(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 572 020 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **93108609.4**

(51) Int. Cl.5: **G03G 15/20**

(22) Date of filing: **27.05.93**

(30) Priority: **29.05.92 JP 161670/92**

(43) Date of publication of application:
01.12.93 Bulletin 93/48

(84) Designated Contracting States:
DE FR GB

(71) Applicant: **SHARP KABUSHIKI KAISHA**
22-22, Nagaike-cho,
Abeno-ku
Osaka-shi, Osaka-fu 545(JP)

(72) Inventor: **Inui, Koichi**
2-20-2, Takaida Moto-machi,
Higashi
Osaka-shi, Osaka-(JP)

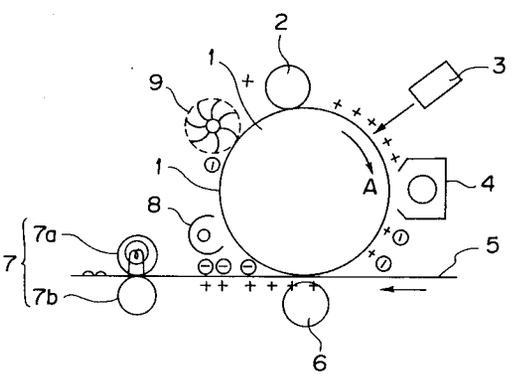
Inventor: **Wakahara, Shirou**
1-5-36-415, Mikuni Hon-machi,
Yodogawa-ku
Osaka-shi, Osaka(JP)
Inventor: **Yamasa, Hideo**
830-2, Ichibu-cho
Ikoma-shi, Nara(JP)
Inventor: **Shimazdu, Fumio**
Rapole Kamatori,
2876-11, Kamatori-cho
Midori-ku, Chiba-shi, Chiba(JP)

(74) Representative: **TER MEER - MÜLLER - STEINMEISTER & PARTNER**
Mauerkircherstrasse 45
D-81679 München (DE)

(54) Image forming apparatus.

(57) The object of the invention to provide an image forming apparatus of electrophotographic type equipped with a conductive contact type transfer roller (6), wherein failure in transfer can be prevented which is caused by a lowering of resistance due to absorption of a recording sheet (5) exposed in a high temperature and high humidity environment. The image forming apparatus of electrophotographic type equipped with a conducive contact type transfer device, is made up with a fixing heat roller assembly (7) that has a volume resistivity of 10^9 Ω•cm or more.

FIG. 1



EP 0 572 020 A2

BACKGROUND OF THE INVENTION

(1) Field of the invention

The present invention relates to an image forming apparatus of electrophotographic type having a conductive contact type transfer device, and more particularly, to an improvement of a fixing heat roller assembly for use in image reproduction apparatus, laser printers and the like.

(2) Description of the Related Art

An image forming apparatus of electrophotographic type has, as shown in Fig.1, a photoreceptive drum 1 of a conductive support with a photoconductive film formed thereon, and further comprises: around photoreceptive drum 1 along the downstream of a rotating direction A of photoreceptive drum 1, a charging device 2; an exposing device 3 for creating an electro-static latent image by light-irradiating photoreceptive drum 1 having its surface uniformly charged by charging device 2; a developing device 4 for visualizing the electrostatic latent image by supplying charged powder (toner) onto the surface of photoreceptive drum 1 formed with the electro-static latent image; a transfer roller 6 for transferring toner-developed image to a recording sheet 5 by impressing a bias voltage to photoreceptive drum 1; and a fixing heat roller assembly 7 disposed downstream of the photoreceptive drum 1 along the recording sheet 5 conveying direction for heating the toner-developed image transferred to recording sheet 5 to melt and fix the toner onto the recording sheet 5.

The fixing heat roller assembly 7 is composed of a heat roller 7a for heating and a silicone roller 7b for pressing as shown in Fig.2(a). Silicone roller 7b creates a pressure in the axial direction thereof, or the roller 7b acts pressure against heat roller 7a to create a contact range along its axial direction in order to effect a sufficient contact- heating therebetween. Heat roller 7a comprises, as shown in Figs.2(b) and 2(c), a core metal member 7c, a film layer for separation 7d of an insulating material such as Teflon (Du Pont Trade name; polytetrafluoroethylene), etc., coated on the core metal, with a heater 7e built in the roller for heating the surface at a constant temperature, and is pressed against silicone roller 7b to heat and fix the toner-developed image on recording sheet 5.

The film layer for separation 7d (see Fig.2(a)) is provided in order to prevent, an offset, or part of the toner from sticking to the heated surface of heat roller 7a upon fixing. The coating member uses a material having a reduced resistance by compounding a conductive material such as carbon, aluminum or the like. Offset is largely attributed to the property of the toner used, so that it is possible to eliminate the problem by modifying the property of toner without reducing the resistance of coating member.

Nevertheless, when an image forming apparatus of electrophotographic type comprising a conductive contact type transfer device such as a transfer roller and the like, and a fixing heat roller assembly 7 including a heat roller 7a with a film layer for separation 7d, is operated in a high temperature and high humidity environment, white void or failure in transfer would occur on the recording sheet printed. The failure in transfer in this case, is caused because the recording paper absorbs moisture during the exposure in such an environment, and significantly reduces its resistance compared to the environment of the room. In accordance with an experiment performed by the present inventors, as absorbing moisture the recording sheet reduces in its resistance from 3×10^8 Ω to 2×10^6 Ω. Here, the experiment by the present inventions was effected as shown in Figs.3(a) and 3(b), by placing a recording paper sheet 5 on a sheet-like insulating film 8; placing on the sheet of paper a pair of electrode rods 9,9 having a length equal to the width of the sheet of paper; and measuring a current flowing between the rods 9,9 while a d.c. voltage of 500 v is applied therebetween, thereby calculating the resistance. With this experiment, the following facts were found out.

That is, when recording sheet 5 is in contact with transfer roller 6, and at this time, if the other end of the recording sheet 5 comes into contact with fixing heat roller assembly 7, the transfer bias voltage to be applied to photoreceptive drum 1 by transfer roller 6 leaks to fixing roller assembly 7 through the recording paper since the resistance of the recording sheet 5 is lowered due to the absorption of moisture (in this case, unless core metal 7c of heat roller 7a is grounded, the leak does not occur.). Accordingly, current required for the transfer will not flow to photoreceptive drum 1 under a high temperature and high humidity environment, so that failure in transfer or white void occurs, disadvantageously.

As an associated prior art of the present application, there is disclosed Japanese Patent Application Publication Hei No.1-22483, in which a heating roll used as a fixing roll for use in an electrostatic printing machine.

The heating roll has a peripheral surface comprised of an inner insulating layer, a heat-generating layer and an outer insulating layer. Here, the heat-generating layer is formed by applying a conductive coating agent and hardening it so as to make a two-dimensional heat-generating layer, and the proper volume resistance is 10^2 Ω•cm or less. Nevertheless, this heating roll is designated to reduce loss of heat generation by using a two dimensional heat-generating layer, in place of heating wire as a heat-generating member. That is, it is not the one that is able to prevent the transfer bias voltage from leaking to fixing heat roller assembly via the recording sheet.

SUMMARY OF THE INVENTION

The present invention has been achieved to eliminate the problems described above, and it is therefore an object of the present invention to provide an image forming apparatus of electrophotographic type equipped with a conductive contact type transfer roller, wherein failure in transfer can be prevented which is caused by a lowering of resistance due to absorption of a recording sheet exposed in a high temperature and high humidity environment.

The above object of the present invention can be achieved by providing an image forming apparatus of electrophotographic type equipped with a conducive contact type transfer device, including a fixing heat roller assembly that has a volume resistivity of 10^9 Ω•cm or more.

In the invention, the fixing roller assembly may preferably comprise a roller for heating and a roller for pressing.

In the invention, the roller for heating may preferably include a layer for separation disposed on its surface layer and a heater means built therein.

In the invention, the layer for separation may preferably comprise a coating of an insulating material having a volume resistivity of 10^9 Ω•cm or more.

In the invention, the roller for pressing may preferably comprises silicone roller.

In the invention, a recording sheet on which an image is formed may preferably have a length in its conveying direction equal to or larger than the distance between said transfer device and said fixing roller assembly.

Thus, in accordance with the present invention, since the volume resistivity of the fixing heat roller is 10^9 Ω•cm or more, when a bias voltage is impressed to the transfer roller as toner-developed image is transferred to a recording sheet, the bias voltage is prevented from leaking to the fixing heat roller side.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is an vertical section of basic structure of an image forming apparatus of electrophotographic type showing its main components;

Figs.2(a), 2(b) and 2(c) are illustrations showing a configurational example of a conventional fixing heat roller assembly; particularly Fig.2(a) is a side view of the conventional fixing heat roller assembly, Fig.2-(b) is a front view of the conventional fixing heat roller assembly and Fig.2(c) is cross-section in B-B line of Fig.2(b);

Figs.3(a) and 3(b) are respectively plan and side views showing a manner of measuring resistance of a recording sheet;

Fig.4 is a side view showing configuration of a fixing heat roller assembly of an image forming apparatus in accordance with an embodiment of the present invention; and

Fig.5 is a sectional view of main elements showing a schematic structure of a laser printer provided with a fixing heat roller assembly shown in Fig.4 in accordance with an embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

One embodiment of the present invention will hereinafter be described with reference to the accompanying drawings.

Fig.4 is a structural side view of a fixing heat roller assembly 7 for use in a laser printer 20 of electrophotographic type in accordance with the embodiment, and Fig.5 is a constructional illustration showing the laser printer.

As shown in Fig.4, in a fixing heat roller assembly 7, the arrangement of a heat roller 7a for heating and a silicone roller 7b for pressing is the same with those shown in Fig.1 and Fig.2(a). However, with respect to the structure of heat roller 7a, a film layer 7d for separation differs in its structure from those of conventional one. Here, the structure is the same with that shown in Fig.2(c) except for film layer 7d for separation, so

the description will be omitted.

Seven heat rollers (specimens No.1, 2, ·····, 6,7) each having a different volume resistivity as shown in Table 1 were prepared by varying the insulating material constituting film layer 7d for separation of heat roller 7a. Each specimen of heat roller 7a was built in fixing heat roller assembly 7, which in turn was used in laser printer 20 configurated as shown in Fig.5. Images including black solid patterns were printed under a high temperature and high humidity (35 °C, 85% R.H.) environment in the thus configured laser printer for all the specimens of heat rollers. In the printed images, occurrence of transfer defects (white void) in black solid patterns was examined, and the evaluation result of image quality is shown in Table 1.

The silicone roller used in the experiment had a volume resistivity of 3×10^{10} Ω•cm, and the image density of white void was measured by a Macbeth density meter.

Table 1

Specimen No.	Volume Resistivity Ω•cm	Density Lowering in White Void (Compared with that of Black Solid)	Evaluation of Image Quality
1	1×10^7	0.5	Bad
2	5×10^7	0.45	Bad
3	1×10^8	0.35	Not Good
4	5×10^8	0.2	Not Good
5	1×10^9	0.1	Good
6	5×10^9	0.05	Good
7	1×10^{10}	0.05	Good
(Note) In the table, "Bad" indicates to be rejected; "Not Good" denotes that the level of image quality cannot be accepted in the market; and "Good" represents the image quality above the standard.			

From the measurement result shown in Table 1, it can be said that an printer of electrophotographic type including a transfer roller and a heat roller having a volume resistivity of 10^9 Ω•cm or more is free from transfer failure.

In the above experiment in laser printer 20 of this embodiment, examination of printing was carried out using recording paper 5 that has a length L_1 larger than an interval L_2 representing the distance between fixing heat roller assembly 7 and transfer roller 6 (when $L_2 > L_1$, the above phenomenon will not occur.).

The laser printer 20 shown in Fig.5 has a photoreceptive drum 1 and further comprises: around photoreceptive drum 1 along the downstream of a rotating direction A of photoreceptive drum 1, a charging device 2; a write-in type exposing device 3a for creating an electro-static latent image by irradiating a laser beam on photoreceptive drum 1; a developing device 4 for visualizing the electrostatic latent image by supplying toner powder onto the surface of photoreceptive drum 1 with an electro-static latent image formed; a transfer roller 6 for transferring toner-developed image to a recording sheet 5 that is conveyed from the sheet feeding station by impressing a bias voltage to the toner-developed image on photoreceptive drum 1; and a fixing heat roller assembly 7 disposed downstream of the photoreceptive drum 1 along the recording sheet 5 conveying direction for heating the toner-developed image transferred to recording sheet 5 to melt and fix the toner onto the recording sheet 5.

Although a transfer roller 6 was used as a transfer device of laser printer 20 described above, the transfer device is not limited to transfer rollers, but conductive contacting member such as conductive brush, or conductive head can be used.

As has been apparent from the above description, in accordance with an image forming apparatus of the present invention, it is possible to prevent failure in transfer in an image forming apparatus of electrophotographic type having a conductive contact type transfer device from occurring even under a high temperature and high humidity by only employing a heat roller having a volume resistivity of 10^9 Ω•cm or more.

Claims

1. An image forming apparatus of electrophotographic type comprising a conductive contact type transfer device, being characterized in that a fixing heat roller assembly has a volume resistivity of 10^9 Ω•cm or more.

2. An image forming apparatus according to Claim 1, wherein said fixing roller assembly comprises a roller for heating and a roller for pressing.

3. An image forming apparatus according to Claim 2, wherein said roller for heating includes a layer for separation disposed on its surface layer and a heater means built therein.

4. An image forming apparatus according to Claim 3, wherein said layer for separation comprises a coating of an insulating material having a volume resistivity of 10^9 Ω•cm or more.

5. An image forming apparatus according to Claim 4 wherein said roller for pressing comprises silicone roller.

6. An image forming apparatus according to Claim 1, wherein a recording sheet on which an image is formed has a length in its conveying direction equal to or larger than the distance between said transfer device and said fixing roller assembly.

FIG. 1

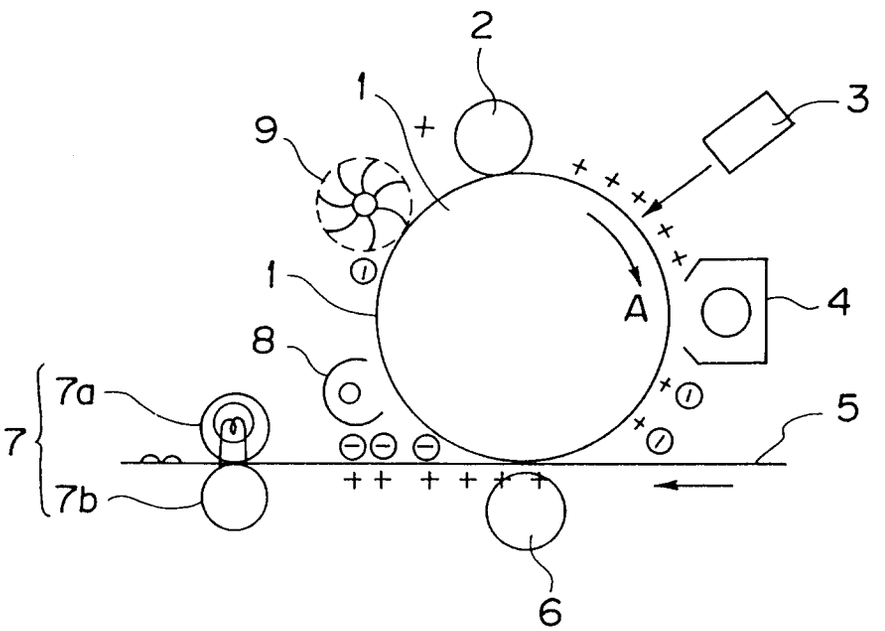


FIG. 2 (a)

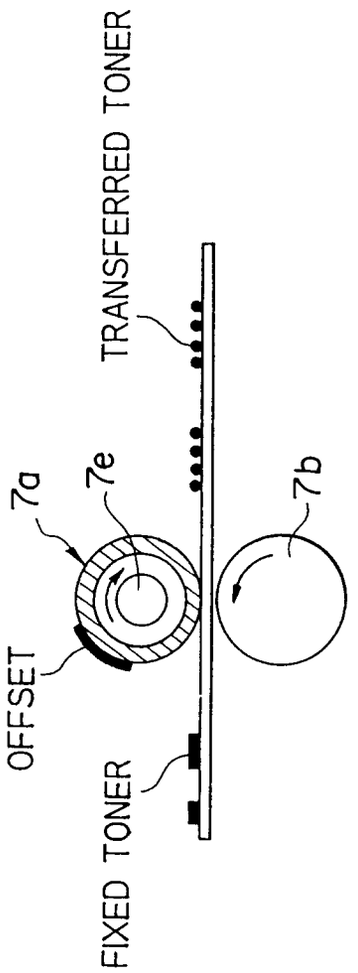


FIG. 2 (b)

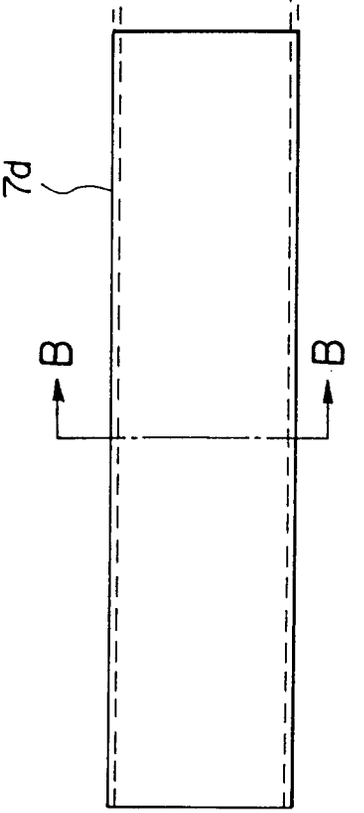


FIG. 2 (c)

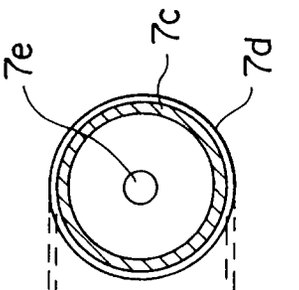


FIG. 3(a)

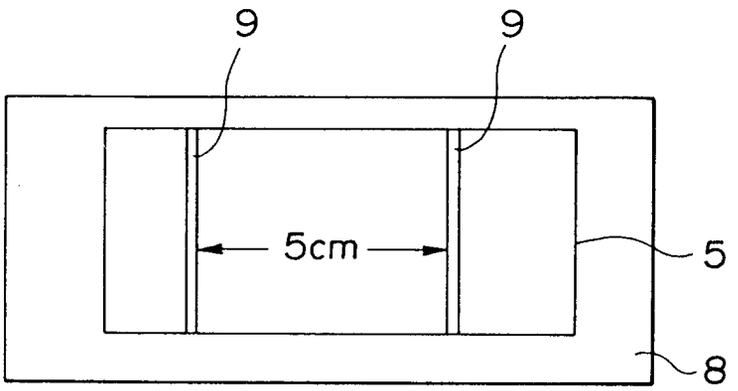


FIG. 3(b)

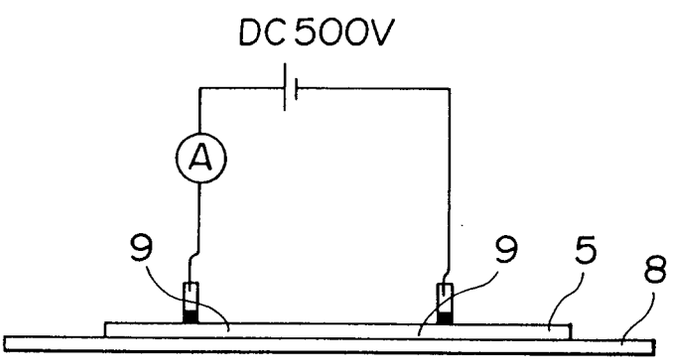


FIG. 4

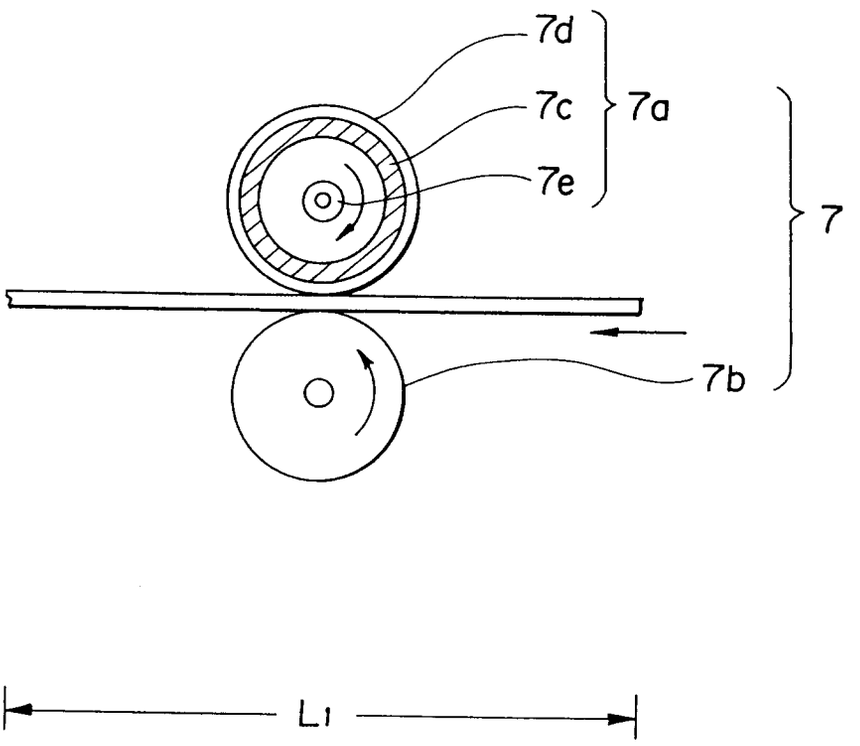


FIG. 5