

Description

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to an image fixing apparatus for fixing a toner image on a recording medium, more particularly to an image fixing apparatus for heating and fixing a toner image through a film.

In a widely used image fixing apparatus wherein an unfixed toner image is fixed, the recording medium is passed through a nip formed between a heating roller maintained at a predetermined temperature and a pressing or back-up roller having an elastic layer and press-contacted to the heating roller, the recording medium supporting the unfixed toner image.

The conventional image fixing system of this type requires that the heating roller is always maintained at an optimum temperature to avoid high temperature toner offset and low temperature toner offset, and the tolerable range of the temperature is narrow.

In order to reduce the temperature variation of the heating roller, the thermal capacity thereof is required to be large, with the result of longer warming period. In order to solve this problem, US-A-3 578 797 and JP-A-51 029 825 propose that the toner is heated and fused through a web or sheet from a heating roller.

An image fixing apparatus of this type is also known from patent document US-A-3 811 828. The image fixing apparatus described therein is an image fixing apparatus according to the preamble of claim 1. It comprises

a heater extending in a direction crossing with the movement direction of a recording material, a film in slidable contact with said heater, and a pressing member cooperable with said heater to form a nip between said film and said heater.

The heater is an infrared radiation source.

An image fixing apparatus using a heater having a linear heat generating layer with very low thermal capacity and using a thin film to fix the toner image, by which the warming period is significantly reduced or eliminated has been proposed. Since, however, the linear heat generating layer has a very low thermal capacity, the temperature difference occurs, when the fixing operation is continued, between the portion where the heat radiation or transfer is large and the portion where it is small. The temperature difference is remarkable between the portion where the recording medium passes and the portion where the recording medium does not pass, even to such an extent that the film is deformed, or the heat generating layer is fused due to excessive temperature rise in the non-heat-passage portion.

The same problem applies to the image fixing apparatus known from US-A-3 811 828.

An image fixing apparatus which is theoretically free from the a.m. problem is known from patent application document JP-A-59-149385.

According to this document, to shorten the pre-heating time and to attain a uniform heating temperature throughout the overall length of a heat roll, both endparts of a resisting heating body layer are made of a material having a higher calorific value than that of the layer material used in the centerpart of the heating body.

It is, however, quite evident that it is very difficult to produce a heat fixing apparatus of this type. Therefore, it will hardly be possible to manufacture a fixing apparatus of this type which is absolutely free from the a.m. problem.

SUMMARY OF THE INVENTION

Accordingly, it is a principal object of the present invention to provide an image fixing apparatus wherein the temperature difference hardly occurs along the length of the heat generating layer.

It is another object of the present invention to provide an image fixing apparatus wherein the temperature rise in the non-sheet-passage portion is prevented.

It is a yet further object of the present invention to provide an image fixing apparatus using a heat generating layer having distributed electric resistances.

According to the present invention these objects are achieved by providing the features claimed in the characterizing portion of claim 1, i.e. by providing the feature that the heater comprises a resistance heat generating layer, the thickness or width of which and thus its resistance value per unit length varies in a predetermined way in its longitudinal direction.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view of an image forming apparatus using an image fixing device according to an embodiment of the present invention.

Figure 2 is an enlarged sectional view of the fixing apparatus according to an embodiment of the present invention.

Figure 3 is a longitudinal sectional view of an image forming apparatus using an image fixing device according to a further embodiment of the present invention.

Figure 4 is an enlarged view of the image fixing apparatus according to this embodiment.

Figure 5 is a cross-sectional view of a heating element used in the embodiment of Figure 4.

Figure 6 is a front view of a heating element and a pressing roller used in Figure 4.

Figure 7 is a top plan view of a pattern of the heat generating element.

Figures 8 and 9 are other examples of the heat generating element.

Figure 10 illustrates heat radiation.

Figure 11 is a graph of a temperature distribution along the length of the heat generating element.

Figure 12 is a top plan view of a pattern of the heat generating element according to another embodiment of the present invention wherein the temperature difference in the distribution is reduced.

Figure 13 is a sectional view of an image fixing apparatus according to a further embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the accompanying drawings, the preferred embodiments of the present invention will be described, wherein the like reference numerals are assigned to the elements having the corresponding functions.

Figure 1 shows a sectional view of an image forming apparatus using an image fixing device according to an embodiment of the present invention. The image forming apparatus comprises an original supporting platen made of transparent material such as glass, which is reciprocable in the directions indicated by an arrow a to scan an original. Right below the original supporting platen 1, there is disposed a short focus small diameter imaging element array 2. An image G of an original placed on the original supporting platen 1 is illuminated by an illumination lamp 7, and the light image provided by the light reflected by the original G is imaged through a slit by the array 2 on a photosensitive drum 3. The photosensitive drum 3 is rotatable in the direction indicated by an arrow b. The apparatus further comprises a charger 4 for uniformly charging the photosensitive drum 3 which is coated with a zinc oxide photosensitive layer or an organic semiconductor photosensitive layer. The photosensitive drum 3 uniformly charged by the charger 4 is exposed to the light image through the array 2, so that an electrostatic latent image is formed thereon. The electrostatic latent image is developed into a visualized image by a developing device 5 with toner particles containing resin material which is softened or fused by heat. On the other hand, a transfer material P which is a sheet-like recording medium accommodated in the cassette S is fed to the photosensitive drum 3 by a pick-up roller 6 and a pair of conveying rollers 9 press-contacted to each other, in timed relation with the image on the photosensitive drum 3. The toner image on the photosensitive drum 3 is transferred onto the transfer material P by a transfer discharger 8. Thereafter, the transfer material P separated from the photosensitive drum 3 by known separating means is conveyed along a conveyance guide 10 into an image fixing apparatus 20, where it is subjected to a heating and fixing operation. Finally, it is discharged to a tray 11. After the toner image is transferred, the toner remaining on the photosensitive drum 3 is re-

moved by a cleaner 12.

Figure 2 is an enlarged sectional view of the image fixing apparatus 20 according to this embodiment. The fixing apparatus 20 comprises a heat generating element 21 including a base member made of electrically insulating and heat-resistive material such as alumina or the like or a compound material containing it, a heat generating layer 28 in the form of a line or a stripe made of Ta₂N or the like and a surface protection layer resistive against sliding, made of Ta₂O₅ or the like. The bottom surface of the heat generating element 21 is smooth, and the front and rear portions thereof are rounded to permit smooth sliding of a heat-resistive film 23 functioning as a fixing film. The heat resistive film 23 is made, for example, of PET treated for heat-resistivity having a thickness of approximately 6 microns. It is wound on a film feeding shaft 24. The film is fed out in the direction indicated by an arrow c. The heat resistive film 23 is contacted to the surface of the heat generating element 21 and is taken upon a film take-up shaft 27 by way of a separating roller 26 having a large curvature. Designated by reference numerals 30 and 32 are a heat-resistive sheet sensor and a guide.

The heat generating layer 28 of the heat generating element 21 has a small thermal capacity, and is pulswisely energized, upon which it is instantaneously heated up to approximately 300 °C each time. The leading and trailing edges of the transfer material P on which the unfixed toner image is formed are detected by a recording sheet detecting lever 25 and a recording sheet detecting sensor 29. In response to the detections, the heat generating layer 28 is energized upon necessity. The energization of the heat generating element 21 may be controlled in accordance with position detection of the transfer material P using a sheet feed sensor of an image forming apparatus with which the image fixing apparatus is used.

On the other hand, the back-up roller 22 includes a core made of metal or the like and an elastic layer made of silicone rubber or the like. It is driven by an unshown driving source and is pressed to the heat generating element 21 through the heat resistive film 23 moving at the same speed as the transfer material P advanced along a conveyance guide 10 and having the unfixed toner image T. The conveyance speed by the pressing roller 22 is preferably substantially the same as the conveyance speed of the sheet during the unfixed toner image formation on the recording sheet. The fixing film 23 speed is determined following this speed.

In this embodiment, the heat generating layer 28 is instantaneously heated upon energization, and therefore, it is not necessary to energize more or less the heat generating layer 28 when the image fixing operation is not performed. For this reason, the temperatures of the pressing roller and the heat resistive

sheet are not increased when the image fixing operation is not performed. During the fixing operation, the heat resistive film 23, the toner image T and the transfer material P are interposed between the heat generating layer 28 and the pressing roller 22, and in addition, the heat generating period is short with the result of steep temperature gradient, by which the pressing roller 22 is not easily raised in temperature. The temperature is maintained lower than the fusing point of the toner even when the image forming operation is continuously performed in a practical manner.

In the apparatus of this embodiment, the toner image T made of heat-fusible toner on the transfer material P is first heated and fused by the sheet generating member 21 through the heat resistive film functioning as the fixing film, and particularly, the surface portion thereof is heated up to highly above the fusing point, by which the toner is completely softened and fused. At this time, the back-up roller 23 establishes close contact between the heat generating member 21, the fixing film 23, the toner image T and the recording sheet P, so that the heat transfer is efficient.

Thereafter, the heat generation of the heat generating element 21 stops, and the recording sheet P is continued to advance and is separated from the heat generating element 21, by which the heat of the toner image T is radiated so that the toner image T is cooled and solidified. Then, the heat resistive film 23 is separated from the recording sheet P by the separating roller 26 having a large curvature. At this time, in this embodiment, the temperature of the back-up roller 22 is maintained lower than the fusing point of the toner, and therefore, the heat radiation of the toner image T is promoted. This reduces the time required for the cooling, so that the size of the apparatus can be reduced.

As described in the foregoing, the toner image T is once completely softened and fused, and then is solidified, and therefore, the coagulation force of the toner is very strong, and the toner behaves as a mass. In addition, since the toner is pressed by the back-up roller 22 when it is softened and fused by heat, at least a part of the toner image T soaks into the surface layer of the transfer material P, and then cooled and solidified. This permits the toner image T to be fixed on the transfer material P without toner offset to the heat resistive film 23.

Here, the state of the toner referred to in this specification will be described. The toner fusing point used here means the minimum temperature required for fixing the toner and covers the case wherein the viscosity thereof decreases to such an extent as can be said to be fused, at the minimum fixable temperature and the case wherein the viscosity decreases to such an extent as can be said to be softened, at the minimum fixable temperature.

Therefore, even when it is said that the toner is

fused for convenience, it actually may mean the viscosity decrease to such an extent that it is actually softened. Similarly, when it is said that the toner is cooled and solidified for convenience, it actually may not be solidified depending on the materials of the toner, but can be said that the viscosity is sufficiently increased.

Referring to Figure 3, a further embodiment will be described. Figure 3 is a sectional view of an image forming apparatus using the fixing apparatus of this embodiment. Generally, it is similar to the apparatus of Figure 1, and therefore, the detailed description is omitted, except for the fixing apparatus.

Figure 4 is a sectional view of the fixing apparatus according to this embodiment.

The fixing apparatus includes a fixing film 34 in the form of an endless belt, which is stretched around a left side driving roller 35, a light side follower roller 36, a separation roller 37 disposed below the driving roller 35, and a low thermal capacity linear heater 30 disposed below the driving roller 35 and the follower roller 36. Those four elements 35, 36, 37 and 30 are extended parallel to each other.

The follower roller 36 functions also as a tension roller for the fixing film 34 in the form of the endless belt, and the fixing film 34 is rotated by the clockwise driving rotation of the driving roller 35, in the clockwise direction at a predetermined speed, that is, the same speed as the transfer material P having the unfixed toner image Ta thereon, without crease, snaking movement or delay.

A pressing member 22 is in the form of a pressing roller having a rubber elastic layer having a good releasing property, such as silicone rubber. It is urged by an unshown urging means to the bottom surface of the heater 30 with the bottom travel of the endless fixing film 34 interposed therebetween, under the total pressure of 4 - 7 kg, for example. It is rotatable co-directionally with the transfer material sheet P conveyance, that is, the counterclockwise direction.

The fixing film 34 in the form of an endless belt is rotated and is repeatedly used for heat-fixing the toner images, and therefore, the material thereof has good heat resistivity, releasing property and durability, and has a small thickness generally not more than 100 microns, preferably not more than 50 microns. For example, it is a single layer film of heat resistive resin material such as polyimide, polyetherimide or PEA, copolymer resin of tetrafluoroethylene and perfluoroalkyl vinyl ether, or a compound film including, for example, a film having a thickness of 20 microns and a releasing layer of 10 micron thickness of PTFE (tetrafluoroethylene resin) added with conductive material at least at a side contactable to the image.

The low thermal capacity linear heater 30 functioning as the heating member, which will be described in detail hereinafter, includes, in this embodiment, an alumina base plate 31 and a heat generating

layer 32 in the form of a line or a stripe provided by applying a heat resistance material such as silver palladium. In this embodiment, the linear or stripe heat generating layer 32 is supplied with electric power by the connection at the longitudinal opposite ends to produce heat along the entire length of the heat generating layer 32. The power supply is in the form of pulses having a period of 20 msec and with DC 100 V. A power supply control circuit is such that the width of the pulse is changed on the basis of the target temperature, the temperature detected by the temperature detecting element 33 and the energy radiation. The pulse width is controlled within the range of 0.5 - 5 msec, and the temperature of the heat generating layer 32 is instantaneously raised upon the pulse energization up to approximately 200 - 300 °C. Upstream of the fixing apparatus 20 with respect to the transfer material conveyance direction and at a position close to the fixing apparatus, a sheet sensor for detecting the leading and trailing edges of the sheet, although not shown. By the sheet detection signal of the sensor, the energization period of the heat generating layer 32 is limited within the period in which the sheet P is present in the fixing apparatus 20.

In this embodiment, the fixing film may be in the form of a non-endless film.

The unfixed toner image Ta is introduced into a nip formed between the fixing film 34 and the pressing roller 22 and is advanced while being pressed thereby. In the nip, the toner image Ta is heated by the heat from the heat generating layer 32 into a fused toner image Tb. Thereafter, by the time when the toner image reaches the separation roller 37, the fused toner image Tb is cooled and solidified into a solidified toner image Tc.

Referring to Figure 5, the heater 30 will be described. Figure 5 is a cross-sectional view of the heater 30. A heater supporting member 30a is an elongated member having a rectangular cross-section extending in a lateral direction of the fixing film (the direction perpendicular to the travel direction of the fixing film 34) and is made of a high rigidity and low thermal conductivity material such as PPS, polyimide or Bakelite. The supporting member 30a is made of the heat resistant and low thermal conductivity material at least at the portion where it is contacted to the heater 31a, and of another material in the other portions.

A heater 31 is elongated and integrally fixed on the bottom surface of the supporting member 30a. The heater 31 in this embodiment comprises an alumina base plate 31a (electrically insulative, and thermally high-conductive) having a length of 240 mm, a width of 10 mm and a thickness of 1.0 mm, a glazing layer 31b having a thickness of 100 microns and formed on the bottom surface of the base plate 31a, a heat generating resistance layer (heat generating layer) 32 made of silver-palladium (Ag/Pd) having a thickness of 10 microns in the form of a line or stripe

provided by a screen printing method along the length of the glazing layer substantially at the middle thereof, and a heater surface protection layer 31c made of anti-wearing material such as glass having a thickness of 10 microns coated on the heat generating layer 32 and the glazing layer 31b. Designated by a reference numeral 33 is a temperature detecting element having a low thermal capacity such as bead thermister disposed within or in contact with the central portion (in a longitudinal direction) of the back side (top side) of the heater base plate 31.

To the bottom surface of the heating element 31 of the heater 30, the top surface portion of the pressing roller 22 is urged through the fixing film 34 or through the fixing film 34 and the transfer sheet P (recording material) under a predetermined pressure.

Figure 6 is a front view of the heater 30 and the pressing roller 22 urged thereto through the fixing film 34 and the transfer sheet P. Figure 7 shows a surface pattern of the Ag/Pd heat generating resistance layer functioning as the heat generating element 32 formed on the glazing layer 31b of the heater 31 along the length thereof. The heat generating resistance layer has a linear or stripe effective heat generating portion 32a (the resistance per unit length is 1 ohm/cm) having a width of 1 mm, a thickness of 10 microns and a length of 230 mm (l_1), and a low heat generating portion 32b (low resistance portion having a resistance of 0.2 ohm/cm) having a width of 5 mm and a thickness of 10 microns. The low heat generating portion 32b are wider and are continuously extended from each of the longitudinal ends of the effective heat generating portion 32a. To the two wide low heat generating portions 32b, power supply electrodes 32c are clamped.

When the electric power is supplied between the electrodes 32c, the heat generating element (Ag/Pd) 32 generates heat. The amounts of generated heat per unit length in the wide low heat generating portions 32b at the opposite ends are one fifth the amount of heat per unit length of the effective heat generating portion 32a since the width is five times, and therefore, the resistance is one fifth, although they have the same thickness (10 microns).

Mainly by the heat generation of the effective heat generating portion 32a, the temperature of the alumina base plate 31a is raised, and the temperature thereof is detected by the temperature detecting element 33 and is fed back to an unshown power supply control circuit. By the control of the power supply to the heat generating element 33, the temperature of the fixing nip corresponding to the effective heat generating portion 32a is maintained at a predetermined fixing temperature. In Figures 6 and 7, there are relationships of $l_2 > g_1 > l_1 > g_2$, where l_2 is a length of the pressing roller 22, g_1 is a width of the fixing film 34, and g_2 is a maximum width of the transfer material which can be used. Therefore, the portions adjacent

to the opposite ends of the heat generating elements where the fixing film 34 is not urged by the pressing roller 22, correspond to the wide heat generating portions 32b having low heat generation.

Accordingly, it is avoided that the portions adjacent to the opposite ends of the heater not contacted to the fixing film or the pressing roller 22 is overheated due to the insufficient heat dissipation with the result of damage (fusing) of the heat generating layer corresponding to that portion.

The experiments by the inventors have shown that when the heater has the heat generating portions 32b, at the longitudinal opposite ends, having the same width, thickness and the resistance (1 ohm/cm) as those of the effective heat generating portion 32a (the opposite end portions are not contacted to the fixing film), the heat generating portions 32b not contacted to the fixing film are broken due to overheating, when the power is supplied continuously only for several minutes. On the other hand, the heater having the effective heat generating portion 32a and wide low heat generating portions (low resistance portion) 32b at the opposite ends (that is, having the resistance distribution wherein the resistance is high in the portion 32a, and the resistance is low in the portion 32b) has had no problem even after it is energized for several hundreds hours continuously.

The means for providing the resistance distribution in the direction of the length of the heat generating element 32 in this embodiment is to make the thickness constant and make the width different. The means may be different. For example, the width is made constant, but the thickness is changed, or the resistance of the material is changed along the length.

Referring to Figure 8, there is shown an embodiment wherein the longitudinal end portions of the heat generating element 32b where it is not contacted to the fixing film, have a thickness t_2 which is larger than the thickness t_1 of the effective heat generating portion 32a, whereas the widths of the portions 32a and 32b are the same. By doing so, the opposite end portions generate smaller amount of heat.

Figure 9 shows an embodiment wherein the portions 32b are made of silver layer 32b' having a resistance lower than that of the silver-palladium.

It is important for the purpose of making the fixing property uniform along the length that the heater portion (the effective heat generating portion 32a of the heat generating element 32) corresponding to the width region g_2 through which the transfer sheet P passes during the fixing operation, provide a uniform temperature distribution in the longitudinal direction.

Referring to Figures 10 and 11, however, the temperature distribution is not uniform due to the difference in the heat transfer or radiation in the longitudinal direction of the heater, as shown in Figure 11 by broken line B, because the heat is easily dissipated through the supporting members 50 for the heat gen-

erating element adjacent to the opposite ends of the heater 30, as shown by arrows in Figure 10, and also because the provision of the temperature detecting element 33 or the thermal fuse 33a at the center of the backside of the heater results in the different heat radiation property there.

In an embodiment of Figure 12, the width of the heat generating layer 32 is changed in the longitudinal direction depending on the temperature distribution, that is, on the difference in the heat dissipation under the condition that the thickness is constant, by which the temperature distribution along the length of the heater in the region where the transfer sheet P passes is made uniform as shown by a solid line A in Figure 11. By doing so, the temperature of the heater in the portion where the transfer sheet passes during the fixing operation has become uniform along the longitudinal direction, so that the uniform fixing property is provided.

The heat generating layer 32 of the heater 30 may be made of, in addition to the silver-palladium, nickel-chrome, tungsten, ruthenium oxide (RuO_2), Ta_2N , an electric resistance material mainly containing one or more of them, or a ceramic heater in the form of a heat generating surface. The temperature detecting element 33 may be in the form of a temperature detecting resistance film such as Pt film applied (by screen printing or the like) on the backside of the heater substrate 31a or on the glazing layer surface at the same side as the heat generating layer 32 in parallel with the heat generating layer 32 or in the form of lamination thereon. The heat generating layer 32 may be formed on the backside of the base plate 31a.

When the fixing film is in the form of a non-endless film as shown in Figure 2, a replaceable rolled film can be employed, wherein when almost all of the fixing film is taken up on the take-up reel, a new roll of film is mounted (a wind-up and exchange type).

In this type, the thickness of the fixing film can be reduced substantially irrespective of the durability of the fixing film, so that the power consumption can be reduced. For example, the fixing film in this case may be made of a less expensive material such as PET (polyester) film which is treated for heat-durability having a thickness of 12.5 microns or lower, for example.

Alternatively, since the toner offset to the fixing film surface is not practically produced, the used fixing film taken up on the take-up shaft can be rewound on the feeding shaft, or the take-up shaft and the feeding shaft are interchanged to use the fixing film repeatedly, if the thermal deformation or thermal deterioration of the fixing film is not significant (a rewinding and repeatedly using type).

In this type, the fixing film is preferably made of a material exhibiting high heat-resistivity and mechanical strength, such as polyimide resin film having a thickness of 25 microns which is coated with a part-

ing layer made of fluorine resin or the like having a good parting property to constitute a multi-layer film. A press-contact releasing mechanism is preferably provided to automatically release the press-contact between the heater and the pressing roller during the rewinding operation.

Where the fixing film is used repeatedly as in the rewinding type and an endless belt type, a felt pad may be provided to clean the film surface and to apply a slight amount of parting agent such as silicone oil by impregnating the pad with the oil, by which the surface of the film is maintained clean and maintained in good parting property. Where the fixing film is treated with insulating fluorine resin, electric charge is easily produced on the film, the electric charge disturbing the toner image. In that case, the fixing film may be rubbed with a discharging brush which is electrically grounded to discharge the film. On the contrary, the film may be electrically charged by applying a bias voltage to such a brush without grounding as long as the toner image is not disturbed. It is a possible measure against the image disturbance due to the electric charge to add carbon black or the like in the fixing film. The same means is applicable against the electric charge of the back-up roller. As a further alternative, anti-electrification agent may be applied or added.

In any of the endless belt type, the winding-up and exchanging type and the rewinding and repeatedly using type, the fixing film may be in the form of a detachably mountable cartridge which is detachably mountable to a predetermined position of the fixing apparatus to facilitate the exchange or the like of the fixing film.

The structure of the heater 20 and the power supply control to the heat generating layer are not limited to those described in the foregoing. The heat generating layer may be made of a chip array of ceramic material having PTC property or a thick resistance material. The power supply control is not limited to the pulsewise energization, but may be in the form of usual AC power supply.

The toner heated and fused by the heating step may be cooled and solidified by the spontaneous heat radiation, or by a forced cooling using a blower or a heat radiation fins. In Figures 2 and 4, the toner is not necessarily sufficiently cooled or solidified at the position of the separating roller. If the toner shows the property in which it is sufficiently fused at the high temperature, it is possible as shown in Figure 13 that after the toner is sufficiently fused at the high temperature in the heating step (fixing nip), the recording material (transfer sheet) P is immediately separated from the fixing film 24 surface without the cooling step after the heating step.

In the foregoing description, an image transfer type electrophotographic copying apparatus is taken, but the means and process for the image formation

are not limited to those of this type. It may be of a type wherein a toner image is directly formed and carried on an electrofax sheet or an electrostatic recording sheet or the like, wherein the image is formed and recorded magnetically, wherein the toner image is formed with a heat-fusible toner on the recording medium by another image forming process and means. An examples of such an apparatus are heat-fixing type copying machine, laser beam printer, facsimile machine, a microfilm reader-printer, display device and recording device. The present invention is applicable to them.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

Claims

1. An image fixing apparatus, comprising:
 - a heater (30) extending in a direction crossing with the movement direction of a recording material (P),
 - a film (34) in slidable contact with said heater (30), and
 - a pressing member (22) cooperable with said heater (30) to form a nip between said film (34) and said heater (30),
 characterized in that
 - said heater (30) comprises a resistance heat generating layer (32a, 32b), the width or the thickness of which and thus its resistance value per unit length varies in a predetermined way in its longitudinal direction.
2. An apparatus according to claim 1, wherein said resistance heat generating layer (32a, 32b) has a larger width or thickness and thus a smaller resistance value per unit length at longitudinal marginal portions than at a central portion.
3. An apparatus according to claim 1, wherein a contact region between said pressing member (22) and said heater (30) is shorter than a length of said resistance heat generating layer (32a, 32b), wherein said resistance heat generating layer has a larger width or thickness and thus a smaller resistance value per unit length in a non-contact region than in the contact region.
4. An apparatus according to claim 1, wherein said film (34) slides on said heater (30) during a fixing operation, and wherein said resistance heat generating layer (32a, 32b) has a length larger than the width of said film, and said resistance heat



ing layer made of fluorine resin or the like having a good parting property to constitute a multi-layer film. A press-contact releasing mechanism is preferably provided to automatically release the press-contact between the heater and the pressing roller during the rewinding operation.

Where the fixing film is used repeatedly as in the rewinding type and an endless belt type, a felt pad may be provided to clean the film surface and to apply a slight amount of parting agent such as silicone oil by impregnating the pad with the oil, by which the surface of the film is maintained clean and maintained in good parting property. Where the fixing film is treated with insulating fluorine resin, electric charge is easily produced on the film, the electric charge disturbing the toner image. In that case, the fixing film may be rubbed with a discharging brush which is electrically grounded to discharge the film. On the contrary, the film may be electrically charged by applying a bias voltage to such a brush without grounding as long as the toner image is not disturbed. It is a possible measure against the image disturbance due to the electric charge to add carbon black or the like in the fixing film. The same means is applicable against the electric charge of the back-up roller. As a further alternative, anti-electrification agent may be applied or added.

In any of the endless belt type, the winding-up and exchanging type and the rewinding and repeatedly using type, the fixing film may be in the form of a detachably mountable cartridge which is detachably mountable to a predetermined position of the fixing apparatus to facilitate the exchange or the like of the fixing film.

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The toner heated and fused by the heating step may be cooled and solidified by the spontaneous heat radiation, or by a forced cooling using a blower or a heat radiation fins. In Figures 2 and 4, the toner is not necessarily sufficiently cooled or solidified at the position of the separating roller. If the toner shows the property in which it is sufficiently fused at the high temperature, it is possible as shown in Figure 13 that after the toner is sufficiently fused at the high temperature in the heating step (fixing nip), the recording material (transfer sheet) P is immediately separated from the fixing film 24 surface without the cooling step after the heating step.

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are not limited to those of this type. It may be of a type wherein a toner image is directly formed and carried on an electrofax sheet or an electrostatic recording sheet or the like, wherein the image is formed and recorded magnetically, wherein the toner image is formed with a heat-fusible toner on the recording medium by another image forming process and means. An examples of such an apparatus are heat-fixing type copying machine, laser beam printer, facsimile machine, a microfilm reader-printer, display device and recording device. The present invention is applicable to them.

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 - a pressing member (22) cooperable with said heater (30) to form a nip between said film (34) and said heater (30),
 characterized in that
 - said heater (30) comprises a resistance heat generating layer (32a, 32b), the width or the thickness of which and thus its resistance value per unit length varies in a predetermined way in its longitudinal direction.
2. An apparatus according to claim 1, wherein said resistance heat generating layer (32a, 32b) has a larger width or thickness and thus a smaller resistance value per unit length at longitudinal marginal portions than at a central portion.
3. An apparatus according to claim 1, wherein a contact region between said pressing member (22) and said heater (30) is shorter than a length of said resistance heat generating layer (32a, 32b), wherein said resistance heat generating layer has a larger width or thickness and thus a smaller resistance value per unit length in a non-contact region than in the contact region.
4. An apparatus according to claim 1, wherein said film (34) slides on said heater (30) during a fixing operation, and wherein said resistance heat generating layer (32a, 32b) has a length larger than the width of said film, and said resistance heat



generating layer (32a, 32b) has a larger width or thickness and thus a smaller resistance value per unit length in a portion where it is not contacted to said film (34) than in a portion where it is contacted to said film (34).

Patentansprüche

1. Bildfixiergerät, mit
 - einer Heizeinrichtung (30), die sich in einer Richtung erstreckt, welche sich mit der Bewegungsrichtung eines Aufzeichnungsmaterials (P) kreuzt,
 - einem Film (34) in verschiebbarer Berührung mit der Heizeinrichtung (30), und
 - einem Andruckelement (22), das mit der Heizeinrichtung (30) zusammenwirken kann, um zwischen dem Film (34) und der Heizeinrichtung (30) einen Spalt auszubilden, dadurch gekennzeichnet, daß
 - die Heizeinrichtung (30) eine Widerstands-Wärmeerzeugungsschicht (32a, 32b) aufweist, deren Breite oder deren Dicke und folglich deren Widerstandswert pro Längeneinheit sich auf eine vorbestimmte Weise in ihrer Längsrichtung ändert.
2. Gerät gemäß Anspruch 1, wobei die Widerstands-Wärmeerzeugungsschicht (32a, 32b) in längseitigen Randabschnitten eine größere Breite oder Dicke und folglich einen kleineren Widerstandswert pro Längeneinheit als in einem mittleren Abschnitt hat.
3. Gerät gemäß Anspruch 1, wobei ein Berührungsbereich zwischen dem Andruckelement (22) und der Heizeinrichtung (30) kürzer als eine Länge der Widerstands-Wärmeerzeugungsschicht (32a, 32b) ist, wobei die Widerstands-Wärmeerzeugungsschicht in einem Nichtberührungsbereich eine größere Breite oder Dicke und folglich einen kleineren Widerstandswert pro Längeneinheit als in dem Berührungsbereich hat.
4. Gerät gemäß Anspruch 1, wobei der Film (34) während einem Fixiervorgang auf der Heizeinrichtung (30) gleitet, und wobei die Widerstands-Wärmeerzeugungsschicht (32a, 32b) eine Länge hat, die größer als die Breite des Films ist, und die Widerstands-Wärmeerzeugungsschicht (32a, 32b) in einem Abschnitt, in dem sie nicht in Berührung mit dem Film (34) ist, eine größere Breite oder Dicke und folglich einen kleineren Widerstandswert pro Längeneinheit als in einem Abschnitt hat, in dem sie in Berührung mit dem Film (34) ist.

Revendications

1. Appareil de fixation d'images, comportant :
 - un élément chauffant (30) s'étendant dans une direction croisant la direction de mouvement d'un support d'enregistrement (P),
 - un film (34) en contact de glissement avec ledit élément chauffant (30), et
 - un élément presseur (22) pouvant coopérer avec ledit élément chauffant (30) pour former une zone de serrage entre ledit film (34) et ledit élément chauffant (30), caractérisé en ce que
 - ledit élément chauffant (30) comporte une couche (32a, 32b) de génération de chaleur par effet Joule, dont la largeur ou l'épaisseur et donc sa valeur de résistance par unité de longueur varient d'une manière prédéterminée dans sa direction longitudinale.
2. Appareil selon la revendication 1, dans lequel ladite couche (32a, 32b) de génération de chaleur par effet Joule présente une largeur ou une épaisseur plus grande et donc une valeur de résistance par unité de longueur plus petite dans des parties marginales longitudinales que dans une partie centrale.
3. Appareil selon la revendication 1, dans lequel une zone de contact entre ledit élément presseur (22) et ledit élément chauffant (30) est plus courte qu'une longueur de ladite couche (32a, 32b) de génération de chaleur par effet Joule, ladite couche de génération de chaleur par effet Joule ayant une largeur ou une épaisseur plus grande et donc une valeur de résistance par unité de longueur plus petite dans une zone sans contact que dans la zone de contact.
4. Appareil selon la revendication 1, dans lequel ledit film (34) glisse sur ledit élément chauffant (30) durant une opération de fixation, et dans lequel ladite couche (32a, 32b) de génération de chaleur par effet Joule présente une longueur plus grande que la largeur dudit film, et ladite couche (32a, 32b) de génération de chaleur par effet Joule présente une largeur ou épaisseur plus grande et donc une valeur de résistance par unité de longueur plus petite dans une partie où elle n'est pas en contact avec ledit film (34) que dans une partie où elle est en contact avec ledit film (34).