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

(57) A fixing device (7) includes an endless fixing belt (22), a pressing member (23) configured to press an outer surface of the fixing belt (22), a heater (31) disposed inside a loop of the fixing belt (22) and configured to heat the fixing belt (22), and a nip formation pad (32) disposed inside the loop of the fixing belt (22). The nip formation pad (32) has a nip formation surface (32c) configured to contact the pressing member (23) to form a fixing nip and a projection (32c) at a position different from an end portion of the nip formation pad (32) in a conveyance direction of a recording medium. The projection (32c) is on a surface opposite the nip formation surface (32a1).

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Description

BACKGROUND

Technical Field

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

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 nip formation pad that is disposed inside of a loop of the fixing belt and contacts the pressing member via the fixing belt to form the fixing nip, and a support to support the nip formation pad.

[0004] The nip formation pad supports the back of the fixing belt and enables the fixing belt to form the fixing nip with the pressing member and press the surface of the recording medium conveyed to the fixing nip with an appropriate pressure.

[0005] For example, JP-6164017-B1 (JP-2015-72302-A) discloses a fixing device including a nip plate having a planar base portion that contacts the back of a fixing belt to form a planar fixing nip and a stay that supports the nip plate from the opposite side of the fixing belt.

[0006] However, the nip formation pad described above is bent by a pressing force of the pressing member such as a pressure roller and causes a problem, that is, ununiform pressure in the fixing nip.

SUMMARY

[0007] It is a general object of the present disclosure to provide an improved and useful fixing device in which the above-mentioned problems 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.

[0008] Advantageously, the fixing device includes an endless fixing belt, a pressing member configured to press an outer surface of the fixing belt, a heater disposed inside a loop of the fixing belt and configured to heat the fixing belt, and a nip formation pad disposed inside the loop of the fixing belt. The nip formation pad has a nip formation surface configured to contact the pressing member to form a fixing nip and a projection at a position different from an end portion of the nip formation pad in a conveyance direction of a recording medium. The projection is on a surface opposite the nip formation surface.

[0009] According to the present disclosure, the projection disposed on the nip formation pad increases rigidity of the nip formation pad to receive a pressing force from the pressing member and reduces a bend of the nip formation pad.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] 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 perspective view of the fixing device illustrated in FIG. 2 with the vertical cross-sectional view of the fixing device;

FIG. 4 is a vertical cross-sectional view of the fixing device viewed from a front side of the fixing device illustrated in FIG. 2;

FIG. 5 is a perspective view of a belt holder;

FIG. 6 is a perspective view of a variation of the belt holder;

FIG. 7 is a perspective view illustrating a part of nip formation pad in the fixing device illustrated in FIG. 2;

FIG. 8 is a vertical cross-sectional view of the fixing device according to a second embodiment of the present disclosure viewed from a lateral side of the fixing device;

FIG. 9 is a perspective view illustrating the nip formation pad in the fixing device in FIG. 8;

FIG. 10 is a cross-sectional view of the nip formation pad of FIG. 8 viewed from the lateral side of the nip formation pad;

FIG. 11 is a vertical cross-sectional view of the fixing device according to a third embodiment of the present disclosure viewed from the lateral side of the fixing device;

FIG. 12 is a vertical cross-sectional view of the fixing device according to a fourth embodiment of the present disclosure viewed from the lateral side of the fixing device;

FIG. 13 is a vertical cross-sectional view of the fixing device according to a fifth embodiment of the present disclosure viewed from the lateral side of the fixing device;

FIG. 14 is a vertical cross-sectional view of the fixing device according to a sixth embodiment of the present disclosure viewed from the lateral side of the fixing device;

FIG. 15 is a vertical cross-sectional view of the fixing device according to a seventh embodiment of the present disclosure viewed from the lateral side of the fixing device;

FIG. 16 is a perspective view of the nip formation pad disposed in the fixing device according to an eighth embodiment of the present disclosure;

FIG. 17 is a vertical cross-sectional view of the fixing device according to a ninth embodiment of the present disclosure viewed from the lateral side of the fixing device;

FIGS. 18A and 18B is vertical cross-sectional views of the nip formation pad disposed in the fixing device according to a tenth embodiment of the present disclosure viewed from the lateral side of the nip formation pad;

FIG. 19 is a vertical cross-sectional view illustrating a variation based on the nip formation pad of FIG. 18 viewed from the lateral side of the nip formation pad;

FIGS. 20A to 20C are top views illustrating variations of projections disposed on the nip formation pad and extending in different directions;

FIGS. 21A to 21D are vertical cross-sectional views illustrating variations of the nip formation pad with the projections having different shapes viewed from the lateral side of the nip formation pad;

FIG. 22 is a vertical cross-sectional view of the fixing device according to an eleventh embodiment of the present disclosure viewed from the lateral side of the fixing device; and

FIG. 23 is a vertical cross-sectional view illustrating a variation based on the nip formation pad of FIG. 22 viewed from the lateral side of the nip formation pad.

[0011] 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

[0012] 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.

[0013] 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.

[0014] Referring now to the drawings, embodiments of the present disclosure are described below. In the drawings illustrating the following embodiments, the same reference codes are allocated to elements (members or components) having the same function or shape and redundant descriptions thereof are omitted below.

[0015] A description is provided of a construction of the image forming apparatus 1. FIG. 1 is a schematic diagram illustrating a configuration of an image forming apparatus 1 according to an embodiment of the present disclosure. Identical reference numerals are assigned to identical components or equivalents and a description of those components is simplified or omitted.

[0016] As illustrated in FIG. 1, the image forming apparatus 1 includes an image forming device 2 disposed in a center portion of the image forming apparatus 1. The image forming device 2 includes four process units 9Y, 9M, 9C, and 9K removably installed in the image forming apparatus 1. The process units 9Y, 9M, 9C, and 9K have an identical structure except that the process units 9Y, 9M, 9C, and 9K contain developers (e.g., yellow, magenta, cyan, and black toners) in different colors, that is, yellow, magenta, cyan, and black corresponding to color separation components of a color image.

[0017] Each process unit 9 includes a photoconductor drum 10 serving as a rotatable image bearer to bear toner as the developer on the surface of the photoconductor drum 10, a charging roller 11 to uniformly charge the surface of the photoconductor drum 10, and a developing device 12 that includes a developing roller to supply toner to the surface of the photoconductor drum 10.

[0018] Below the process units 9Y, 9C, 9M, and 9K, an exposure device 3 is disposed. The exposure device 3 emits laser light beams based on image data.

[0019] Above the image forming device 2, a transfer device 4 is disposed. The transfer device 4 includes, e.g., a drive roller 14, driven rollers 15 and 27, an intermediate transfer belt 16, a belt cleaning unit 280, and four primary transfer rollers 17. The intermediate transfer belt 16 is an endless belt rotatably stretched around the drive roller 14, the driven roller 15, and the like. Each of the four primary transfer rollers 17 is disposed opposite the corresponding photoconductor drum 10 in each of the process units 9Y, 9C, 9M, and 9K via the intermediate transfer belt 16. At the different positions, the primary transfer rollers 17 press against an inner circumferential surface of the intermediate transfer belt 16. Thus, primary transfer nips are formed at positions at which the photoconductor drums 10 contact respective pressed portions of the intermediate transfer belt 16 pressed by the primary transfer rollers 17.

[0020] The drive roller 14 rotates the intermediate transfer belt 16. In addition, the transfer device 4 includes a secondary-transfer roller 18 disposed opposite the drive roller 14 via the intermediate transfer belt 16. The secondary-transfer roller 18 is pressed against an outer circumferential surface of the intermediate transfer belt

16, and thus a secondary-transfer nip is formed between the secondary-transfer roller 18 and the intermediate transfer belt 16.

[0021] A sheet feeder 5 is disposed in a lower portion of the image forming apparatus 1. The sheet feeder 5 includes a sheet tray 19, which contains sheets P as recording media, and a sheet feeding roller 20 to feed the sheets P from the sheet tray 19.

[0022] The sheets P are conveyed along the conveyance passage 6 from the sheet feeder 5 toward a sheet ejector 8. Conveyance roller pairs including a registration roller pair 21 are disposed along the conveyance passage 6.

[0023] A fixing device 7 is disposed downstream from the secondary-transfer nip in a sheet conveyance direction. The fixing device 7 includes a fixing belt 22 heated by a heater and a pressure roller 23 as a pressing member to press the fixing belt 22.

[0024] The sheet ejector 8 is disposed at the extreme downstream side of the conveyance passage 6 in the image forming apparatus 1. The sheet ejector 8 includes an ejection roller pair 24 and an output tray 25. The ejection roller pair 24 ejects the sheets P onto the output tray 25 disposed atop a housing of the image forming apparatus 1. Thus, the sheets P lie stacked on the output tray 25.

[0025] In an upper portion of the image forming apparatus 1, removable toner bottles 29Y, 29C, 29M, and 29K are disposed. The toner bottles 29Y, 29C, 29M, and 29K are filled with fresh toner of yellow, cyan, magenta, and black, respectively. A toner supply tube is interposed between each of the toner bottles 29Y, 29C, 29M, and 29K and the corresponding developing device 12. The fresh toner is supplied from each of the toner bottles 29Y, 29C, 29M, and 29K to the corresponding developing device 12 through the toner supply tube.

[0026] Next, a description is given of a basic operation of the image forming apparatus 1 with reference to FIG. 1.

[0027] As the image forming apparatus 1 receives a print job and starts an image forming operation, the exposure device 3 emits laser light beams onto the outer circumferential surfaces of the photoconductor drums 10 of the process units 9Y, 9M, 9C, and 9K according to image data, thus forming electrostatic latent images on the photoconductor drums 10. The image data used to expose the respective photoconductor drums 10 by the exposure device 3 is monochrome image data produced by decomposing a desired full color image into yellow, magenta, cyan, and black image data. After the exposure device 3 forms the electrostatic latent images on the photoconductor drums 10, the drum-shaped developing rollers of the developing devices 12 supply yellow, magenta, cyan, and black toners stored in the developing devices 12 to the electrostatic latent images, rendering visible the electrostatic latent images as developed visible images, that is, yellow, magenta, cyan, and black toner images, respectively.

[0028] In the transfer device 4, the intermediate transfer belt 16 moves along with rotation of the drive roller 14 in a direction indicated by arrow D in FIG. 1. A power supply applies a constant voltage or a constant current control voltage having a polarity opposite a polarity of the toner to the primary transfer rollers 17. As a result, a transfer electric field is formed at the primary transfer nip. The yellow, magenta, cyan, and black toner images are primarily transferred from the photoconductor drums 10 onto the intermediate transfer belt 16 successively at the primary transfer nips such that the yellow, magenta, cyan, and black toner images are superimposed on a same position on the intermediate transfer belt 16.

[0029] As the image forming operation starts, the sheet feeding roller 20 of the sheet feeder 5 disposed in the lower portion of the image forming apparatus 1 is driven and rotated to feed a sheet P from the sheet tray 19 toward the registration roller pair 21 through the conveyance passage 6. The registration roller pair 21 conveys the sheet P fed to the conveyance passage 6 by the sheet feeding roller 20 to the secondary-transfer nip formed between the secondary-transfer roller 18 and the intermediate transfer belt 16 supported by the drive roller 14, timed to coincide with the superimposed toner image on the intermediate transfer belt 16. At this time, a transfer voltage having the polarity opposite the toner charge polarity of the toner image formed on the surface of the intermediate transfer belt 16 is applied to the sheet P and the transfer electric field is generated in the secondary-transfer nip. Due to the transfer electric field generated in the secondary-transfer nip, the toner image formed on the intermediate transfer belt 16 is transferred onto the sheet P collectively.

[0030] The sheet P bearing the full color toner image is conveyed to the fixing device 7 where the fixing belt 22 and the pressure roller 23 fix the full color toner image onto the sheet P under heat and pressure. The sheet P having the fixed toner image thereon is separated from the fixing belt 22 and conveyed by the conveyance roller pair to the sheet ejector 8. The ejection roller pair 24 of the sheet ejector 8 ejects the sheet P onto the output tray 25.

[0031] The above describes the image forming operation of the image forming apparatus 1 to form the full color toner image on the sheet P. Alternatively, the image forming apparatus 1 may form a monochrome toner image by using any one of the four process units 9Y, 9M, 9C, and 9K or may form a bicolor toner image or a tricolor toner image by using two or three of the process units 9Y, 9M, 9C, and 9K.

[0032] As illustrated in FIG. 2, the fixing device 7 according to a first embodiment of the present disclosure includes the fixing belt 22, the pressure roller 23, a halogen heater 31 as a heater, a nip formation pad 32, a stay 33 as a support, and a reflector 34. In the following description, the width direction of the fixing belt 22, that is, a direction perpendicular to a sheet surface of FIG. 2 is simply referred to as the width direction.

[0033] The fixing belt 22 is a cylindrical fixing member to fix an unfixed image T onto the sheet P and is disposed on the side of the sheet P on which the unfixed image 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.

[0034] 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 a hollow roller, the heater 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 heater 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.

[0035] A driver disposed inside the image forming apparatus 1 drives and rotates the pressure roller 23 in the 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.

[0036] 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.

[0037] The halogen heater 31 is a heater disposed inside a loop of the fixing belt 22 and emitting infrared light, and radiant heat from the halogen heater 31 heats the fixing belt 22 from the inside. Alternatively, instead of the halogen heater 31, a carbon heater, a ceramic heater or the like may be employed as the heater. In the present embodiment, one halogen heater 31 is disposed in the loop of the fixing belt 22, but a plurality of halogen heaters 31 having different heat generation areas may be used according to the width of the sheet.

[0038] The nip formation pad 32 sandwiches the fixing belt 22 together with the pressure roller 23, to form the fixing nip N. Specifically, the nip formation pad 32 is disposed inside the loop of the fixing belt 22, extends in a longitudinal direction thereof parallel to the width direction of the fixing belt 22, and has a nip formation portion 32a having a planar nip formation surface 32a1 that is in contact with an inner circumferential surface of the fixing belt 22 and a pair of bent portions 32b that are arc-shaped portions bent from both end portions of the nip formation portion 32a in the belt rotation direction B to the opposite side to the pressure roller 23. A plurality of projections 32c is disposed on a center portion of the nip formation portion 32a in a sheet conveyance direction indicated by arrow C in FIG. 2. A detailed description of the projections 32c is described below. A pressing member such as a spring presses both ends of the pressure roller 23 in the width direction against the nip formation pad 32 (see arrows H in FIG. 4), 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.

[0039] As illustrated in FIG. 2, the nip formation surface 32a1 directly contacts the inner circumferential surface of the fixing belt 22, and the fixing belt 22 slides along the nip formation surface 32a1 when the fixing belt 22 rotates. In order to improve the abrasion resistance and the slidability of the nip formation surface 32a1, preferably the nip formation surface 32a1 is treated with alumite or coated with a fluororesin material. Additionally, a lubricant such as a fluorine-based grease may be applied to the nip formation surface 32a1 in order to ensure slidability over time. In the present embodiment, the nip formation surface 32a1 is planar. Alternatively, the nip formation surface 32a1 may define a recess or other shape. The planar nip formation surface 32a1 forms the planar fixing nip N that can apply a uniform pressure to the sheet P.

[0040] The nip formation pad 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 pad 32 is preferably copper (thermal conductivity: 398 W / mk) or aluminum (thermal conductivity: 236 W / mk). The nip formation pad 32 made of the material having 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 pad 32 to 1 mm or less can shorten a heat transfer time in which the heat transfers from the nip formation pad 32 to the fixing belt 22, which is advantageous in shortening a warm-up time of the fixing device 7. In contrast, setting the thickness of the nip formation pad 32 to be larger than 1 mm and 5 mm or less can improve a heat storage capacity of the nip formation pad 32.

[0041] The stay 33 is the support to support the nip formation pad 32 against the pressing force of the pressure roller 23. Similar to the nip formation pad 32, the stay 33 extends in a longitudinal direction thereof parallel to the width direction of the fixing belt 22 and is disposed inside the loop of the fixing belt 22. In the present embodiment, the stay 33 has a pair of side wall portions 33a and a bottom wall portion 33b that connects the pair of side wall portions 33a. One of the pair of side wall portions 33a in an upstream area in the sheet conveyance direction has a bent portion 33c bent from an end of the one of side wall portions 33a in the upstream area in the sheet conveyance direction. In the present embodiment, one of the pair of side wall portions 33a in a downstream area in the sheet conveyance direction is longer than the other side wall portion 33a in the upstream area. The upstream area in the sheet conveyance direction means an area upstream (right side in FIG. 2) from the center of the short side of the nip formation pad 32, and the downstream area in the sheet conveyance direction means an area downstream (left side in FIG. 2) from the center of the short side of the nip formation pad 32. Hereinafter, the upstream area in the sheet conveyance direction is simply referred to as the upstream area, and the downstream area in the sheet conveyance direction is referred to as the downstream area.

[0042] The bent portion 33c of stay 33 supports the bent portion 32b in the upstream area of the nip formation pad 32, and the side wall portion 33a of the stay 33 supports the downstream area of the nip formation portion 32a. The stay 33 supporting the back face of the nip formation pad 32 strengthens the rigidity of the nip formation pad 32 in a pressing direction in which the pressure roller 23 presses against the nip formation pad 32 and reduces the bend of the nip formation pad 32 caused by the pressing force of the pressure roller 23. Particularly in the downstream area, the side wall portion 33a in the downstream area extending in the pressing direction of the pressure roller 23 that is a vertical direction in FIG. 2 supports the downstream area of the nip formation portion 32a, which can strengthen the rigidity of the nip formation pad 32. 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.

[0043] 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 pad 32. In the present embodiment, the reflector 34 has a reflector portion 34a formed as a trapezoid cross-section to cover the halogen heater 31 and a pair of bent portions 34b bent from both ends of the reflector portion 34a in a direction parallel to the sheet conveyance direction and a direction in which the bent portions separate from each other in the belt rotation direction B. In the present embodiment, a height of each bent portion 34b is different, and the bent portion 34b in the upstream area is positioned higher than the bent portion 34b in the downstream area as illustrated in FIG. 2. Each bent portion 34b is sandwiched between the stay 33 and the nip formation pad 32 to hold the reflector 34.

[0044] A surface of the reflector portion 34a is arranged to face the nip formation pad 32 to reflect the radiant heat from the halogen heater 31 toward the nip formation pad 32. That is, the halogen heater 31 directly irradiates the nip formation pad 32 with the infrared light, and, additionally, the nip formation pad 32 is also irradiated with the infrared light reflected by the reflector portion 34a. Therefore, the nip formation pad 32 is effectively heated.

[0045] Since the reflector portion 34a is interposed between the halogen heater 31 and the stay 33, the reflector portion 34a functions to block the infrared light from the halogen heater 31 to the stay 33. This function eliminates wasteful energy use to heat the stay 33. Additionally, in the present embodiment, thermal insulation of the layer of air in a gap between the stay 33 and the reflector portion 34a blocks heat transfer to the stay 33.

[0046] As described above, in the present embodiment, the reflector 34 is provided to cover the halogen heater 31, and the radiant heat from the halogen heater 31 and the radiant heat reflected by the reflector 34 are efficiently collected to an opening of the reflector 34, that is, to the nip formation pad 32. The heated nip formation pad 32 can efficiently heat the fixing belt 22 in the fixing nip N. The stay 33 is disposed to cover the outer surface of the reflector 34. The fixing belt 22 is disposed outside the stay 33. That is, in the circumferential direction of the fixing belt 22, the fixing belt 22 faces the halogen heater 31 through the nip formation pad 32 in the fixing nip N and, in the portion other than the fixing nip N, faces the halogen heater 31 through the reflector 34 and the stay 33.

[0047] The surface of the reflector portion 34a 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.

[0048] Alternatively, the stay 33 may have the function of reflection and thermal insulation of the reflector 34. For example, performing the thermal insulation treatment or the mirror finishing on the inner surface of the stay 33 in the halogen heater 31 side enables the stay 33 to function as the reflector 34. Such a configuration can obviate the reflector 34 that is a separate component from the stay 33. The reflectance of the stay 33 subjected to the mirror finishing is preferably similar to the reflectance of the reflector 34.

[0049] The temperature sensors 28 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.

[0050] As illustrated in FIG. 4, a pair of belt holders 35 is inserted in both lateral ends of the fixing belt 22 in the axial direction of the fixing belt 22 to rotatably support the fixing belt 22. As described above, the belt holders 35 inserted into the inner periphery of the fixing belt 22 support the fixing belt 22 in a state in which the fixing belt 22 is not basically applied with tension in a circumferential direction thereof while the fixing belt 22 does not rotate, that is, by a free belt system.

[0051] As illustrated in FIGS. 3 to 5, the belt holders 35 include a C-shaped supporter 35a inserted into the inner periphery of the fixing belt 22 to support the fixing belt 22 and a flange 35b that contacts an end face of the fixing belt 22 to stop a movement of the fixing belt 22 in the width direction, that is, walking of the fixing belt 22 in the width direction. As illustrated in FIG. 6, the supporter 35a may have a cylindrical shape which is continuous over its entire circumference. As illustrated in FIG. 4, each of belt holders 35 is fixed on a pair of side plates 36 that are frames of the fixing device 7. The belt holders 35 define opening 35c as illustrated in FIG. 5, and both ends of the halogen heater 31 and the stay 33 are fixed to the side plates 36 through the openings 35c. The halogen heater 31 and the stay 33 may be fixed to the belt holder 35.

[0052] Next, with reference to FIGS. 2 to 7, a detailed description is given of the projections 32c disposed on the nip formation pad 32 according to the present embodiment.

[0053] As illustrated in FIG. 2, the plurality of projections 32c (in the present embodiment, five projections) is provided side by side in the sheet conveyance direction on a center area of the nip formation portion 32a in the sheet conveyance direction. As illustrated in FIG. 7, each projection 32c extends in the width direction of the fixing belt and projects on an opposite side of the pressure roller 23 in a direction intersecting with the sheet conveyance direction (in the present embodiment, a direction substantially orthogonal to the sheet conveyance direction), and each of the projections 32c has a substantially same height.

[0054] The projections 32c are made of the same material as the material of the nip formation portion 32a. For example, extrusion processing may be used to form one unit including the nip formation portion 32a and the projections 32c. Alternatively, the projections 32c may be separately made from and welded to the nip formation portion 32a. In such a case, when the nip formation pad 32 is made from a plate, for example, the plate is bent to form the nip formation portion 32a and the bent portions 32b, and the projections 32c are provided by post-processing. In the following embodiments, the projections may be formed by the above-described methods.

[0055] Providing the projections 32c as described in the present embodiment can improve the rigidity of the nip formation pad 32. That is, providing the projections 32c that project to the opposite side of the pressure roller 23 on a surface opposite to the nip formation surface 32a1 of the nip formation portion 32a can reduce the bend of the nip formation portion 32a (mainly a bend in a direction perpendicular to the width direction of the fixing belt) when the pressure roller 23 is pressed against the nip formation pad 32 via the fixing belt 22. As a result, the nip formation pad 32 can form a flat fixing nip N with little unevenness with the pressure roller 23. The flat fixing nip N can reduce a pressure deviation in positions of the sheet P passing through the fixing nip N. The pressure deviation would cause creases of the sheet P and abnormal movement of the sheet P, which cause a conveyance error and the toner image to rub parts near the fixing nip N and uneven heat amount distribution on the sheet P depending on positions of the fixing nip N. The uneven heat amount distribution would cause a fixing error (cold offset) on a part of the toner image or abnormal images such as hot offset due to too much heat amount. In the present embodiment, providing the above-described projections 32c prevents the above-described disadvantage from occurring.

[0056] In the present embodiment, providing the projections 32c on the center area of the nip formation portion 32a in the sheet conveyance direction which the pressure roller 23 presses with the largest pressing force efficiently reduces the bend of the nip formation portion 32a.

[0057] In addition, providing the projections 32c increases a surface area of the face opposite to the nip formation surface 32a1 of the nip formation portion 32a, that is, the surface facing the halogen heater 31. Increasing the surface area can improve heat efficiency of the nip formation pad 32.

[0058] Hereinafter, embodiments of the fixing device 7 are described that are different from the above-described first embodiment, in particular, have different configurations of the projections 32c disposed on the nip formation pad 32. Redundant descriptions concerning the configurations similar to that of the above-described embodiment is omitted, focusing on the different configurations.

[0059] As illustrated in FIG. 8, in the fixing device 7 of a second embodiment, the projections 32c are disposed on a different area from the first embodiment. Specifically, in the first embodiment, the projections 32c are provided on the center area of the nip formation portion 32a in the sheet conveyance direction as illustrated in FIG. 2. In contrast, in the second embodiment, the projections 32c are provided on the nip formation portion 32a from upstream to downstream in the sheet conveyance direction.

[0060] At both ends in the sheet conveyance direction, the bent portions 32b are provided on the nip formation pad 32. Each of the bent portions 32b is supported by each of the side wall portions 33a of the stay 33 and sandwiches the bent portion 34b of the reflector 34 together with the side wall portion 33a. In the second embodiment, the bent portions 32b project in a direction perpendicular to the sheet conveyance direction and have the same height at both ends that substantially equals to a height of the projections 32c. Additionally, the stay 33 and the reflector 34 in the second embodiment are substantially symmetrical with respect to a lateral direction in FIG. 8. The pair of side wall portions 33a of the stay 33 has the same length, and the bent portions 34b are provided at both ends of the reflector 34 in the sheet conveyance direction to be at the same height.

[0061] As illustrated in FIG. 9, similar to the above-described embodiment, projections 32c extend in the width direction of the fixing belt and have the substantially same height.

[0062] Providing the projections 32c from upstream to downstream in the sheet conveyance direction as described above can improve the rigidity of the nip formation portion 32a from upstream to downstream in an entire area of the fixing nip N, which can flatten the entire area of the fixing nip N.

[0063] As illustrated in FIG. 10, a covering surface 32d coated with a heat-absorbing material is provided on a surface of the nip formation pad 32 on a side of the projections 32c. A specific example of coating the covering surface 32d with the heat-absorbing material is coating a ceramic material excellent in heat conductivity and heat absorbability on the surface of the nip formation pad on the side of the projections 32c and thinning a sheet material excellent in heat conductivity such as a graphite sheet and forming a thin film on the surface of the nip formation pad 32 on the side of the projections 32c. In a viewpoint of heat conductivity, it is most preferred to coat the surface with micronized diamond. Providing the covering surface 32d improves heat absorption property of the surface of the nip formation pad 32 facing the halogen heater and enables the nip formation pad 32 to more efficiently absorb the heat from the halogen heater 31. Note that the nip formation surface 32a1 is not coated with the heat-absorbing material.

[0064] The surface of the nip formation pad 32 on the side of the projections 32c may be processed by sandblasting to increase the surface roughness of the nip formation surface 32a1 and the surface area. Increasing the surface area improves heat absorption efficiency of the nip formation pad 32.

[0065] As illustrated in FIG. 11, similar to the second embodiment, in the fixing device 7 according to a third embodiment of the present disclosure, the projections 32c are provided on the nip formation portion 32a from upstream to downstream in the sheet conveyance direction. A point in the third embodiment different from the second embodiment is, in addition to the bent portions 32b, having a projection 32c1 most upstream in the sheet conveyance direction and a projection 32c6 most downstream in the sheet conveyance direction among the projections 32c. Each of the projections 32c1 and 32c6 is supported by each of the side wall portions 33a of the stay 33 and sandwiches each of the bent portions 34b of the reflector 34 together with each of the side wall portions 33a in addition to the bent portion 32b.

[0066] Providing the projections 32c on the nip formation portion 32a as described above can increase the rigidity of the nip formation pad 32 with respect to the pressing force of the pressure roller. Increasing the rigidity as described above enables support positions of the nip formation pad 32 supported by the stay 33 and the reflector 34 to be arranged more inside the nip formation pad 32. That is, the rigidity of the nip formation pad 32 can be ensured above a certain level even if contact positions at which the stay 33 and the reflector 34 contact the nip formation pad 32 are arranged on the projections 32c1 and 32c6 inside the bent portions 32b provided at both ends in the sheet conveyance direction. The above-described configuration enables the width of the stay 33 and the width of the reflector 34 in the sheet conveyance direction to be smaller than a conventional configuration. As a result, the diameter of the loop of the fixing belt 22 can be reduced, and the entire fixing device 7 can be downsized. For example, assuming that a conventional fixing belt is indicated by a dotted line portion in FIG. 11, the fixing belt 22 of the third embodiment can be made small as indicated by a solid line portion in FIG. 11.

[0067] As illustrated in FIG. 12, in the fixing device 7 according to a fourth embodiment of the present disclosure, the heights of the projections 32c1 to 32c6 provided on the nip formation pad 32 increase from upstream to downstream in the sheet conveyance direction. That is, the projection 32c1 is lowest, and the projection 32c6 is highest.

[0068] As described above, increasing the surface area of the nip formation pad 32 on the halogen heater 31 side can increase the heat amount received by the nip formation pad 32. In the fourth embodiment, the surface areas of the projections 32c increase from upstream to downstream in the sheet conveyance direction, and the heat amounts stored in the projections 32c increase from upstream to downstream. Accordingly, the above-described configuration can maintain high temperature from an entrance to an exit in the fixing nip N, and continuously apply a certain amount or more of heat to the sheet P that passes through the fixing nip N. As a result, the fixing device 7 can fix the image onto the surface of the sheet P in a good state with high gloss.

[0069] As illustrated in FIG. 13, in the fixing device 7 according to a fifth embodiment of the present disclosure, contrary to the fourth embodiment, heights of the projections 32c1 to 32c6 provided on the nip formation pad 32 decrease from upstream to downstream in the sheet conveyance direction. That is, the projection 32c1 is highest, and the projection 32c6 is lowest.

[0070] In the fifth embodiment, compared with the fourth embodiment, the heat amount received by the nip formation pad 32 on the exit in the fixing nip N becomes relatively small, and the temperature of the fixing belt 22 in the fixing nip N becomes relatively low. The above-described temperature distribution can prevent the sheet P from being wound around the fixing belt 22 and facilitate separation of the sheet P from the fixing belt 22 on the exit in the fixing nip N.

[0071] As illustrated in FIG. 14, in the fixing device 7 according to a sixth embodiment of the present disclosure, the projections 32c3 and 32c4 on a center area of the nip formation pad 32 in the sheet conveyance direction are higher than the projections 32c1 and 32c6 on end areas among the projections 32c1 to 32c6 disposed on the nip formation pad 32.

[0072] The above-described configuration according to the sixth embodiment can increase the rigidity of the center area of the nip formation pad 32 in the sheet conveyance direction. Surface pressure from the pressure roller 23 to the nip formation pad 32 is greatest on the center area in the sheet conveyance direction. Therefore, the configuration according to the sixth embodiment can reduce the bend of the nip formation pad 32 caused by the pressing force from the pressure roller 23 and maintain a certain width or more of the fixing nip N on the center area in the sheet conveyance direction. In addition, providing the projections on the end areas of the nip formation pad 32 in the sheet conveyance direction can also increase the rigidity of the end areas of the nip formation portion 32a, and relatively decreasing the heights of the projections on the end areas of the nip formation pad 32 can reduce the heat capacity of the nip formation pad 32.

[0073] As illustrated in FIG. 15, in the fixing device 7 according to the seventh embodiment of the present disclosure, contrary to the sixth embodiment, the projections 32c3 and 32c4 on the center area of the nip formation pad 32 in the sheet conveyance direction are lower than the projections 32c1 and 32c6 on the end areas among the projections 32c1 to 32c6 disposed on the nip formation pad 32.

[0074] The nip formation pad 32 according to the seventh embodiment ensures the surface area on the entrance and the exit of the fixing nip N, and the projections 32c1 and 32c6 on the end areas that is the farthest area from the halogen heater 31can be near the halogen heater 31. Therefore, the above described configuration can prevent temperature of the fixing nip N on the end areas upstream and downstream in the sheet conveyance direction that are areas in each of which the temperature of the fixing nip N easily drops, that is, specifically, the temperature of the fixing belt 22 at the end in the width direction of the fixing belt 22, from dropping.

[0075] As illustrated in FIG. 16, in the fixing device 7 according to an eighth embodiment of the present disclosure, each of the projections 32c of the nip formation pad 32 has an arc shape extending in the width direction of the fixing belt 22, and the height of the projection 32c changes in the width direction of the fixing belt 22. Specifically, the height H2 on the center area of the projection 32c in the width direction is highest, and the heights H1 and H3 on the end areas are relatively lower. The projections 32c have the substantially same height.

[0076] The above-described configuration according to the eighth embodiment can increase the rigidity of the center area of the nip formation pad 32 in the width direction and efficiently reduce the bend of the nip formation pad 32 when the pressure roller 23 contacts and presses the nip formation pad 32.

[0077] As illustrated in FIG. 17, in the fixing device 7 according to a ninth embodiment of the present disclosure, each of the projections 32c1 to 32c6 provided on the nip formation pad 32 has an inclined surface facing the halogen heater 31. For example, as illustrated in an enlarged view of FIG. 17, an end face 32ca of each of the projections 32c3 and 32c4 on the halogen heater 31 side is formed as the inclined surface facing the halogen heater 31. Such a configuration can improve heat absorption efficiency of the nip formation pad 32.

[0078] As illustrated in FIG. 18A, the nip formation pad 32 provided in the fixing device according to a tenth embodiment of the present disclosure includes a first nip plate 321 as a first nip member and a second nip plate 322 as a second nip member provided inside the first nip plate 321 to overlap the first nip plate 321.

[0079] The first nip plate 321 is made of a flat copper plate and has a shape in which both ends in the sheet conveyance direction are bent in the vertical direction. The second nip plate 322 is made of an aluminum material or a copper plate and formed to have a flat surface on a side of the first nip plate 321 and a plurality of projections on a side opposite the first nip plate 321.

[0080] As illustrated in FIG. 18B, the second nip plate 322 is provided inside the first nip plate 321 to make the nip formation pad 32 as one unit. A plate-shaped portion of the first nip plate 321 and the second nip plate 322 are overlapped to constitute the nip formation portion 32a. The surface of the plate-shaped portion of the first nip plate 321 and opposite to the second nip plate 322 is the nip formation surface 32a1. The plurality of projections provided on the second nip plate 322 function as the projections 32c of the nip formation pad 32.

[0081] The first nip plate 321 made of the cupper plate can improve the heat conductivity and the rigidity of the nip formation pad 32 on the fixing nip side. Making the second nip plate 322 including the projections 32c from the aluminum material allows employing the extruding processing described above that easily forms the projections 32c, that is, improves workability. As described above, the nip formation pad 32 can get good workability and functionality such as the rigidity and the heat conductivity.

[0082] As illustrated in FIG. 19, hemming bend may form the projections 322c from the second nip plate 322 made of a metal material.

[0083] In the above-described embodiments, as illustrated in FIG. 7 and other drawings, the plurality of projections 32c extending in the width direction of the fixing belt are arranged side by side in the sheet conveyance direction. However, on the contrary, the plurality of projections 32c may extend in the sheet conveyance direction and be arranged side by side in the width direction. For example, as illustrated in FIG. 20A, the projections 32c may extend in a direction substantially parallel to the sheet conveyance direction indicated by arrow C in FIG. 20A. Alternatively, as illustrated in FIGS. 20B and 20C, the projections 32c may incline with respect to the sheet conveyance direction. In FIG. 20B, each projection 32c extends to incline from one end of the projection 32c upstream in the sheet conveyance direction to the other end of the projection 32c downstream in the sheet conveyance direction, and the other end is positioned at a center side of the nip formation pad 32 in a longitudinal direction, that is, a lateral direction in FIG. 20B, with respect to the one end of the projection 32c. On the contrary, the other end may be positioned at an end side in the longitudinal direction of the nip formation pad 32 with respect to the one end. In FIG. 20C, the projections 32c incline toward one side in the longitudinal direction from upstream to downstream in the sheet conveyance direction. The projections 32c extending in the longitudinal direction as illustrated in FIG. 7 or the like have an effect of mainly reducing the bend of the nip formation pad 32 in a direction perpendicular to the longitudinal direction. In contrast, the projections 32c extending in the sheet conveyance direction as illustrated in FIG. 20A, 20B, or 20C have an effect of mainly reducing the bend of the nip formation pad 32 in the direction perpendicular to the sheet conveyance direction.

[0084] A shape of the end face facing the halogen heater 31 on the projection 32c disposed on the nip formation pad 32 is not limited to a flat face as illustrated in FIG. 2 or the inclined surface as illustrated in FIG. 17. For example, the end face on the projection 32c may be rounded as illustrated in FIG. 21A or sharpened as illustrated in FIG. 21B. Alternatively, as illustrated in FIG. 21C, an entire shape of the projection 32c may be a curved shape, for example, a semicircle. The heights of projections 32c may be randomly set as illustrated in FIG. 21D.

[0085] The nip formation pad may have a multilayer structure that has a hollow ring shape in a cross section perpendicular to the width direction of the fixing belt 22. For example, as in the fixing device according to an embodiment of the present disclosure illustrated in FIG. 22, the nip formation pad 42 includes a first layer 421 having a nip formation surface 421a and a second layer 422 facing the halogen heater 31. There is a clearance between the first layer 421 and the second layer 422. The first layer 421 and the second layer 422 are connected at both ends in the sheet conveyance direction to form a tube structure extending in the longitudinal direction that is a direction perpendicular to a sheet surface of FIG. 22. The nip formation pad 42 may be a square tube that is a hollow structure having a rectangular cross-section extending in the width direction of the fixing belt.

[0086] The nip formation pad 42 includes reinforcing portions 423 that are bridges between the first layer 421 and the second layer 422. A plurality of reinforcing portions 423 may be provided in the longitudinal direction or may be longitudinal portions extending in the longitudinal direction. The reinforcing portion 423 can be obviated depending on the rigidity of the nip formation pad 42.

[0087] As illustrated in an enlarged view of FIG. 22, the second layer 422 may have a through-hole 422a penetrating the second layer 422 in the vertical direction in FIG. 22. The through-hole 422a can improve heat transfer from the halogen heater 31 to the fixing belt 22. A plurality of through-hole 422a may be disposed in the longitudinal direction of the nip formation pad or the sheet conveyance direction. The through-hole 422a may be a longitudinal hole extending in the longitudinal direction.

[0088] The multilayer structure of the nip formation pad 42 that includes layers extending in the longitudinal direction of the nip formation pad 42 as described in the present embodiment can improve the rigidity of the nip formation pad 42 and can mainly reduce the bend of the nip formation pad 42 in the direction perpendicular to the width direction of the fixing belt.

[0089] As illustrated in FIG. 23, a first L-shaped member 43 and a second L-shaped member 44 may be overlapped to form the nip formation pad 42 having the same shape as the nip formation pad 42 in FIG. 22. In such a case, for example, after each of two metal plates is bent to have the L-shaped form, the two bent metal plates are joined together to form the nip formation pad 42.

[0090] The present disclosure is not limited to the details of the embodiments described above and various modifications and improvements are possible.

[0091] The image forming apparatus 1 according to the present embodiment of the present disclosure is applicable not only to a color image forming apparatus illustrated in FIG. 1 but also to a monochrome 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.

[0092] 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. An extending direction of the projection 32c is not limited to the directions described in the above embodiments. As described above, providing the projection 32c that projects on the opposite side of the pressure roller 23 from the surface opposite to the nip formation surface 32a1 of the nip formation portion 32a increases the rigidity of the nip formation pad 32 with respect to the pressing force of the pressure roller 23.

[0093] The present disclosure is not limited to the above-described embodiments, and the configuration of the present embodiment can be appropriately modified other than suggested in each of the above embodiments within the scope of the technological concept of the present disclosure. In addition, the positions, the shapes, and the number of components are not limited to the disclosed embodiments, and they may be modified suitably in implementing the present disclosure.

Claims

1. A fixing device (7) comprising:

an endless fixing belt (22);
a pressing member (23) configured to press an outer surface of the fixing belt (22);
a heater (31) disposed inside a loop of the fixing belt (22) and configured to heat the fixing belt (22); and
a nip formation pad (32) disposed inside the loop of the fixing belt (22),
the nip formation pad (32) having a nip formation surface (32a1) configured to contact the pressing member (23) to form a fixing nip;
the nip formation pad (32) having a projection (32c) at a position different from an end portion of the nip formation pad (32) in a conveyance direction of a recording medium, the projection (32c) being on a surface opposite the nip formation surface (32a1).

2. The fixing device (7) according to claim 1, wherein the nip formation pad (32) has a plurality of projections (32c) including the projection (32c).

3. The fixing device (7) according to claim 2, wherein the plurality of projections (32c) are arranged in the conveyance direction of the recording medium, and wherein a highest projection (32c) of the plurality of projections (32c) is disposed in a downstream area in the conveyance direction of the recording medium.

4. The fixing device (7) according to claim 2, wherein the plurality of projections (32c) are arranged in the conveyance direction of the recording medium, and wherein a highest projection (32c) of the plurality of projections (32c) is disposed in an upstream area in the conveyance direction of the recording medium.

5. The fixing device (7) according to claim 2, wherein the plurality of projections (32c) are arranged in the conveyance direction of the recording medium, and wherein, of the plurality of projections (32c), a height of a first projection (32c3, 32c4) on a center area of the nip formation pad (32) in the conveyance direction of the recording medium is higher than a height of a second projection (32c1, 32c6) that is closer to the end portion of the nip formation pad (32) than the first projection (32c3, 32c4) in the conveyance direction of the recording medium.

6. The fixing device (7) according to claim 2, wherein the plurality of projections (32c) are arranged in the conveyance direction of the recording medium, and wherein, of the plurality of projections (32c), a height of a first projection (32c3, 32c4) on a center area of the nip formation pad (32) in the conveyance direction of the recording medium is lower than a height of a second projection (32c1, 32c6) that is closer to the end portion of the nip formation pad (32) than the first projection (32c3, 32c4) in the conveyance direction of the recording medium.

7. The fixing device (7) according to any one of claims 1 to 6, wherein the projection (32c) extends in a width direction of the fixing belt (22), and a height of a center area of the projection (32c) in the width direction is higher than a height of an end area of the projection (32c).

8. The fixing device (7) according to any one of claims 1 to 7,
wherein the projection (32c) is provided at a center area of the nip formation pad in the conveyance direction of the recording medium.

9. The fixing device (7) according to any one of claims 1 to 8,
wherein the projection (32c) and a nip formation portion (32a) having the nip formation surface (32a1) are molded as one unit.

10. The fixing device (7) according to any one of claims 1 to 8,
wherein the nip formation pad (32c) includes a first nip member (321) having the nip formation surface (32a1) and a second nip member (322) having the projection (32c).

11. The fixing device (7) according to any one of claims 1 to 10,
wherein the surface including the projection (32c) opposite the nip formation surface (32a1) is coated with a heat-absorbing material.

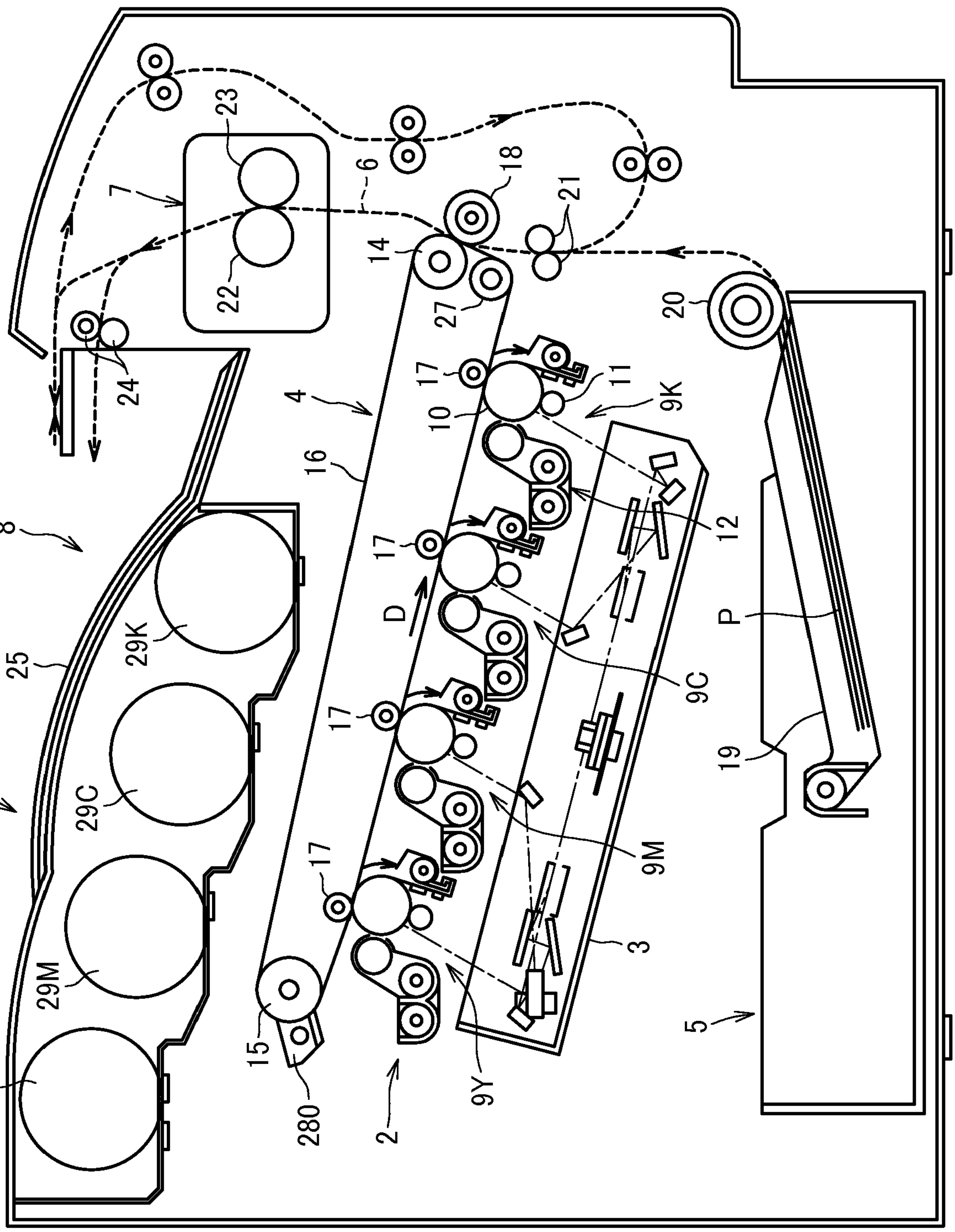
12. The fixing device (7) according to any one of claims 1 to 11,
wherein the surface opposite the nip formation surface (32a1) is rougher than the nip formation surface (32a1).

13. The fixing device (7) according to any one of claims 1 to 12, further comprising:

a support (33) disposed inside the loop of the fixing belt (22) and configured to support the nip formation pad (32),
wherein a plurality of projections(32c) including the projection (32c) is arranged in the conveyance direction of the recording medium, and
wherein the support (33) contacts at least one of a most upstream projection (32c1) and a most downstream projection (32c6) of the plurality of projections (32c) in the conveyance direction of the recording medium.

14. The fixing device (7) according to any one of claims 1 to 13,
wherein an end face of the projection (32c) in a direction in which the projection (32c) projects is an inclined surface facing the heater (31).

15. An image forming apparatus (1) comprising the fixing device (7) according to any one of claims 1 to 14.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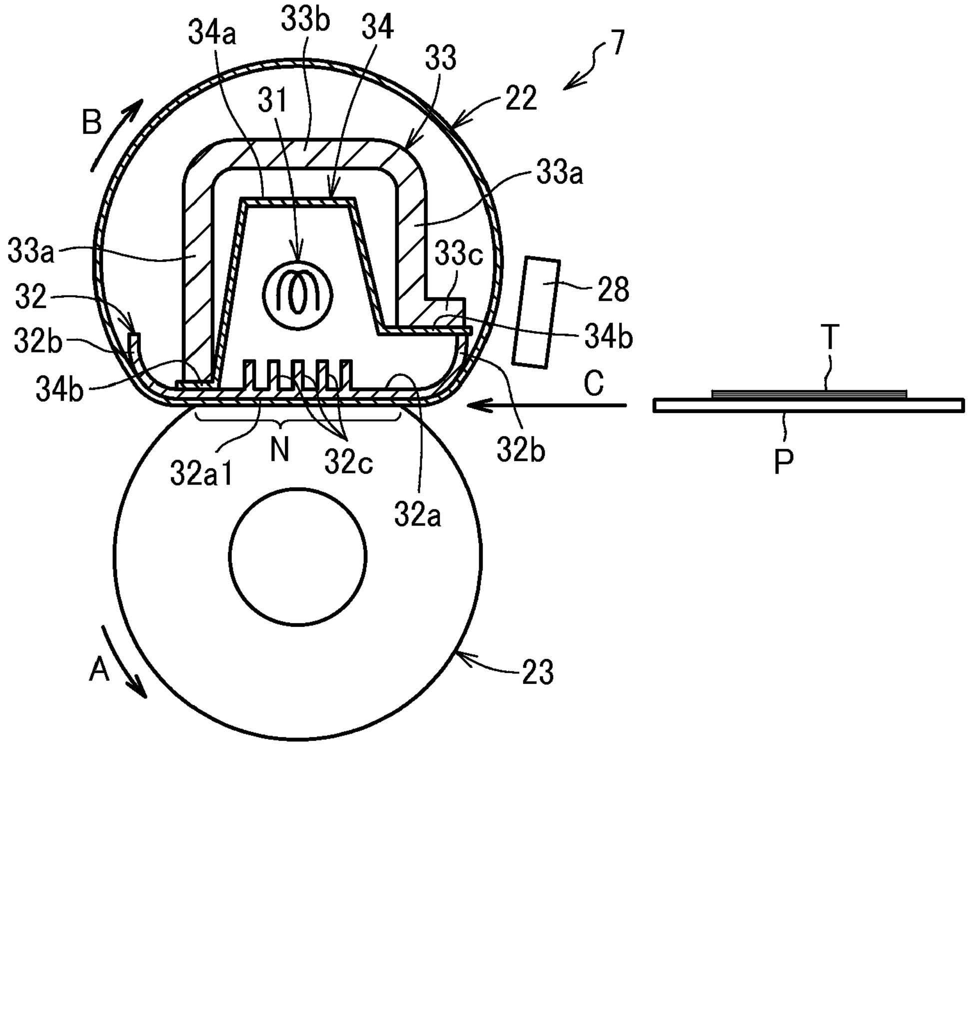
D
P

FIG. 1

FIG. 2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B
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33c
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32a
A
23

FIG. 3

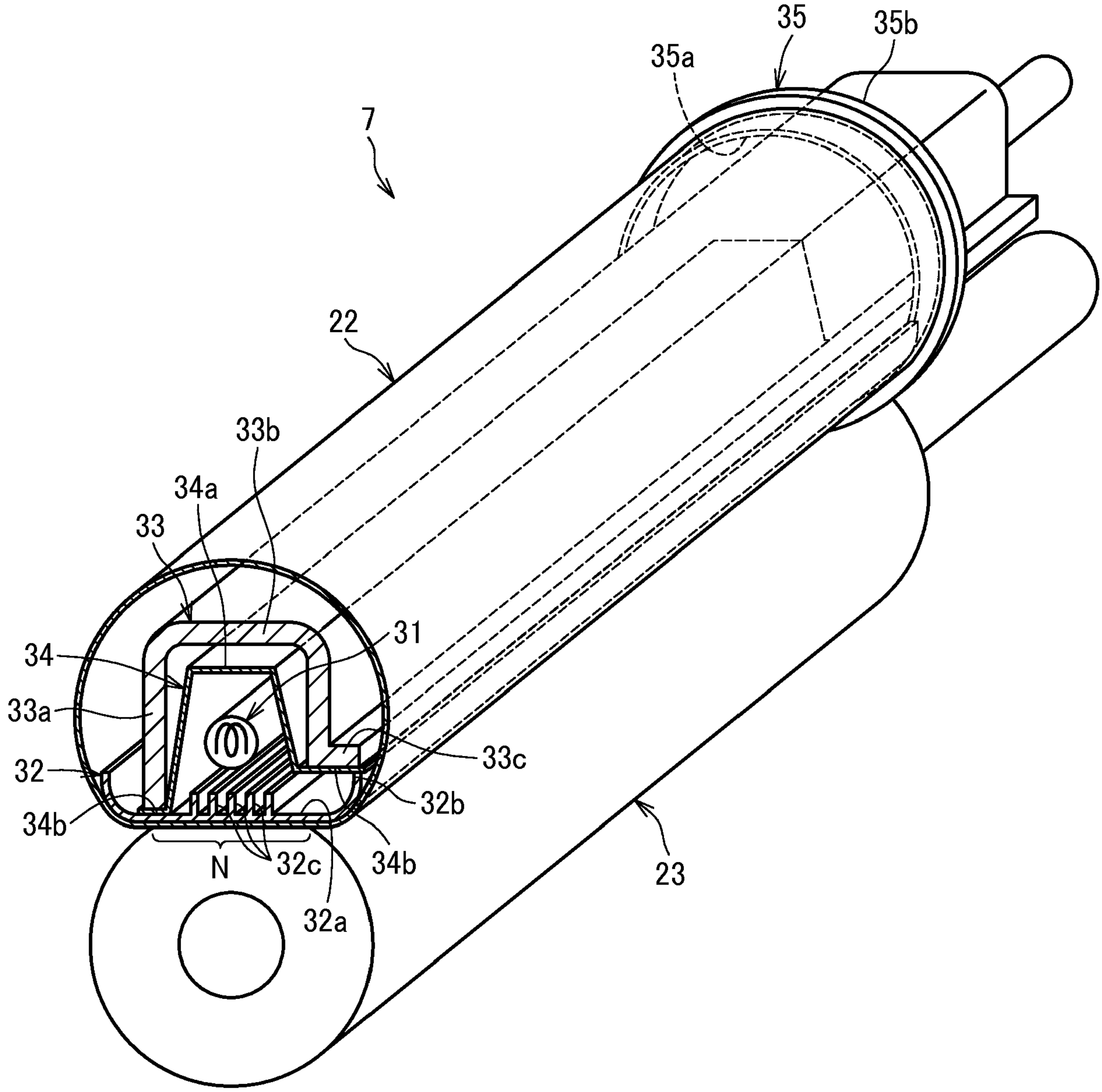


FIG. 4

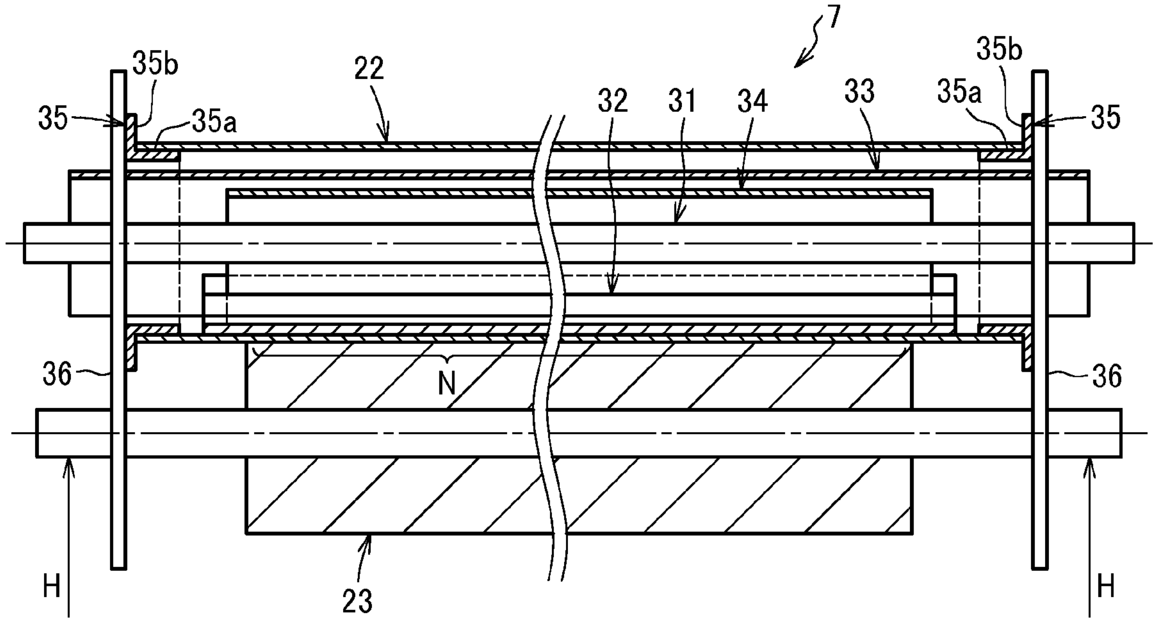


FIG. 5

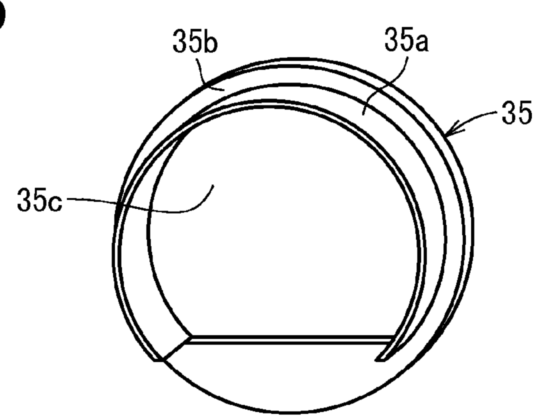


FIG. 6

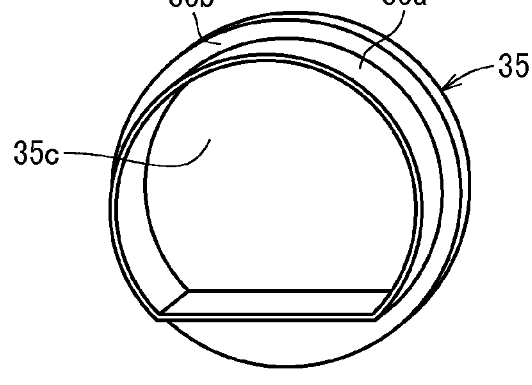


FIG. 7

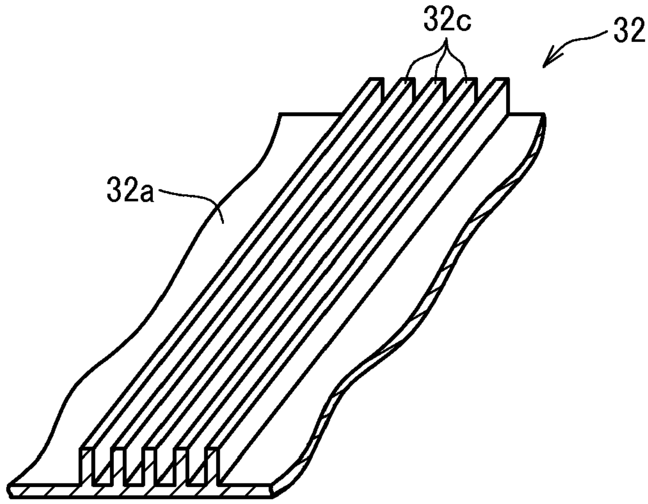
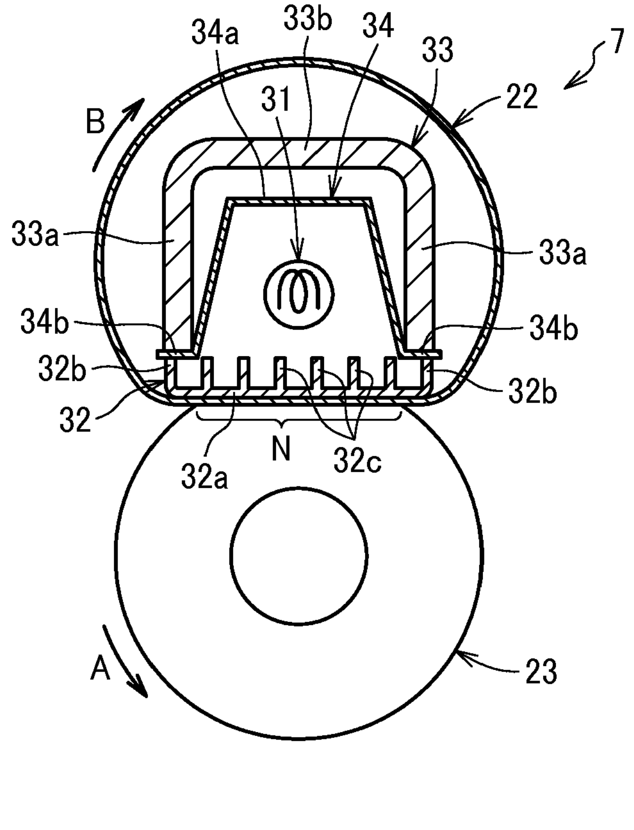

32c
32
32a

FIG. 8


34a
33b
34
33
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32a
A
23

FIG. 9

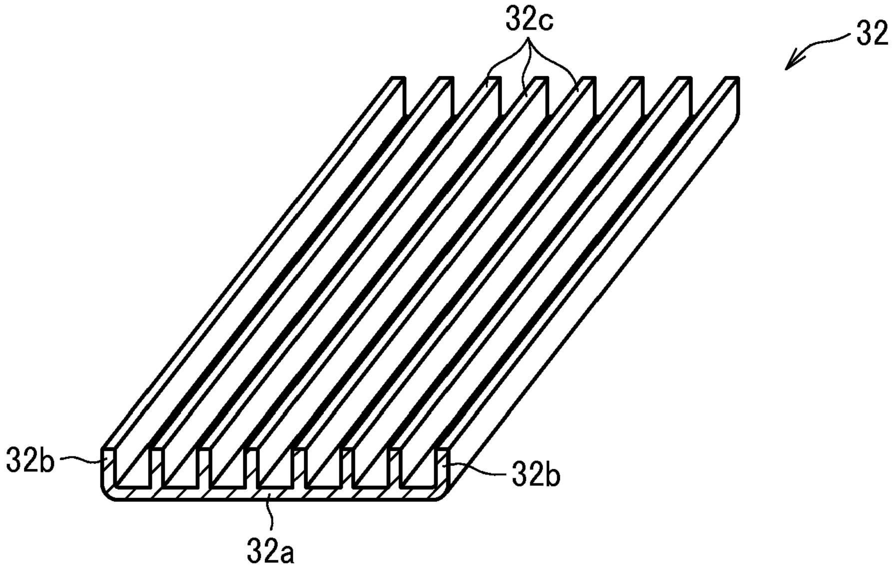


FIG. 10

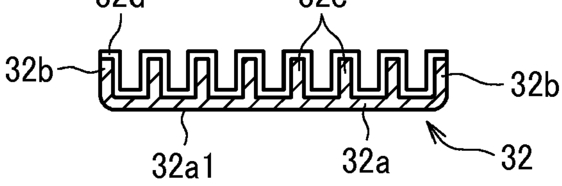
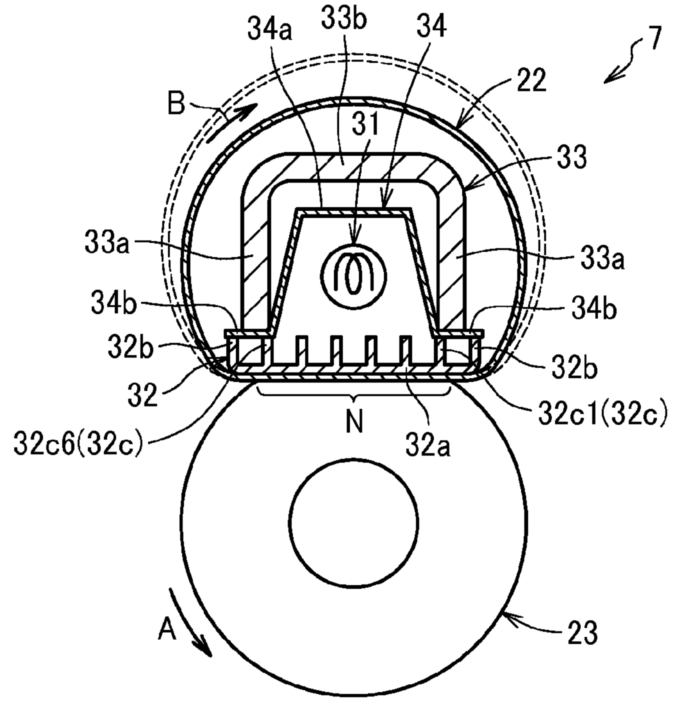
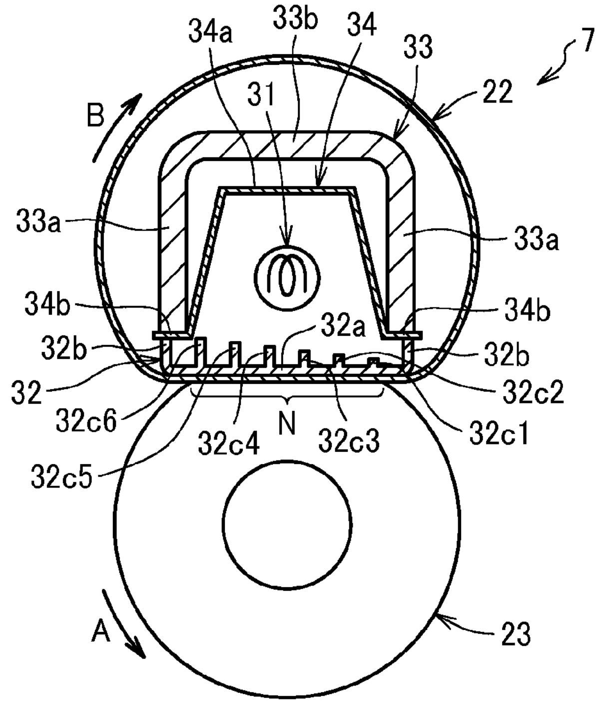


FIG. 11



34a
33b
34
7
22
B
31
33
33a
33a
34b
34b
32b
32b
32
32c1(32c)
32c6(32c)
N
32a
A
23

FIG. 12



34a
33b
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33
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22
B
31
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33a
34b
34b
32a
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32b
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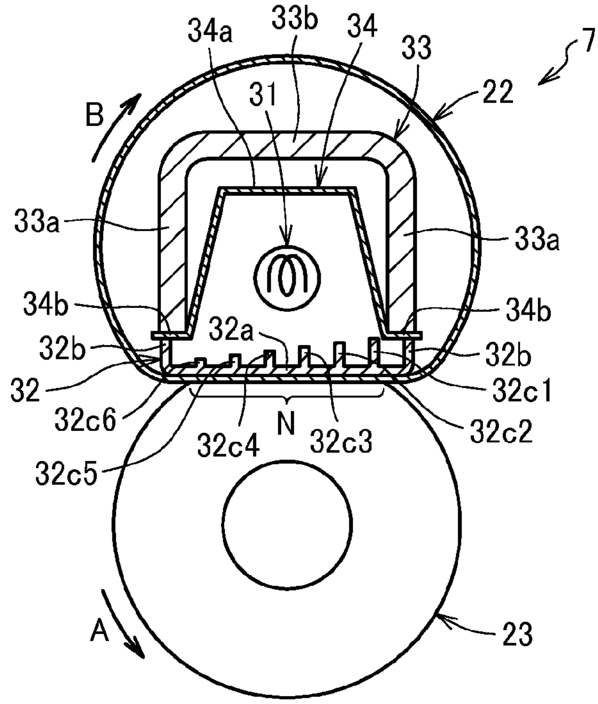
32c2
32c6
32c1
32c4
N
32c3
32c5
A
23

FIG. 13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22
31
B
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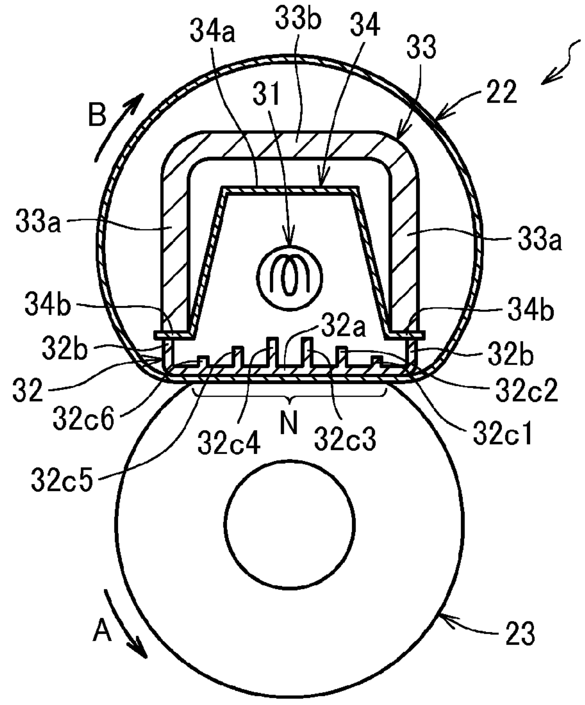
33a
34b
34b
32a
32b
32b
32
32c1
32c6
N
32c2
32c4
32c3
32c5
A
23

FIG. 14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34
33
7
22
31
B
33a
33a
34b
34b
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32b
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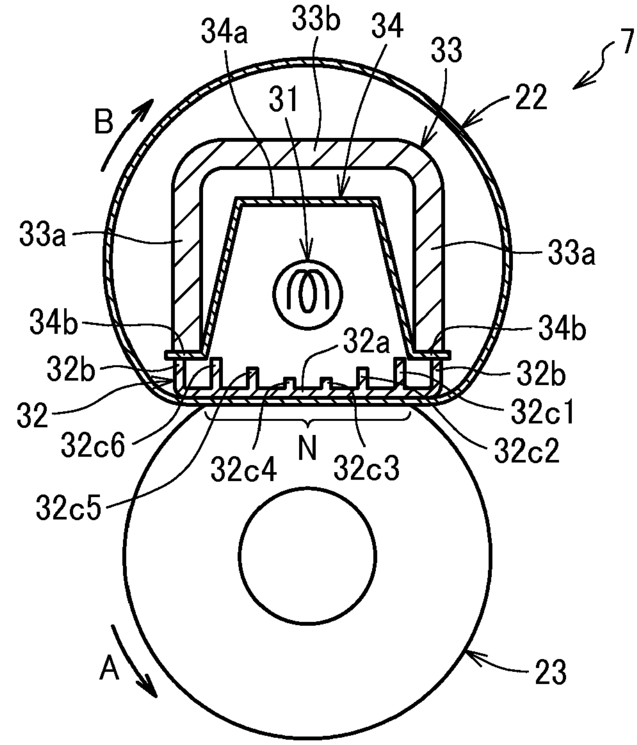
32c2
32c6
N
32c1
32c4
32c3
32c5
A
23

FIG. 15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34b
34b
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32c1
32c6
32c2
N
32c4
32c3
32c5
A
23

FIG. 16

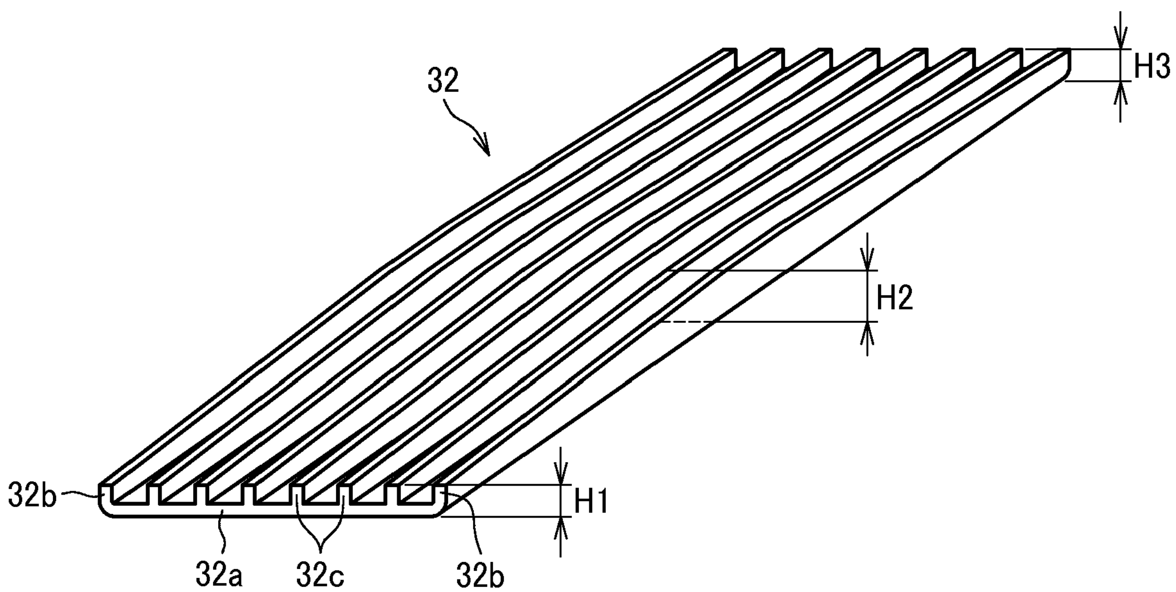

32
H3
H2
32b
H1
32a
32c
32b

FIG. 17

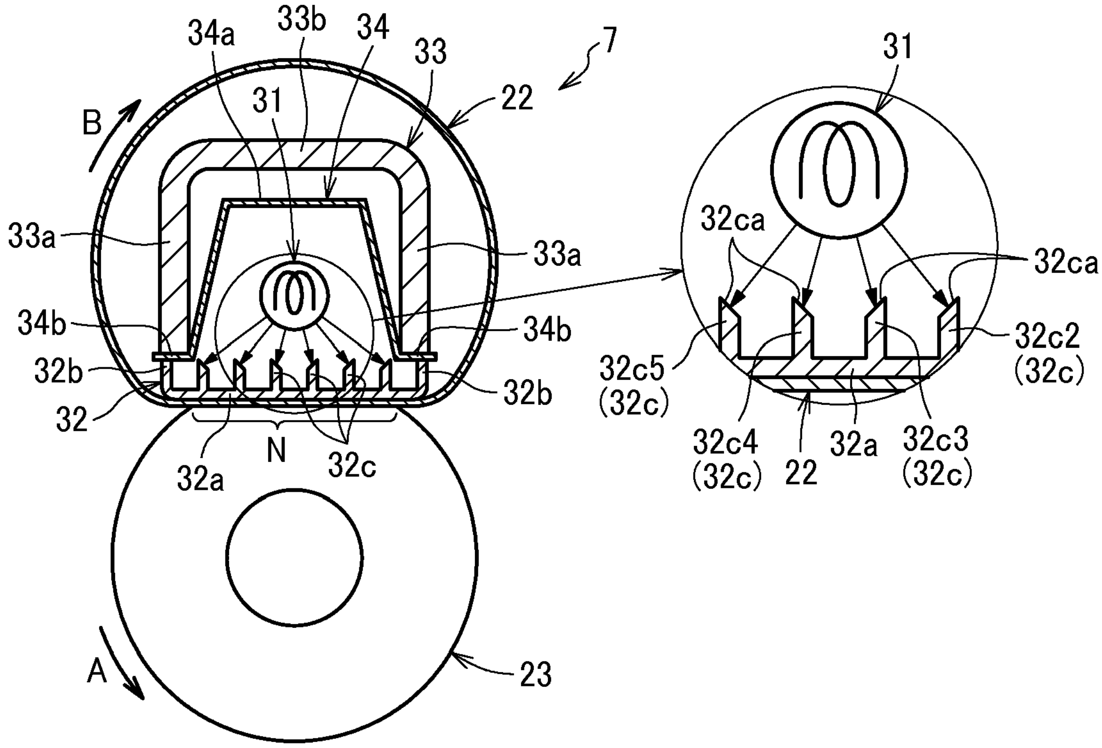


FIG. 18A

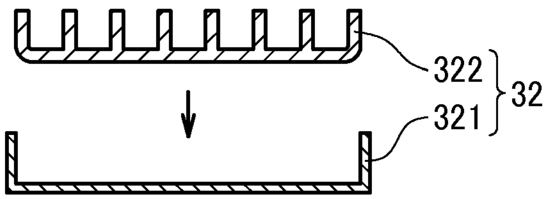


FIG. 18B

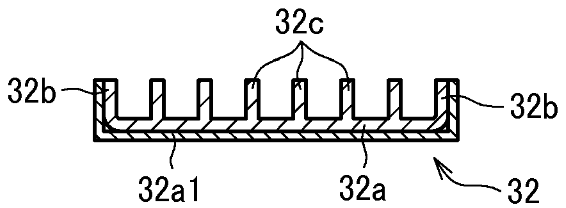


FIG. 19

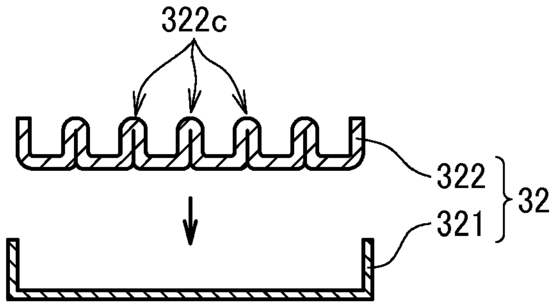


FIG. 20A

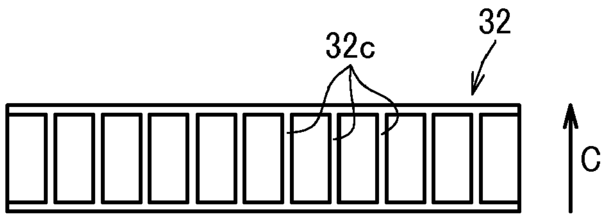


FIG. 20B

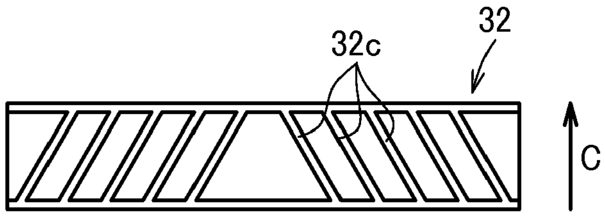


FIG. 20C

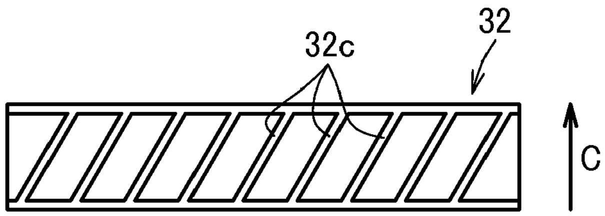


FIG. 21A

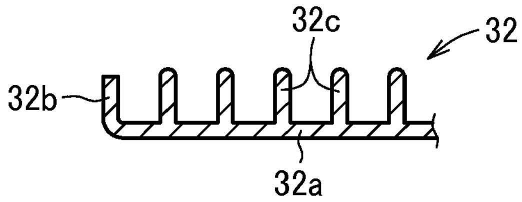


FIG. 21B

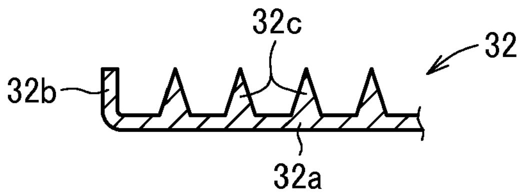


FIG. 21C

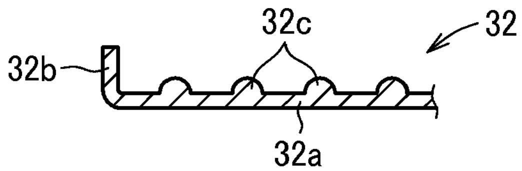


FIG. 21D

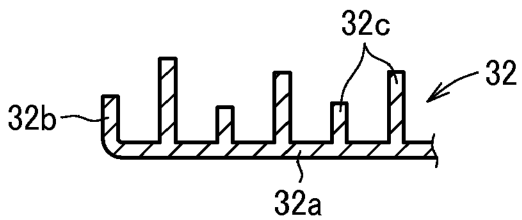
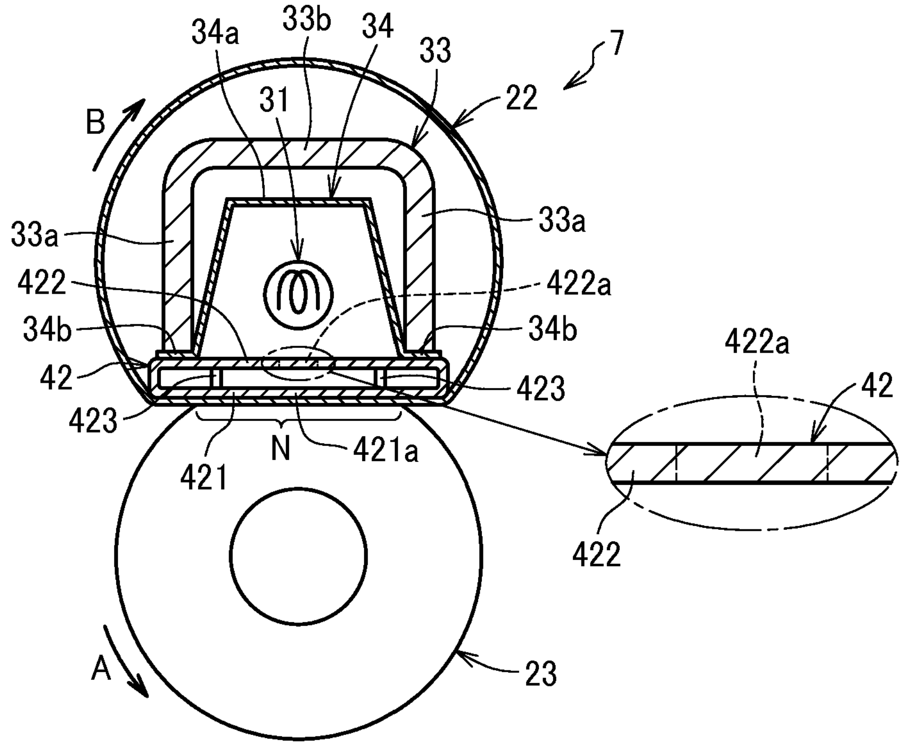


FIG. 22


34a
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421
422a
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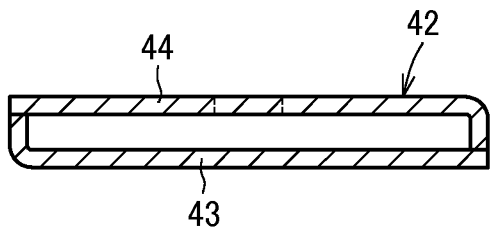
422
A
23

FIG. 23


42
44
43

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- JP 2015072302 A **[0005]**