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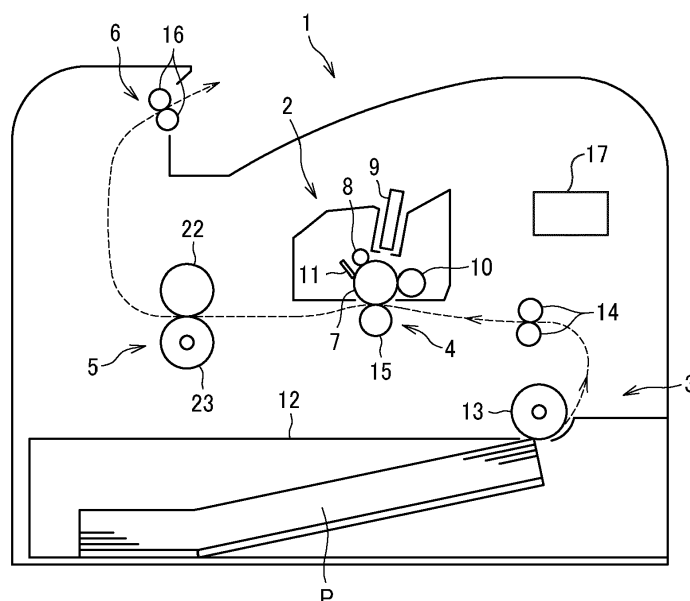
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(54) **FIXING DEVICE AND IMAGE FORMING APPARATUS INCORPORATING SAME**

(57) A fixing device (5) includes a fixing belt (22) in an endless form, a pressing member (23) configured to press the fixing belt (22), a nip formation member (32) disposed inside a loop of the fixing belt (22) and configured to contact the pressing member (23) via the fixing belt (22) to form a fixing nip, a heat generator (31) disposed inside the loop of the fixing belt (22) and configured

to heat the fixing belt (22), a first heat shield (35), and a second heat shield (36). The first heat shield (35) has a heat shield area to block heat from the heat generator (31). The second heat shield (36) has a heat shield area disposed in a different position from the heat shield area of the first heat shield (35) in a circumferential direction and a longitudinal direction of the fixing belt (22).

FIG. 1



Description

BACKGROUND

5 Technical Field

[0001] Embodiments of the present disclosure generally relate to a fixing device and an image forming apparatus incorporating the fixing device.

10 Description of the Related Art

[0002] An image forming apparatus such as a copier, a printer, a facsimile machine, and a multi-functional apparatus including at least two functions of the copier, printer, facsimile machine includes a fixing device to convey a recording medium such as a sheet on which an unfixed image is formed to a fixing nip formed between a fixing belt and a pressing member in the fixing device, heat the recording medium, and fix the unfixed image onto the recording medium.

[0003] The fixing device includes a heat generator such as a halogen heater to heat the fixing belt. The heat generator has a longitudinal shape extending in a longitudinal direction of the fixing belt that is a width direction of the fixing belt. The heat generator heats the fixing belt via a nip formation member disposed inside a loop of the fixing belt and raises a temperature of the fixing belt to a fixing temperature that enables fixing an image onto a recording medium.

[0004] One of technical issues of such a fixing device is temperature unevenness in the longitudinal direction of the fixing belt. Since side plates to support the fixing belt and other parts located outside a sheet conveyance span on the fixing belt that do not face the heat generator draw heat from an end portion of the sheet conveyance span of the fixing belt, a temperature at the end portion of the fixing belt becomes smaller than a temperature at a central portion of the fixing belt, that is, temperature decrease at the end portion occurs, and the temperature decrease may cause a fixing failure at the end portion of the fixing belt in the longitudinal direction. On the contrary, when small sheets continuously pass through the fixing device, since the small sheets do not draw heat from the end portion of the fixing belt, the temperature at the end portion of the fixing belt becomes higher than the temperature at the central portion of the fixing belt, and the high temperature at the end portion of the fixing belt may cause deterioration of the fixing belt.

[0005] In particular, in a configuration in which one heat generator such as a halogen heater extends in the longitudinal direction, reducing the temperature unevenness in the longitudinal direction of the fixing belt is difficult because increasing the output of the heat generator results in increase of the amount of heat generated in the entire region of the heat generator in the longitudinal direction, and it is difficult that controlling the output of the heat generator after the increase of the amount of heat produces a difference in the amount of heat between an end portion of the heat generator and a central portion of the heat generator in the longitudinal direction.

[0006] To solve the above-described technical issues, for example, JP-2013-164430-A discloses the fixing device including two heaters, that is, one heater that mainly heats the central portion of the fixing belt in the longitudinal direction and the other heater that heats the end portion of the fixing belt in the longitudinal direction, and a controller that controls heat generation amounts of these heaters separately. In addition, the above-described fixing device includes a pair of heat shields outside the sheet conveyance span of the largest recording medium in the longitudinal direction to block heat and prevents portions of the fixing belt outside the sheet conveyance span of the largest recording medium from overheating to prevent the fixing belt from deteriorating. Providing a plurality of heat generators having different main heat generation areas in the longitudinal direction as described above can generate the difference in the amount of heat in the longitudinal direction of the fixing belt and reduce the temperature unevenness in the longitudinal direction even when the temperature unevenness occurs.

[0007] Providing the plurality of heat generators as in JP-2013-164430-A has a certain effect for reducing the temperature unevenness in the longitudinal direction of the fixing belt, but further improvement is desired to reduce the temperature unevenness.

SUMMARY

[0008] Under the above-described circumstances, an object of the present disclosure is to reduce a temperature unevenness of the fixing belt in the longitudinal direction.

[0009] It is a general object of the present disclosure to provide an improved and useful fixing device in which the above-mentioned disadvantages are eliminated. In order to achieve the above-mentioned object, there is provided a fixing device according to claim 1. Advantageous embodiments are defined by the dependent claims.

[0010] Advantageously, the fixing device includes a fixing belt in an endless form, a pressing member configured to press the fixing belt, a nip formation member disposed inside a loop of the fixing belt and configured to contact the pressing member via the fixing belt to form a fixing nip, a heat generator disposed inside the loop of the fixing belt and

configured to heat the fixing belt, a first heat shield, and a second heat shield. The first heat shield has a heat shield area to block heat from the heat generator. The second heat shield has a heat shield area disposed in a different position from the heat shield area of the first heat shield in a circumferential direction and a longitudinal direction of the fixing belt.

[0011] According to the present disclosure, the heat shields described above can reduce the temperature unevenness in the longitudinal direction of the fixing belt.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic diagram illustrating a configuration of an image forming apparatus according to an embodiment of the present disclosure;

FIG. 2 is a vertical cross-sectional view of a fixing device according to a first embodiment of the present disclosure viewed from a lateral side of the fixing device;

FIG. 3 is a vertical cross-sectional view of the fixing device viewed from a front side of the fixing device;

FIGS. 4A and 4B are plan views illustrating heat shields;

FIGS. 5A to 5C are plan views illustrating variations of openings disposed in the heat shields;

FIG. 6A is a perspective view of a belt supporter;

FIG. 6B is a front view of the belt supporter;

FIG. 6C is a rear view of the belt supporter;

FIG. 7 is a schematic diagram illustrating a mechanism that moves the belt supporter to move a heater relative to other parts such as a fixing belt;

FIG. 8A is an explanatory diagram illustrating a layout of parts when the belt supporter is positioned at the farthest position;

FIG. 8B is an explanatory diagram illustrating a layout of parts when the belt supporter is positioned at the closest position;

FIG. 9 illustrates a variation of a contact and separation mechanism; and

FIG. 10 is a vertical cross-sectional view of the fixing device according to another embodiment viewed from a front side of the fixing device.

[0013] The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

DETAILED DESCRIPTION OF EMBODIMENTS

[0014] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that have a similar function, operate in a similar manner, and achieve a similar result.

[0015] Although the embodiments are described with technical limitations with reference to the attached drawings, such description is not intended to limit the scope of the disclosure and all of the components or elements described in the embodiments of this disclosure are not necessarily indispensable.

[0016] A description is given of embodiments of the present disclosure below, with reference to the drawings attached. In the drawings for describing the embodiments of the present disclosure, identical reference numerals are assigned to elements such as members and parts that have an identical function or an identical shape as long as differentiation is possible, and a description of those elements is omitted once the description is provided.

[0017] FIG. 1 is a schematic diagram illustrating a configuration of an image forming apparatus according to an embodiment of the present disclosure. Referring to FIG. 1, a configuration and operation of the image forming apparatus according to the present embodiment are described below.

[0018] The image forming apparatus 1 illustrated in FIG. 1 is a monochrome electrophotographic laser printer. The image forming apparatus 1 according to the embodiments of the present disclosure may be a copier, a facsimile machine, a multifunction peripheral (MFP) having at least two of copying, printing, scanning, facsimile, and plotter functions in addition to the printer. The image forming apparatus 1 is not limited to a monochrome image forming apparatus and may be a color image forming apparatus.

[0019] As illustrated in FIG. 1, the image forming apparatus 1 includes an image forming device 2 to form an image,

a recording medium feeding device 3 to feed a sheet P as a recording medium to the image forming device 2, a transfer device 4 to transfer the image onto the fed sheet P, a fixing device 5 to fix the image transferred onto the sheet P, and a sheet ejection device 6 to eject the sheet P with the fixed image to an outside of the image forming apparatus 1.

[0020] The image forming device 2 includes a drum-shaped photoconductor 7, a charging roller 8 as a charging device to charge a surface of the photoconductor 7, an exposure device 9 as a latent image forming device that exposes the surface of the photoconductor 7 to form an electrostatic latent image on the photoconductor 7, a developing roller 10 as a developing device that supplies toner as a developer to the surface of the photoconductor 7 to visualize the electrostatic latent image, and a cleaning blade 11 as a cleaner to clean the surface of the photoconductor 7.

[0021] As an image forming operation start is instructed, in the image forming device 2, the photoconductor 7 starts to rotate, and the charging roller 8 uniformly charges the surface of the photoconductor 7 to a high potential. Next, based on image data of an original document read by a scanner or print data instructed by a terminal device, the exposure device 9 exposes the surface of the photoconductor 7. Potential of an exposed surface drops, and the electrostatic latent image is formed on the photoconductor 7. The developing roller 10 supplies toner to the electrostatic latent image, thereby developing the latent image into the toner image on the photoconductor 7.

[0022] The toner image formed on the photoconductor 7 is transferred onto the sheet P in a transfer nip between the photoconductor 7 and a transfer roller 15 disposed in the transfer device 4. The sheet P is fed from the recording medium feeding device 3. In the recording medium feeding device 3, a sheet feeding roller 13 feeds the sheet P from a sheet tray 12 to a feeding path one by one. A timing roller pair 14 sends out the sheet P fed from the sheet tray 12 to a transfer nip, timed to coincide with the toner image on the photoconductor 7. The toner image on the photoconductor 7 is transferred onto the sheet P at the transfer nip. After the toner image is transferred from the photoconductors 7 onto the sheet P, the cleaning blade 11 removes residual toner on the photoconductor 7.

[0023] The sheet P bearing the toner image is conveyed to the fixing device 5. In the fixing device 5, heat and pressure when the sheet P passes through between a fixing belt 22 and a pressure roller 23 fixes the toner image onto the sheet P. Subsequently, the sheet P is conveyed to the sheet ejection device 6, and an ejection roller pair 16 ejects the sheet P outside the image forming apparatus 1, and a series of print operations are completed.

[0024] With reference to FIGS. 2 and 3, a detailed description is provided of a construction of the fixing device 5. FIG. 2 is a vertical cross-sectional view of the fixing device 5 viewed from a lateral side of the fixing device 5, and FIG. 3 is a vertical cross-sectional view of the fixing device 5 viewed from a front side of the fixing device 5, which schematically illustrate the fixing device 5.

[0025] In FIGS. 2 and 3, belt supporters to support both ends of the fixing belt 22 in a width direction are obviated. The belt supporters are illustrated in detail below.

[0026] As illustrated in FIG. 2, the fixing device 5 includes the fixing belt 22, a pressure roller 23 as a pressing member, a halogen heater 31 as a heat generator, a nip formation member 32, a stay 33 as a contact member, a reflector 34, a first heat shield 35, and a second heat shield 36. The halogen heater 31, the nip formation member 32, the stay 33, the reflector 34, the first heat shield 35, and the second heat shield 36 are members having longitudinal shapes extending along a width direction of the fixing belt 22 (see FIG. 3). Note that the width direction of the fixing belt 22 is a direction perpendicular to a surface of the paper on which FIG. 2 is drawn and the longitudinal direction of the fixing belt 22. The circumferential direction of the fixing belt 22 is a rotation direction of the fixing belt 22 illustrated in FIG. 2. In the following description, the width direction of the fixing belt 22 is simply referred to as the width direction.

[0027] As illustrated in FIG. 2, the fixing belt 22 is a cylindrical fixing member to fix an unfixed image T to the sheet P and is disposed on the side of the sheet P on which the unfixed image T is held. The fixing belt 22 in the present embodiment is an endless belt or film, including a base layer formed on an inner side of the fixing belt 22 and made of a metal such as nickel and stainless steel (SUS) or a resin such as polyimide, and a release layer formed on the outer side of the fixing belt 22 and made of tetrafluoroethylene-perfluoroalkylvinylether copolymer (PFA), polytetrafluoroethylene (PTFE), or the like. Optionally, an elastic layer made of rubber such as silicone rubber, silicone rubber foam, and fluoro rubber may be interposed between the base layer and the release layer. While the fixing belt 22 and the pressure roller 23 press the unfixed toner image against the sheet P to fix the toner image onto the sheet P, the elastic layer having a thickness of about 100 micrometers elastically deforms to absorb slight surface asperities of the fixing belt 22, preventing variation in gloss of the toner image on the sheet P. In the present embodiment, the fixing belt 22 is thin and has a small loop diameter to decrease the thermal capacity of the fixing belt 22. For example, the base layer of the fixing belt 22 has a thickness of from 20 μm to 50 μm and the release layer has a thickness of from 10 μm to 50 μm . Thus, the fixing belt 22 has a total thickness not greater than 1 mm. When the fixing belt 22 includes the elastic layer, the thickness of the elastic layer may be set to 100 to 300 μm . In order to further decrease the thermal capacity of the fixing belt 22, the fixing belt 22 may have the total thickness not greater than 0.20 mm and preferably not greater than 0.16 mm. In the present embodiment, the fixing belt 22 may have a loop diameter from 20 to 40 mm and preferably 30 mm or less.

[0028] The pressure roller 23 is an opposed member disposed opposite an outer circumferential surface of the fixing belt 22. The pressure roller 23 includes a cored bar; an elastic layer coating the cored bar and being made of silicone rubber foam, fluoro rubber, or the like; and a release layer coating the elastic layer and being made of PFA, PTFE, or

the like. According to the present embodiment, the pressure roller 23 is a solid roller. Alternatively, the pressure roller 23 may be a hollow roller. When the pressure roller 23 is the hollow roller, the heat generator such as the halogen heater may be disposed inside the pressure roller 23. The elastic layer of the pressure roller 23 may be made of solid rubber. Alternatively, if no heat generator is disposed inside the pressure roller 23, the elastic layer of the pressure roller 23 is preferably made of sponge rubber to enhance thermal insulation of the pressure roller 23. Such a configuration reduces heat conduction from the fixing belt 22 to the pressure roller 23 and improves heating efficiency of the fixing belt 22.

[0029] A driver disposed inside the image forming apparatus 1 drives and rotates the pressure roller 23 in a direction indicated by arrow A in FIG. 2. The rotation of the pressure roller 23 drives the fixing belt 22 to rotate in a direction indicated by arrow B in FIG. 2 (hereinafter, belt rotation direction B) due to frictional force therebetween. After the toner image is transferred onto the sheet P, the sheet P bearing the unfixed toner image T is conveyed to a fixing nip N between the fixing belt 22 and the pressure roller 23. The rotating fixing belt 22 and the rotating pressure roller 23 conveys the sheet P, and the sheet P passes through the fixing nip N. When the sheet P passes through the fixing nip N, heat and pressure applied to the sheet P fix the unfixed toner image T onto the sheet P.

[0030] The pressure roller 23 and the fixing belt 22 are configured to be able to contact and separate from each other. If the sheet is jammed in the nip N, separating the pressure roller 23 and the fixing belt 22 from each other and opening the nip N enables the jammed sheet to be removed. One of the pressure roller 23 and the fixing belt 22 may be configured to be fixed and the other may be configured to be movable so that the pressure roller 23 and the fixing belt 22 contact and separate from each other. Alternatively, both the pressure roller 23 and the fixing belt 22 may be configured to move so that the pressure roller 23 and the fixing belt 22 contact and separate from each other.

[0031] The halogen heater 31 is a heat generator disposed inside the loop of the fixing belt 22 to emit infrared light, and radiant heat from the halogen heater 31 heats the fixing belt 22 from the inside. One halogen heater 31 is disposed in the fixing belt 22. Alternatively, instead of the halogen heater 31, a carbon heater, a ceramic heater or the like may be employed as the heat generator.

[0032] The nip formation member 32 sandwiches the fixing belt 22 together with the pressure roller 23, to form the fixing nip N. Specifically, the nip formation member 32 is disposed inside the loop of the fixing belt 22 and extends in the longitudinal direction thereof parallel to the width direction of the fixing belt 22. The nip formation member 32 has a planar nip formation portion 32a that is in contact with an inner circumferential surface of the fixing belt 22 and a pair of bent portions 32b that are bent from both end portions of the nip formation portion 32a in a belt rotation direction B to the opposite side to the pressure roller 23. A pressing member such as a spring presses the pressure roller 23 against the nip formation member 32, which causes the pressure roller 23 to contact the fixing belt 22 and form the fixing nip N between the pressure roller 23 and the fixing belt 22.

[0033] A nip formation surface 32c on the nip formation portion 32a facing the fixing belt 22 directly contacts the inner circumferential surface of the fixing belt 22. Therefore, when the fixing belt 22 rotates, the fixing belt 22 slides along the nip formation surface 32c. In order to improve the abrasion resistance and the slidability of the nip formation surface 32c, preferably the nip formation surface 32c is treated with an alumite or a fluororesin material coating. Additionally, a lubricant such as a fluorine-based grease may be applied to the nip formation surface 32c to ensure slidability over time. In the present embodiment, the nip formation surface 32c is planar. Alternatively, the nip formation surface 32c may define a recess or other shape. For example, the nip formation surface 32c having a concave shape recessed to the side opposite to the pressure roller 23 leads the outlet of the sheet in the fixing nip N to be closer to the pressure roller 23, which improves separation of the sheet from the fixing belt 22.

[0034] The nip formation member 32 is made of a material having a thermal conductivity larger than a thermal conductivity of the stay 33. For example, the material of the nip formation member 32 is preferably copper (thermal conductivity: 398 W / mK) or aluminum (thermal conductivity: 236 W / mK). The nip formation member 32 made of the material having such a large thermal conductivity absorbs the radiant heat from the halogen heater 31 and effectively transmits heat to the fixing belt 22. For example, setting the thickness of the nip formation member 32 to 1 mm or less can shorten a heat transfer time in which the heat transfers from the nip formation member 32 to the fixing belt 22, which is advantageous in shortening a warm-up time of the fixing device 5. In contrast, setting the thickness of the nip formation member 32 to be larger than 1 mm but not larger than 5 mm can improve a heat storage capacity of the nip formation member 32.

[0035] The stay 33 is the contact member that contacts a rear side surface of the nip formation member 32 to support the nip formation member 32 against the pressure of the pressure roller 23. The stays 33 are a pair of members extending in a pressing direction of the pressure roller 23 that is a direction perpendicular to a sheet conveyance direction and a vertical direction in FIG. 2, and one ends of the stays 33 in the pressing direction contact the back surface of the nip formation member 32 at one end and the other end of the nip formation member 32 in the sheet conveyance direction. Extending the stays 33 in the pressing direction of the pressure roller 23 strengthens the rigidity of the stay 33 in the pressing direction and reduces the bend of the nip formation portion 32a caused by the pressing force of the pressure roller 23. Such a configuration results in a uniform width of the nip in the longitudinal direction. The stay 33 is preferably made of an iron-based metal such as stainless steel (SUS) or Steel Electrolytic Cold Commercial (SECC) that is electrogalvanized sheet steel to ensure rigidity.

[0036] The reflector 34 is disposed opposite the halogen heater 31 inside the loop of the fixing belt 22 to reflect the radiant heat that is infrared light emitted from the halogen heater 31 to the nip formation member 32. The reflectors 34 are a pair of members formed into a convex-curved surface closest to the halogen heater 31 at a position facing the halogen heater 31. The reflectors 34 formed such the convex-curved surfaces reflect the infrared light emitted from the halogen heater 31 in various directions. Since the infrared light reflected by the reflectors 34 formed the convex-curved surfaces reaches the nip formation member 32 or the fixing belt 22 with a smaller number of reflections than the infrared light reflected by a flat reflector, the attenuation of the infrared light due to the increase in the number of reflections decreases, and the infrared light reflected by reflectors 34 formed the convex-curved surfaces can effectively heats the nip formation member 32 or the fixing belt 22. In the present embodiment, the halogen heater 31 is disposed to be relatively movable in the fixing device 5 as described in detail below, and the arrangement in FIG. 2 is an example.

[0037] Each of the reflectors 34 has bent portions 34a and 34b at both ends in the vertical direction in FIG. 2. The bent portions 34a are bent in a direction away from each other in the sheet conveyance direction, and the bent portions 34b are bent in the direction away from each other, too. Each bent portion 34a is sandwiched between each stay 33 and the nip formation portion 32a of the nip formation member 32 to hold the reflector 34.

[0038] The reflector 34 reflects the infrared light emitted from the halogen heater 31 to the fixing belt 22 and the nip formation member 32. Since the reflector 34 is interposed between the halogen heater 31 and the stay 33, the reflector 34 functions to block the infrared light from the halogen heater 31 to the stay 33.

[0039] The surface of the reflector 34 facing the halogen heater 31 is treated with mirror finish or the like to increase reflectance. In the present embodiment, reflectance is measured using the spectrophotometer that is the ultraviolet visible infrared spectrophotometer UH4150 manufactured by Hitachi High-Technologies Corporation in which the incident angle is set 5°. In general, the color temperature of the halogen heater varies depending on the application. The color temperature of the heater for the fixing device is about 2500 K. The reflectance of the reflector 34 used in the present embodiment is preferably 70% or more with wavelengths of high emission intensity in the halogen heater 31, that is, specifically the wavelengths of 900 to 1600 nm and more preferably 70% or more with the wavelengths of 1000 to 1300 nm.

[0040] The first heat shield 35 and the second heat shield 36 are members to block heat from the halogen heater 31 and separately disposed corresponding to different areas in the circumferential direction of the fixing belt 22 to block heat toward the different areas in the circumferential direction of the fixing belt 22. Specifically, the first heat shield 35 blocks the heat from the halogen heater 31 to the nip formation member 32, the second heat shield 36 mainly blocks the heat from the halogen heater 31 to an upper portion of the fixing belt 22 in FIG. 2.

[0041] The temperature sensors 28 as temperature detectors are disposed outside the loop of the fixing belt 22 and detect temperatures of the fixing belt 22. In the present embodiment, the temperature sensors 28 are disposed at two positions, the central position in the width direction of the fixing belt 22, and one end position in the belt width direction of the fixing belt 22. Output of the halogen heater 31 is controlled based on the temperature of the outer circumferential surface of the fixing belt 22 detected by the temperature sensor 28. Thus, the temperature of the fixing belt 22 is adjusted to a desired fixing temperature. The temperature sensor 28 may be either contact type or non-contact type. The temperature sensor 28 may be a known temperature sensor type such as a thermopile, a thermostat, a thermistor, or a non-contact (NC) sensor.

[0042] Next, with reference to FIGS. 3, 4A, and 4B, a description is provided of a heat shield area of each heat shield in the width direction and heating the fixing belt 22 and the nip formation member 32 by the halogen heater 31.

[0043] As illustrated in FIG. 3, the first heat shield 35 has an opening 35a at a position corresponding to a central portion of the fixing belt 22 in the width direction (see FIG. 4B). On the other hand, the second heat shield 36 has openings 36a at positions corresponding to end portions of the fixing belt 22 in the width direction (see FIG. 4A). Note that the central portion of the fixing belt 22 in the width direction means a middle portion when the fixing belt 22 is divided into three in the width direction, and the end portions of the fixing belt 22 in the width direction mean both portions obtained by dividing the fixing belt 22 into three. In the present embodiment, since the first heat shield 35 and the second heat shield 36 have different opening areas in the width direction, the first heat shield 35 and the second heat shield 36 have different heat shield areas. In the present embodiment, the opening 35a and the opening 36a do not overlap in the width direction. In the first heat shield 35 of the present embodiment, a surface facing the halogen heater 31 functions as a reflection face that reflects heat or light. Although the reflection face according to the present embodiment is mirror-finished, the reflection face according to the present disclosure may be any surface that has a reflectance greater than 0 for a wavelength from 800 μm to 1500 μm . The first heat shield 35 and the second heat shield 36 may be made of heat insulating material such as polyimide foam.

[0044] As illustrated by arrows in FIG. 3, the radiant heat radiated from the halogen heater 31 to the nip formation member 32 is blocked by the end portions of the first heat shield 35 in the width direction and reaches the central portion of the nip formation member 32. Accordingly, in a lower portion of the fixing belt 22 in FIG. 3, the nip formation member 32 mainly heats the central portion of the fixing belt 22 in the width direction. On the other hand, the radiant heat radiated from the halogen heater 31 to an upper portion of FIG. 3 is blocked by the central portion of the second heat shield 36 in the width direction and reaches the end portions of the fixing belt 22. Accordingly, in an upper portion of the fixing belt

22 in FIG. 3, the radiant heat mainly heats the end portions of the fixing belt 22 in the width direction. Table 1 summarizes the heat shield areas of each heat shield in respective directions described above.

Table 1

	FIRST HEAT SHIELD	SECOND HEAT SHIELD
CIRCUMFERENTIAL DIRECTION	RADIANT HEAT TO NIP FORMATION MEMBER IS MAINLY BLOCKED	RADIANT HEAT TO FIXING BELT IS BLOCKED
WIDTH DIRECTION	RADIANT HEAT TO END PORTIONS IS BLOCKED	RADIANT HEAT TO CENTRAL PORTION IS BLOCKED

[0045] As described above, different heat shield areas of the heat shields in the circumferential direction of the fixing belt 22 and the width direction of the fixing belt 22 enables the heat shields to separate heat transfer paths from the halogen heater 31. Specifically, the heat shields can provide different heat transfer paths, that is, the path to the central portion of the fixing belt 22 and the path to the end portions of the fixing belt 22 in the width direction. In the heat transfer path to the central portion of the fixing belt 22 in the present embodiment, the radiant heat from the halogen heater 31 transfers to the nip formation member 32, and the heat of the nip formation member 32 transfers to the nip of the fixing belt 22. In the heat transfer path to the end portions of the fixing belt 22 in the present embodiment, the radiant heat from the halogen heater 31 transfers to a portion of the fixing belt 22 opposite to the nip of the fixing belt 22, and the heat of the portion of the fixing belt 22 transfers to the nip of the fixing belt 22.

[0046] In particular, in the present embodiment, providing the opening in the heat shield changes the heat shield area of the heat shield. That is, an area in which the opening is provided becomes an area in which heat is not blocked (see FIGS. 4A and 4B).

[0047] In the present embodiment, the halogen heater 31 is disposed to be relatively movable with respect to other parts in the fixing device 5. A direction of relative movement of the halogen heater 31 is a direction in which the halogen heater 31 approaches the nip formation member 32 or moves away from the nip formation member 32 (see a double-headed arrow in FIG. 2). As a method to relatively move the halogen heater 31, the fixing device 5 may be configured so that the halogen heater 31 can move with respect to other parts, or, on the contrary, the fixing belt 22, the pressure roller 23, and parts in a loop of the fixing belt 22 other than the halogen heater 31 can move with respect to the halogen heater 31. For example, a biasing member such as a spring to press the nip formation member 32 against the pressure roller 23 is provided inside the loop of the fixing belt 22, and the fixing device 5 is configured so that the pressing force that presses the pressure roller 23 against the nip formation member 32 can be changed. In such a configuration, the small pressing force of the pressure roller 23 enables a biasing force of the biasing member to move the nip formation member 32 toward the pressure roller 23, which can move the fixing belt 22 and the parts inside the loop of the fixing belt 22 other than the halogen heater 31 toward the pressure roller 23. In contrast, the large pressing force of the pressure roller 23 can move the nip formation member 32, the fixing belt 22, and the parts inside the loop of the fixing belt 22 other than the halogen heater 31 in a direction away from the pressure roller 23.

[0048] Relatively moving the halogen heater 31 upward in FIG. 2 enables the halogen heater 31 to get farther away from the nip formation member 32 and approach the upper portion of the fixing belt 22 in FIG. 2. The above-described movement can increase an amount of heat added to the end portions of the fixing belt 22 in the width direction and decrease an amount of heat added to the central portion of the fixing belt 22 in the width direction. On the contrary, relatively moving the halogen heater 31 downward in FIG. 2 can decrease the amount of heat added to the end portions of the fixing belt 22 in the width direction and increase the amount of heat added to the central portion of the fixing belt 22 in the width direction.

[0049] As described above, the fixing device 5 in the present embodiment has different heat transfer paths in which the heat shields block heat at different portions in the width direction, that is, the center portion and the end portions. In addition, the relatively movable halogen heater 31 can increase the amount of heat transfer in one of the heat transfer paths and decrease the amount of heat transfer in the other one of the heat transfer paths. The above-described configuration can increase or decrease the amount of heat added through each heat transfer path according to situations. Therefore, even in a configuration of the fixing device 5 including one heater as described in the present embodiment, the amount of heat added to the fixing belt 22 can be partially increased or decreased in the width direction to reduce a temperature unevenness in the width direction of the fixing belt 22. Accordingly, the above-described configuration can reduce the temperature unevenness on the fixing belt 22 and prevent a fixing failure on the sheet caused by a partial temperature shortage on the fixing belt 22 or deterioration and wear of the fixing belt 22 caused by a partial overheating of the fixing belt 22. Additionally, the above-described configuration can reduce energy consumption due to unnecessary heat generation and achieve energy saving of the fixing device.

[0050] Examples of the occurrence of temperature unevenness in the width direction of the fixing belt 22 as described

above are described below.

[0051] At a start-up operation of the fixing device 5, the heat of the fixing belt 22 is transmitted to flanges holding the end portions of the fixing belt 22 in the width direction and side plates holding the flanges and lost. Therefore, a temperature at the end portion of the fixing belt 22 in the width direction is less likely to rise than a temperature at the central portion of the fixing belt 22. On the other hand, after the start-up operation, continuously printing small-size sheets tends to cause higher temperature at the end portions of the fixing belt 22 than the central portion of the fixing belt 22 because the sheets do not take heat from non-sheet conveyance areas of the fixing belt 22 in the end portions of the fixing belt 22 in the width direction.

[0052] Based on the above-described examples, in an example of the control of the fixing device 5 according to the present embodiment, the halogen heater 31 is controlled to approach the upper portion of the fixing belt 22 to prevent temperature decrease at the end portion of the fixing belt 22 in the width direction at the start-up operation and normal operations. The above-described control at the start-up operation can shorten a time for the start-up operation of the fixing device 5. On the contrary, when the temperature at the end portion of the fixing belt 22 in the width direction is likely to rise greatly, for example, continuous printing of the small-size sheets, relatively moving the halogen heater 31 downward in FIG. 2 prevents excessive heat supply to the end portion of the fixing belt 22 in the width direction. That is, the fixing device can be properly used in each situation. The above-described configuration can reduce the temperature unevenness of the fixing belt 22 in the width direction, which occurs at the start-up operation and continuous printing of the small-size sheets, and improve both situations.

[0053] In particular, in the present embodiment, the halogen heater 31 uses the heat transfer path in which the halogen heater 31 heats the lower portion of the fixing belt 22 in FIG. 2 mainly via the nip formation member 32 to heat the central portion of the fixing belt 22 in the width direction. To heat the end portions of the fixing belt 22 in the width direction, the halogen heater 31 uses the heat transfer path in which the halogen heater 31 directly heats the upper portion of the fixing belt 22 in FIG. 2. Using different heat transfer paths described above can prevent the temperature at the end portions of the fixing belt 22 in the width direction from excessively rising at the continuous printing of small-size sheets. That is, since the fixing belt 22 is thinner than the nip formation member 32 and has a smaller thermal capacity than that of the nip formation member 32, the fixing belt 22 easily transmits the heat in the width direction. On the other hand, the nip formation member 32 of the present embodiment has a relatively higher thermal capacity and does not easily transmit the heat in the width direction. Therefore, since the halogen heater 31 heats the end portions of the fixing belt 22 in the width direction via the heat transfer path in which the halogen heater 31 directly heats the upper portion of the fixing belt 22 in FIG. 2, the heat received in the end portions of the fixing belt 22 in the width direction can be easily transmitted to other portions of the fixing belt 22 in the width direction, which can prevent the temperature at the end portions of the fixing belt 22 in the width direction from rising at the continuous printing of small-size sheets.

[0054] In the present embodiment, a controller 17 controls a relative position of the halogen heater 31 to the other parts in the fixing device 5 based on results detected by the temperature sensors 28 facing the central portion and the end portion of the fixing belt 22 in the width direction. That is, when the controller 17 determines that the temperature of either the central portion or the end portion of the fixing belt 22 in the width direction is relatively low based on the results detected by the temperature sensors 28, the controller 17 can change the relative position of the halogen heater 31 to the other parts in the fixing device 5 to increase the amount of heat added to the portion having the relatively low temperature. The above-described control can suitably change the relative position of the halogen heater 31 to the other parts in the fixing device 5 to efficiently reduce the temperature unevenness of the fixing belt 22 in the width direction. For example, when the temperature of either the central portion or the end portion of the fixing belt 22 in the width direction becomes equal to or higher than 150 degrees Celsius as an example of a threshold value, the controller 17 relatively moves the halogen heater 31. The threshold value is predetermined based on experiments so as to avoid the occurrence of an abnormal image caused by an excessively high temperature of the fixing belt 22. In this case, the controller 17 changes the relative position of the halogen heater 31 to the other parts in the fixing device 5 to decrease the amount of heat added to the portion having the temperature higher than 150 degrees and increase the amount of heat added to the other portion.

[0055] Additionally, before the start of the image forming operation, the halogen heater 31 may be relatively moved upward in FIG. 2. As described above, while the halogen heater 31 heats the fixing belt 22 to the fixing temperature to perform the image forming operation, the temperature at the end portion of the fixing belt 22 in the width direction tends to be lower than the temperature at the central portion of the fixing belt 22 in the width direction. Therefore, when the halogen heater 31 starts to heat the fixing belt 22, the halogen heater 31 may be relatively moved to increase the amount of heat added to the end portions of the fixing belt 22 in the width direction. On the other hand, when the small-size sheets are printed after the start of the image forming operation, that is, after the temperature of the fixing belt 22 reaches the fixing temperature, and after the first sheet reaches the fixing nip N, the temperature at the end portion of the fixing belt 22 may be excessively high. Therefore, when the controller 17 receives an instruction signal of the start of the image forming operation, the controller 17 may control a mechanism that relatively moves the halogen heater 31 to the nip formation member 32, that is, lower side in FIG. 2 based on data of sheet size and a number of sheets so that the

halogen heater 31 is relatively moved to decrease the amount of heat added to the end portions of the fixing belt 22 in the width direction. The above-described control can reduce the temperature unevenness of the fixing belt 22 in the width direction. The above-described control is possible even in the fixing device 5 without the temperature sensor 28 described above.

[0056] The controller 17 may change the relative position of the halogen heater 31 to the other parts in the fixing device 5 based on a size of sheet to be printed. That is, when the small-size sheet passes through the fixing device 5 after the start of the image forming operation, the temperature at the end portion of the fixing belt 22 in the width direction becomes high. Therefore, the halogen heater 31 may be relatively moved to downward in FIG. 2. The controller 17 may determine an amount of movement of the halogen heater 31 based on the size and the number of sheets. Further, in combination with the above control, the controller 17 may change a timing of relative movement of the halogen heater 31 downward in FIG. 2 after the start of the image forming according to the size of the sheet to be printed.

[0057] Next, with reference to FIGS. 6A to 6C and 7 to 9, a specific configuration is described of the mechanism for relatively moving the halogen heater 31.

[0058] As illustrated in FIGS. 6A to 6C, a belt supporter 40 includes a belt holder 40a and a side plate holder 40b. The belt supporter 40 illustrated in FIGS. 6A to 6C is disposed at one end of the fixing belt 22 in the width direction, and another belt supporter paired therewith is disposed at the other end of the fixing belt 22.

[0059] The belt holder 40a protrudes towards the end of the fixing belt 22 and forms a partial cylinder. The fixing belt 22 is fitted around the belt holder 40a. The belt holder 40a limits lateral movement of the fixing belt 22 in the width direction and guides a rotation of the fixing belt 22 in places other than the fixing nip N when the fixing belt 22 is sandwiched between the pressure roller 23 and the nip formation member 32 at the fixing nip N and rotated. The side plate holder 40b includes a slot 40c in an outer circumferential part, for example, in an upper end face and a lower end face. A side plate of the fixing device 5 falls into the slot 40c and supports the belt supporter 40 slidable in the side plate of the fixing device 5.

[0060] Additionally, the side plate holder 40b includes a first support portion 40d that is a hole to support a longitudinal end of the stay 33, the first heat shield 35, and the second heat shield 36 and a second support portion 40f that is a hole to support the halogen heater 31 movable.

[0061] The longitudinal ends of the stay 33, the first heat shield 35, and the second heat shield 36 fit parts in the first support portion 40d of the belt supporter 40 each corresponding to the stay 33, the first heat shield 35, and the second heat shield 36, and the first support portion supports the stay 33, the first heat shield 35, and the second heat shield 36.

[0062] The second support portion 40f is a slot shaped as a rounded rectangle elongated in a direction in which the belt supporter 40 slides with respect to the side plate of the fixing device 5. The halogen heater 31 is inserted into the second support portion 40f from the longitudinal direction and is supported. In the illustrated embodiment, the second support portion 40f is the slot shaped the rounded rectangle, but the second support portion 40f may be a general rectangular shape, an elliptical shape, or a polygonal shape as long as the second support portion 40f limits a movement of the halogen heater in the sheet conveyance direction.

[0063] FIG. 7 illustrates an example of a mechanism that moves the belt supporter 40 to relatively move the halogen heater 31 with respect to the other parts such as the fixing belt 22. The contact-separation mechanism as illustrated in FIG. 7 includes a first pressing lever 41 to press the belt supporter 40 toward the fixing nip (a right side in FIG. 7), a press and release cam 42, a second pressing lever 43 that includes a roller at each of both ends and is pivoted by the press and release cam 42, and a pressure spring 44 each end of which is attached to the first pressing lever 41 and the second pressing lever 43. A rotation of the press and release cam 42 pivots the first pressing lever 41 having an end fixed and supported by the side plate of the fixing device 5 to slide the belt supporter 40 that is coupled with the first pressing lever 41.

[0064] Moving the belt supporter 40 described above moves parts supported by the belt supporter 40 such as the fixing belt 22 and changes the relative positional relationship of the halogen heater 31 with respect to these parts. Note that, as described below, the position of the halogen heater 31 itself is not completely fixed, and the position of the halogen heater 31 changes as the belt supporter 40 moves.

[0065] With reference to FIGS. 8A and 8B, how the halogen heater 31 inserted into the second support portion 40f of the belt supporter 40 moves in the second support portion 40f is described when the belt supporter 40 slides in a direction orthogonal to the sheet conveyance direction that is a lateral direction in FIGS. 8A and 8B.

[0066] As illustrated in FIG. 8A, the longitudinal ends of the stay 33, the first heat shield 35, and the second heat shield 36 fit parts in the first support portion 40d each corresponding to the stay 33, the first heat shield 35, and the second heat shield 36, and as a result, the belt supporter 40 supports the stay 33, the first heat shield 35, and the second heat shield 36.

[0067] An adjustment mechanism related to the displacement of the halogen heater 31 is configured by the second support portion 40f of the belt supporter 40 and a pressing member 45 that is a narrow plate-shaped member or a strip-like member fixed to the side plate of the fixing device 5 or the image forming apparatus 1. The position of the pressing member 45 in the lateral direction in FIGS. 8A and 8B is between the fixing nip and the halogen heater 31. The pressing

members 45 are arranged corresponding to both ends of the halogen heater 31 that are outside of the belt supporters 40 in the longitudinal direction of the stay 33. Even when the belt supporters 40 slide, the positions of the pressing members 45 fixed to the side plates of the fixing device 5 or the image forming apparatus 1 do not change.

[0068] As illustrated in FIGS. 8A and 8B, the movement of the belt supporter 40 in the lateral direction in FIGS. 8A and 8B moves parts supported by the belt supporter 40 such as the fixing belt 22 and the stay 33 in the same direction as the movement direction of the belt supporter 40. That is, the halogen heater 31 moves in the second support portion 40f to change the relative position of the halogen heater 31 to the fixing belt 22 and the other parts in the fixing device 5. Note that the position of the pressure roller 23 does not change due to the movement of the belt supporter 40 in the lateral direction in FIGS. 8A and 8B. That is, the pressure roller 23 is crushed at the fixing nip N by an amount corresponding to the movement of the belt supporter 40 to the right side in FIG. 8B. In the following description, a position at which the belt supporter 40 is farthest from the pressure roller 23 as illustrated in FIG. 8A is referred to as a separated position of the belt supporter 40, and a position at which the belt supporter 40 is closest to the pressure roller 23 as illustrated in FIG. 8B is referred to as the closest position of the belt supporter 40. The halogen heater 31 is closest to the fixing nip N of the fixing belt 22 when the belt supporter 40 is at the separated position and is farthest from the fixing nip N when the belt supporter 40 is at the closest position.

[0069] A length L, in FIG. 6B, of the slot as the second support portion 40f in a direction of sliding movement of the belt supporter 40 is determined as follows. When the belt supporter 40 is at the separated position as illustrated in FIG. 8A, the halogen heater 31 contacts an end of the second support portion 40f near the fixing nip, that is, a right end of the second support portion 40f in FIG. 8A. In this state, the length L is set such that the halogen heater 31 is slightly in contact with the pressing member 45 or slightly separated from the pressing member 45. When the belt supporter 40 moves from the separated position to the closest position illustrated in FIG. 8B, the fixing belt 22 moves to the right side in FIGS. 8A and 8B and increases a pressing amount in a pressure contact portion with the pressure roller 23. When the belt supporter 40 reaches the closest position, the halogen heater 31 contacts an end of the second support portion 40f opposite to the fixing nip, that is, a left end of the second support portion 40f in FIG. 8B. In this state, the pressing member 45 is in contact with a surface of the halogen heater 31 facing the fixing nip to stop the movement of the halogen heater 31 to the fixing nip and elastically deformed by a contact force of the halogen heater 31. As a result, as can be seen from a comparison between FIGS. 8A and 8B, a distance H2 between the halogen heater 31 and the nip formation member when the belt supporter 40 is at the closest position is larger than a distance H1 between the halogen heater 31 and the nip formation member when the belt supporter 40 is at the separated position, that is, the distance H1 between the halogen heater 31 and a right end of the first heat shield 35 in FIG. 8A. The above-described configuration can determine the position of the halogen heater 31 with respect to the nip formation member 32 when the belt supporter 40 is at the separated position and the closest position and ensure to avoid contact between the halogen heater 31 and parts around the halogen heater 31.

[0070] If the halogen heater 31 can get a position not to contact the stay 33 and the fixing belt 22 when the belt supporter 40 moves between the separated position and the closest position, the halogen heater 31 may be configured not to move when the halogen heater 31 is relatively moved in the second support portion of the belt supporter 40. Instead of the pressing member 45 in FIGS. 8A and 8B, as illustrated in FIG. 9, a fixed member 46 may be used to fix and support the halogen heater 31 at a predetermined position. In this case, the halogen heater 31 has a certain clearance with respect to the fixing belt 22 and the nip formation member 32 when the belt supporter 40 is located at the closest position. On the other hand, when the belt supporter 40 is located at the separated position, the halogen heater 31 has a relative position relation not to contact the fixing belt 22 and the stay 33. Since the fixed member 46 is not elastically deformed like the pressing member 45, the end of the second support portion 40f of the belt supporter 40 in the opposite side of the fixing nip is extended longer from the fixing nip than the one in the embodiment of the pressing member 45.

[0071] The above-described mechanism can change the relative position of the halogen heater 31 and adjust the amounts of heat added to the central portion of the fixing belt 22 and the end portions of the fixing belt 22.

[0072] The present disclosure is not limited to the details of the embodiments described above and various modifications and improvements are possible.

[0073] The opening of the heat shield may be suitably arranged based on needs and is not limited to be arranged as described above. That is, the configuration of the present disclosure is not limited to the configuration in which one opening of one heat shield is arranged at the central portion in the width direction of the fixing belt 22 and the other opening of the other heat shield is arranged at the end portions in the width direction. The openings of the first heat shield 35 and the second heat shield 36 may partially overlap in the width direction. Conversely, there may be a portion in the width direction where none of the openings are arranged as illustrated in FIG. 10. In the present disclosure, when the first heat shield 35 and the second heat shield 36 have different heat shield areas, the heat shield areas may partially overlap. Three or more heat shields may be provided to arrange three or more heat transfer paths each heating different areas of the fixing belt in the width direction.

[0074] A shape of the opening in the first heat shield 35 or the second heat shield 36 is not limited to the rectangular as illustrated in FIGS. 4A and 4B. For example, the shape of the opening may be a shape in which the opening length

(a vertical length in FIG. 5A) gradually increases toward the end in the width direction as illustrated in FIG. 5A or elliptical as illustrated in FIG. 5B. Alternatively, as illustrated in FIG. 5C, the shape of the opening may have the opening length reduced toward the center in the width direction. Changing the opening length of the opening in the width direction can change the amount of heat reaching the fixing belt 22 or the nip formation member 32 from the halogen heater 31 in the width direction, for example, gradually decrease the amount of heat stepwise in the width direction.

[0075] The image forming apparatus according to the present embodiment of the present disclosure is applicable not only to a monochrome image forming apparatus illustrated in FIG. 1 but also to a color image forming apparatus, a copier, a printer, a facsimile machine, or a multifunction peripheral including at least two functions of the copier, printer, and facsimile machine.

[0076] The sheets P serving as recording media may be thick paper, postcards, envelopes, plain paper, thin paper, coated paper, art paper, tracing paper, overhead projector (OHP) transparencies, plastic film, prepreg, copper foil, and the like.

[0077] Blocking heat by the heat shield described above does not necessarily mean completely blocking heat, but naturally includes blocking a part of heat. For example, some of the heat may leak between the heat shield and another member. Heat absorbed by the heat shield may be transmitted to the opposite side. However, even in these cases, it is considered that the heat shield blocks the heat.

[0078] Numerous additional modifications and variations are possible in light of the above teachings. It is therefore to be understood that, within the scope of the above teachings, the present disclosure may be practiced otherwise than as specifically described herein. With some embodiments having thus been 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 scope of the present disclosure and appended claims, and all such modifications are intended to be included within the scope of the present disclosure and appended claims.

Claims

1. A fixing device (5) comprising:

a fixing belt (22) in an endless form;
 a pressing member (23) configured to press the fixing belt (22);
 a nip formation member (32) disposed inside a loop of the fixing belt (22) and configured to contact the pressing member (23) via the fixing belt (22) to form a fixing nip;
 a heat generator (31) disposed inside the loop of the fixing belt (22) and configured to heat the fixing belt (22);
 a first heat shield (35) having a heat shield area to block heat from the heat generator (31); and
 a second heat shield (36) having a heat shield area disposed in a different position from the heat shield area of the first heat shield (35) in a circumferential direction and a longitudinal direction of the fixing belt (22).

2. The fixing device (5) according to claim 1,
 wherein the first heat shield (35) and the second heat shield (36) have openings (35a, 36a) having different opening areas in the longitudinal direction of the fixing belt (22).

3. The fixing device (5) according to claim 2,
 wherein the opening (35a) of the first heat shield (35) faces an end portion of the fixing belt (22) in the longitudinal direction, and
 wherein the opening (36a) of the second heat shield (36) faces a central portion of the fixing belt (22) in the longitudinal direction.

4. The fixing device (5) according to any one of claims 1 to 3,
 wherein the heat generator (31) is relatively movable with respect to the fixing belt (22) and the nip formation member (32).

5. An image forming apparatus (1) comprising the fixing device (5) according to any one of claims 1 to 4.

6. An image forming apparatus (1) comprising:

the fixing device (5) according to claim 4; and
 a controller (17) configured to control a relative position of the heat generator (31) with respect to the fixing belt (22) and the nip formation member (32),

wherein the controller (17) changes the relative position of the heat generator (31) after a first recording medium in an image forming operation reaches the fixing nip.

7. An image forming apparatus (1) comprising:

5 the fixing device (5) according to claim 4; and
a controller (17) configured to control a relative position of the heat generator (31) with respect to the fixing belt (22) and the nip formation member (32),
10 wherein the controller (17) changes the relative position of the heat generator (31) before a first recording medium in an image forming operation reaches the fixing nip.

8. An image forming apparatus (1) comprising:

15 the fixing device (5) according to claim 4; and
a controller (17) configured to control a relative position of the heat generator (31) with respect to the fixing belt (22) and the nip formation member (32),
wherein the controller (17) causes the heat generator (31) to relatively move with respect to the fixing belt (22) and the nip formation member (32) when a temperature of the fixing belt (22) becomes equal to or higher than
20 a predetermined temperature.

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FIG. 1

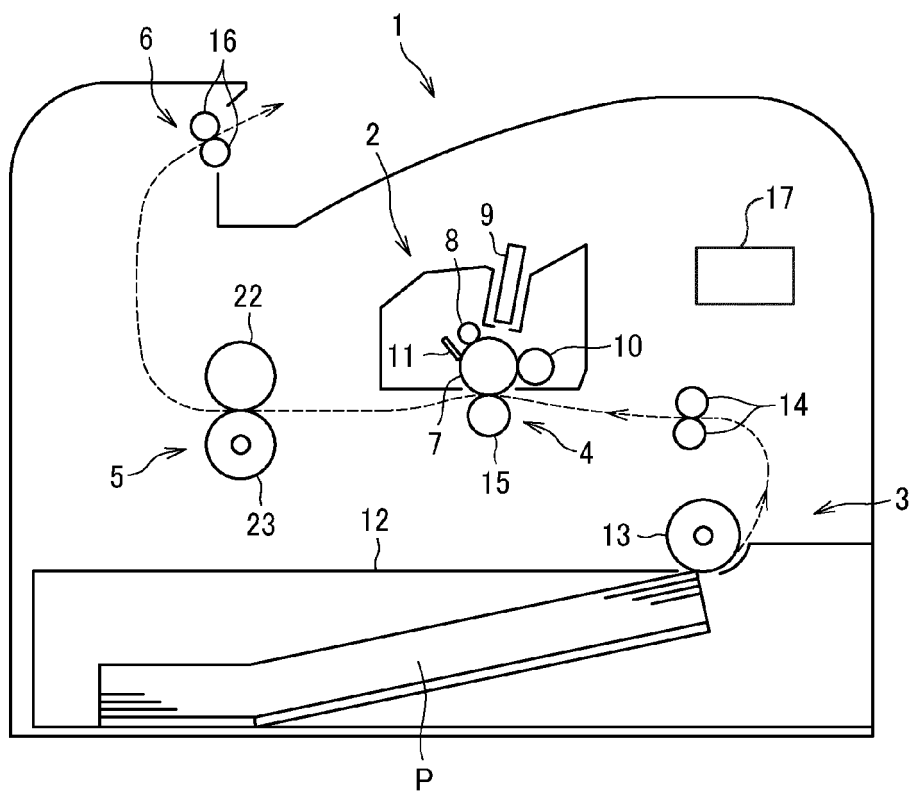


FIG. 2

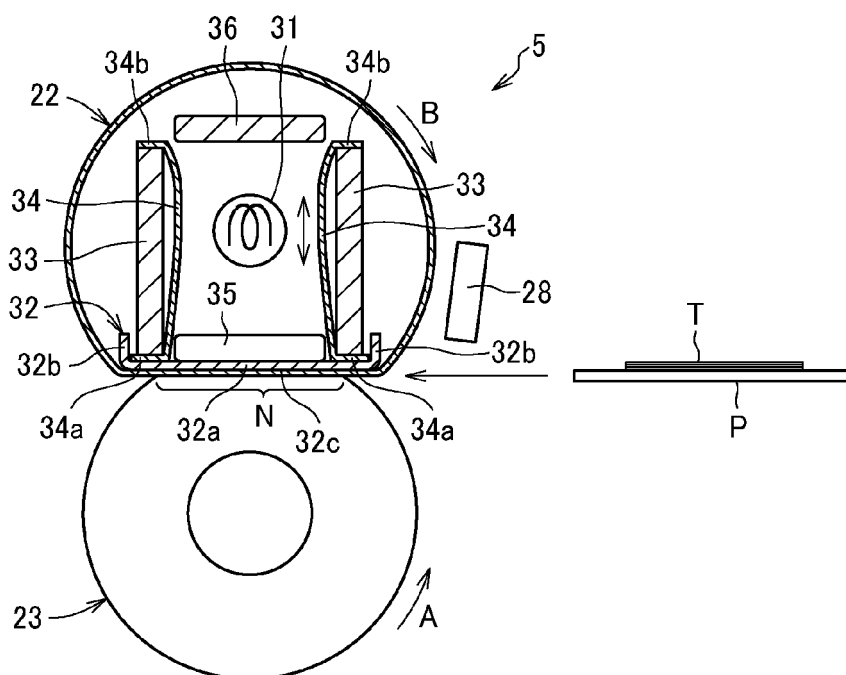


FIG. 3

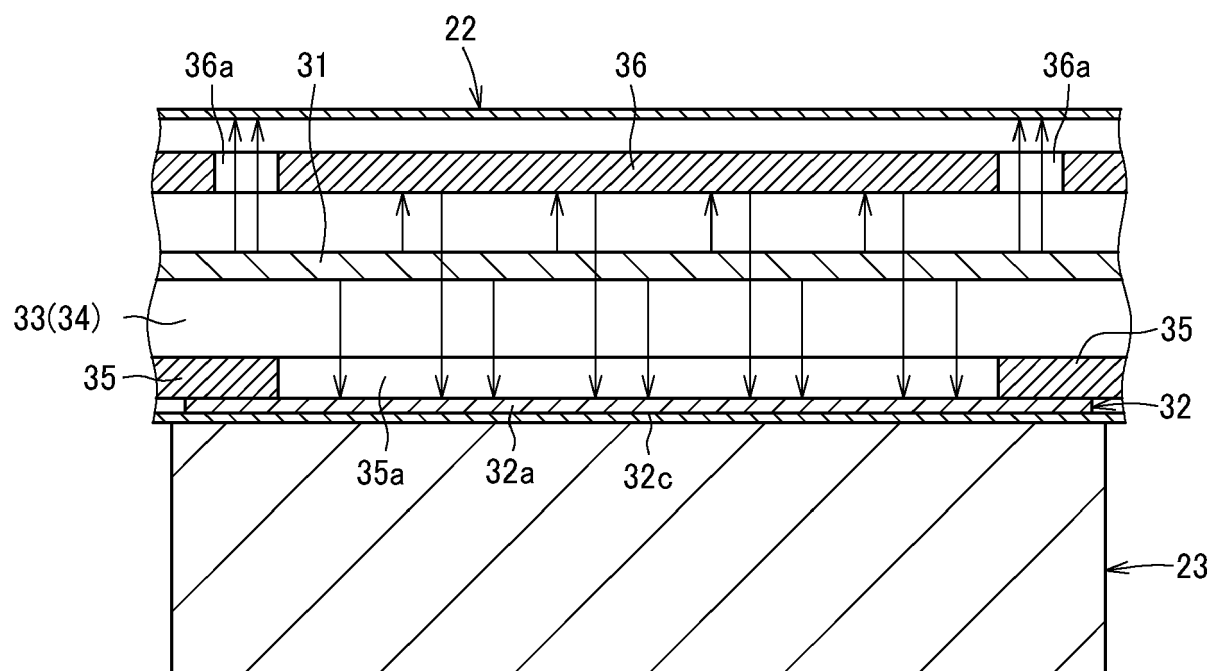


FIG. 4A

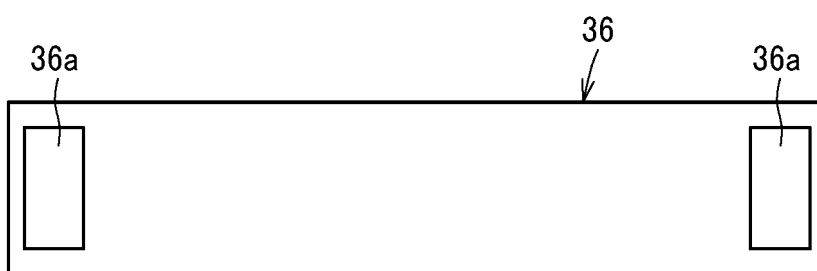


FIG. 4B

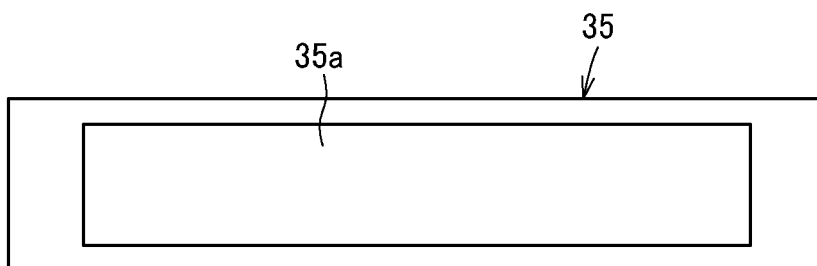


FIG. 5A



FIG. 5B

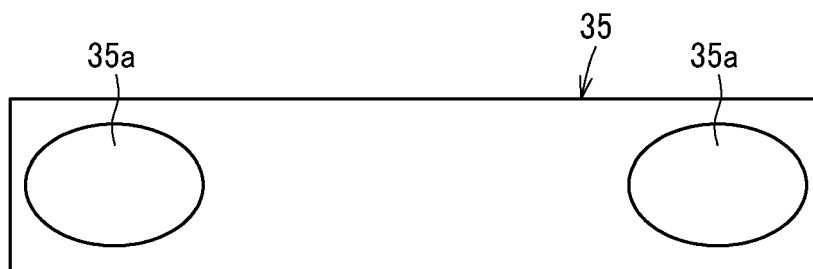


FIG. 5C

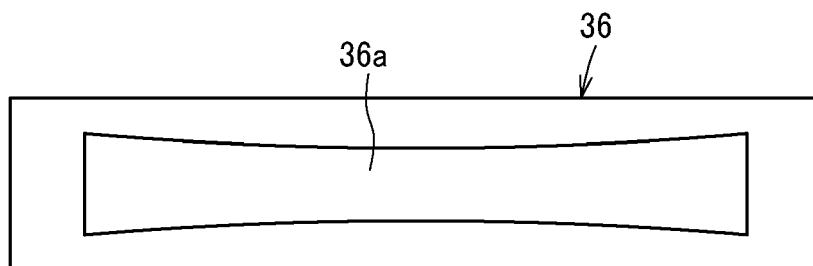


FIG. 6A

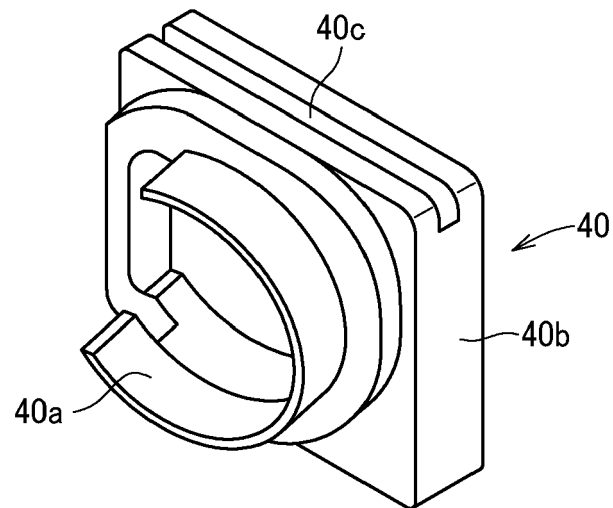


FIG. 6B

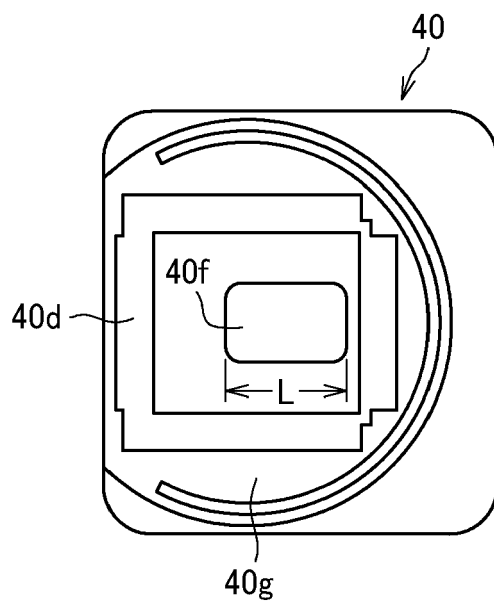


FIG. 6C

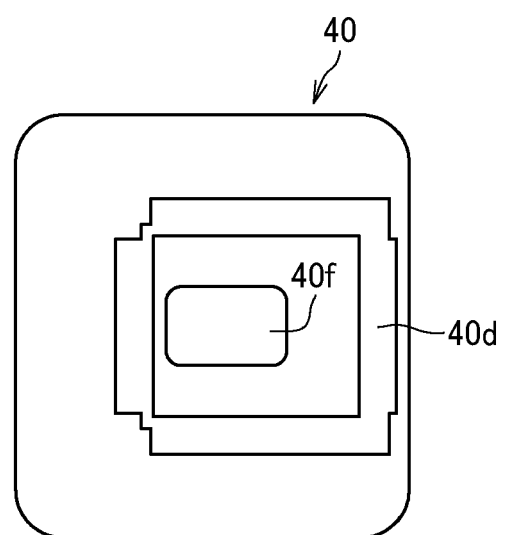


FIG. 7

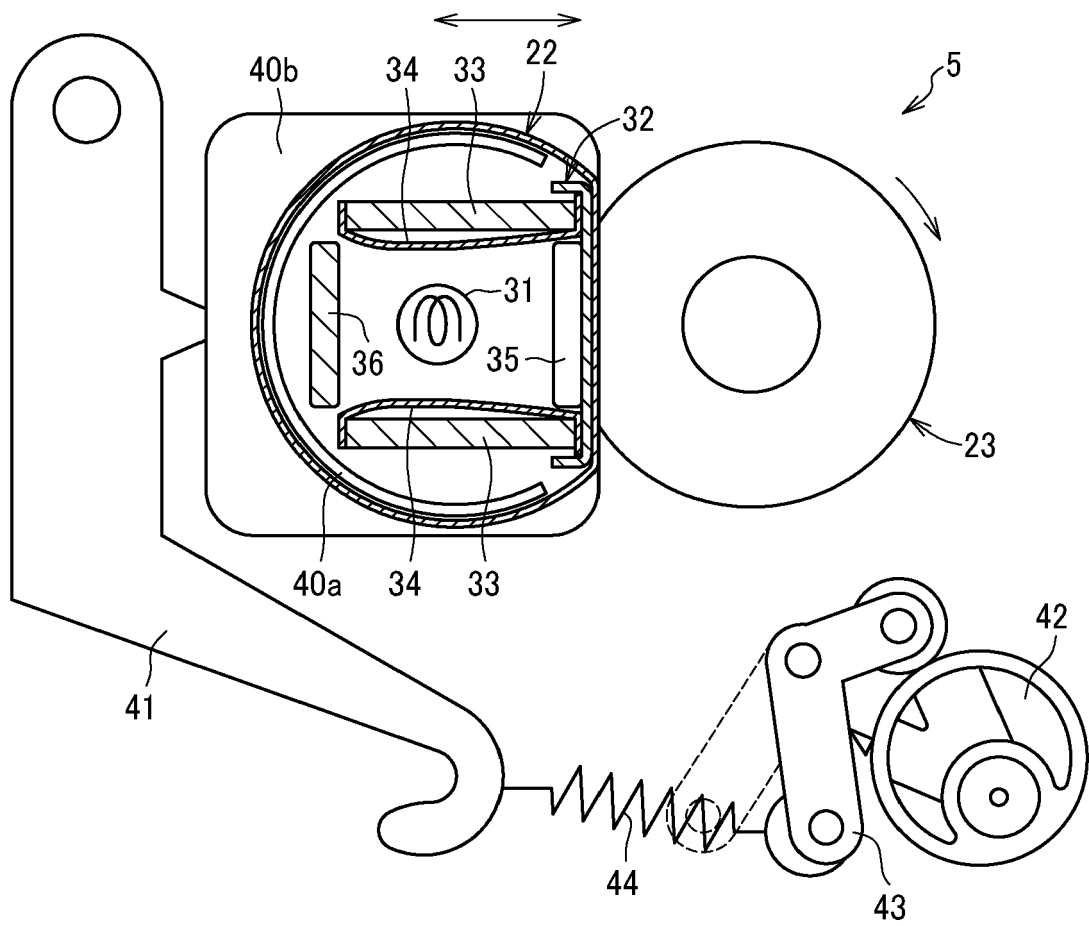


FIG. 8A

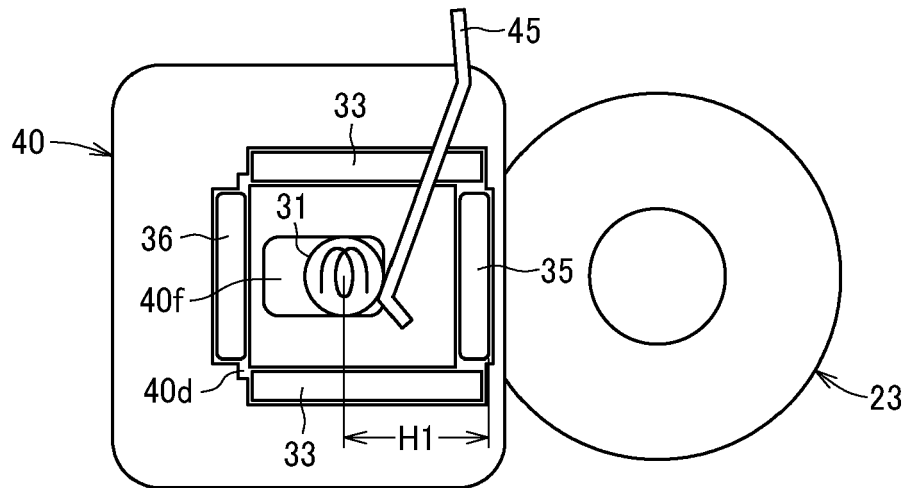


FIG. 8B

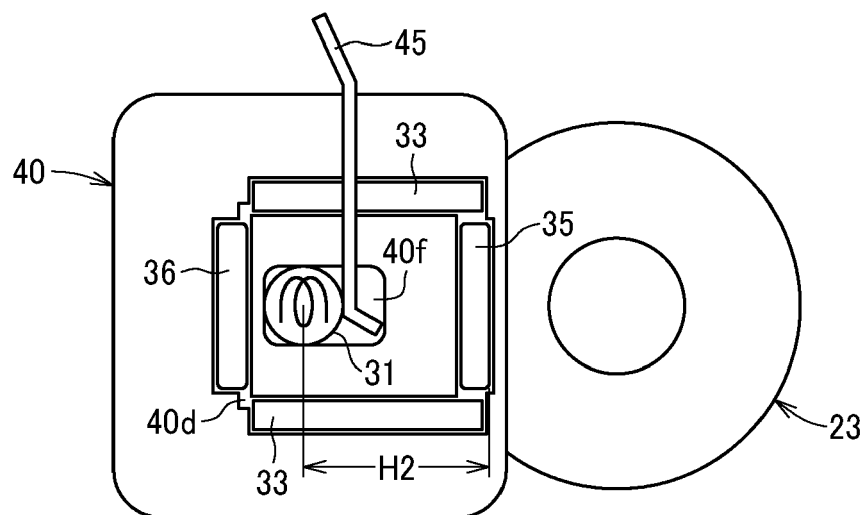


FIG. 9

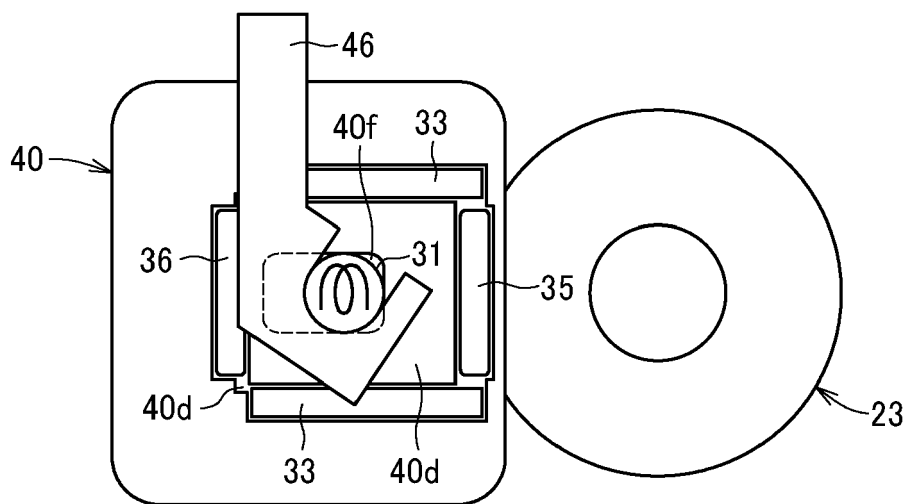
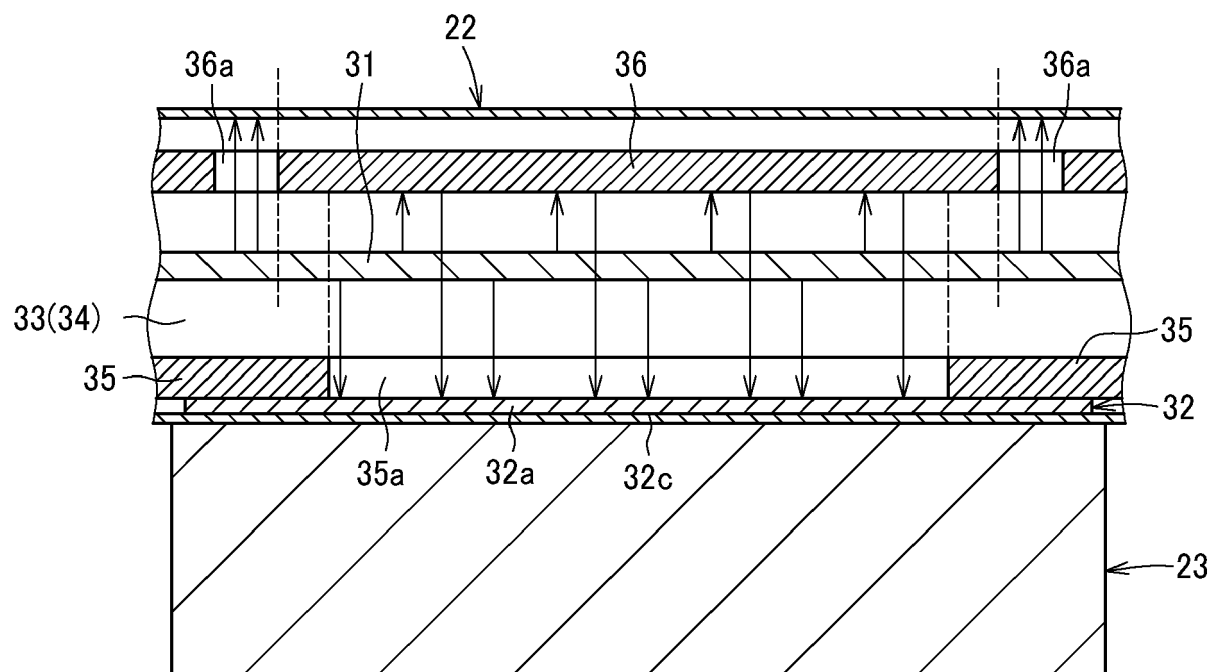


FIG. 10





EUROPEAN SEARCH REPORT

 Application Number
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Place of search Munich		Date of completion of the search 1 July 2020	Examiner Billmann, Frank
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