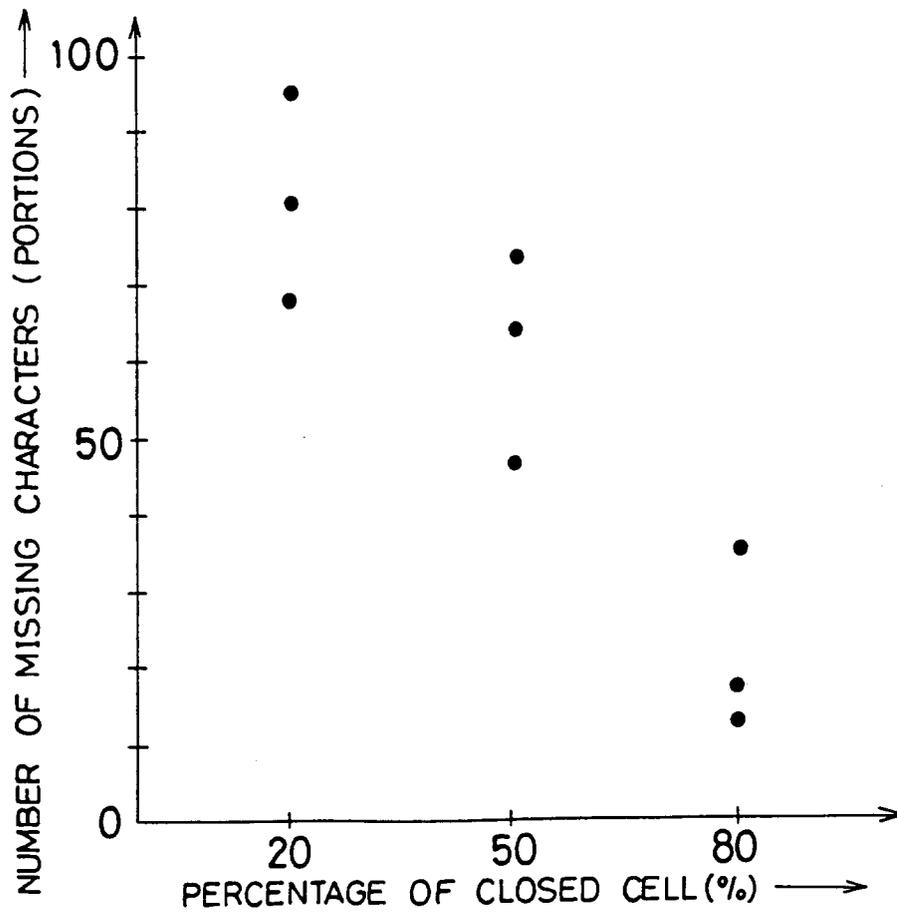
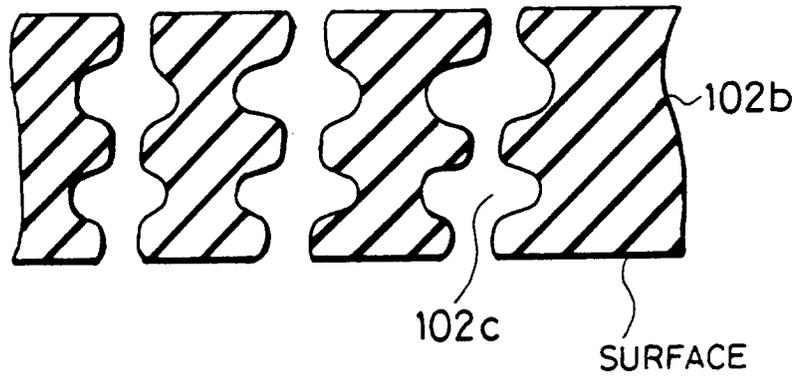


FIG. 5





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EUROPEAN SEARCH REPORT

Application Number

EP 93 10 3792

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-4 956 211 (SHINJI SAITO) * column 1, line 1 - line 35 * * column 3, line 9 - line 11 * ---	1,6	G03G15/16
A	PATENT ABSTRACTS OF JAPAN vol. 12, no. 206 (M-708)14 June 1988 & JP-A-63 009 715 (ASAHI) 16 January 1988 * abstract * -----	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			G03G
Place of search	Date of completion of the search	Examiner	
THE HAGUE	05 JULY 1993	ROWLES K.E.G.	
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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