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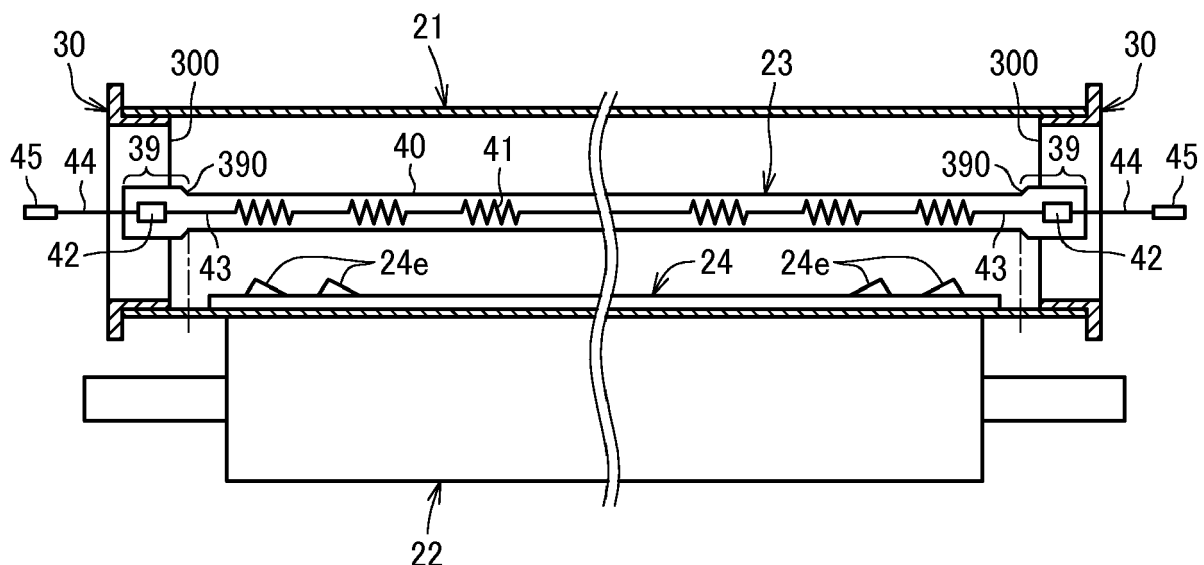
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(54) **FIXING DEVICE AND IMAGE FORMING APPARATUS INCORPORATING THE SAME**

(57) A fixing device (5) includes a fixing member (21), an opposed rotator (22) disposed opposite an outer surface of the fixing member (21), a heater (23) disposed inside a loop of the fixing member (21) to heat the fixing member (21) by radiant heat, and a nip formation pad (24) disposed inside the loop of the fixing member (21)

to sandwich the fixing member (21) with the opposed rotator (22) to form a nip. The nip formation pad (24) includes a slope (24e) that inclines toward a center of the fixing member (21) in a width direction of the fixing member (21) and is disposed on a heater-side surface (24d) of the nip formation pad (24) facing the heater (23).

FIG. 12



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.

Background Art

[0002] An electrophotographic image forming apparatus such as a copier and a printer has a fixing device to convey a recording medium such as a sheet on which an unfixed image is formed to a nip formed between members such as a roller and a belt facing each other, heat the recording medium, and fix the unfixed image on the recording medium.

[0003] As such a fixing device, for example, JP2011-237523-A discloses the fixing device including a fixing belt, a nip formation pad such as a nip plate disposed in an inner loop of the fixing belt, and a pressing roller disposed outside the fixing belt, and the fixing device has the nip formed on the fixing belt sandwiched by the nip formation pad and the pressing roller. Additionally, in the fixing device, the radiant heat from the halogen lamp is transmitted to the fixing belt through the nip formation pad made of a material having a large thermal conductivity to heat the fixing belt.

[0004] A region inside a sheet conveyance span of the nip formation pad absorbs much of the radiant heat emitted from the halogen lamp, and a region outside the sheet conveyance span of the nip formation pad absorbs a part of the radiant heat. The radiant heat absorbed by the region outside the sheet conveyance span is not effectively used to heat the sheet and gives room for improvement from the viewpoint of thermal energy efficiency.

SUMMARY

[0005] 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. Advantageously, the fixing device includes a fixing member, an opposed rotator disposed opposite an outer surface of the fixing member, a heater disposed inside a loop of the fixing member to heat the fixing member by radiant heat, and a nip formation pad disposed inside the loop of the fixing member to sandwich the fixing member with the opposed rotator to form a nip. The nip formation pad includes a slope that inclines toward a center of the fixing member in a width direction of the fixing member and is disposed on a heater-side surface of the nip formation pad facing the heater.

[0006] According to the present disclosure, the slope reflects the radiant heat radiated from the heater toward the center in a width direction of the fixing member, and the thermal energy of the reflected radiant heat heats the fixing member inside the slope in the width direction. Therefore, thermal energy is used effectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] 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 viewed from a lateral side of the fixing device; FIG. 3 is a perspective view of the fixing device 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; FIG. 5 is a perspective view of a belt holder; FIG. 6 is a perspective view of the belt holder according to a variation;

FIG. 7 is a top view of a nip formation pad viewed from a halogen heater;

FIG. 8 is a perspective view illustrating a configuration of the nip formation pad at one end in a longitudinal direction;

FIG. 9 is an explanatory diagram illustrating a work of a slope;

FIG. 10 is a diagram illustrating an example of the slopes having different inclination angles;

FIG. 11 is a top view of an example of the nip formation pad having recessed portions inclined with respect to a rotation direction of a belt;

FIG. 12 is a diagram illustrating a positional relation between the slope and the belt holder and a positional relation between the slope and a halogen heater;

FIG. 13 is a diagram illustrating comparison of positional relation between positions of recesses and axial end positions of a roller portion of the pressing roller;

FIG. 14 is a perspective view illustrating an example of a configuration of the nip formation pad having many slopes at one end in the longitudinal direction; FIG. 15 is an explanatory diagram illustrating a distance between valleys of the recessed portions adjacent to each other;

FIG. 16 is a perspective view illustrating an example of a configuration of the nip formation pad having cylindrical convex portions at one end in the longitudinal direction;

FIG. 17 is a perspective view illustrating an example

of a configuration of the nip formation pad having hemispherical convex portions at one end in the longitudinal direction;

FIG. 18 is a perspective view illustrating an example of a configuration of the nip formation pad having the hemispherical convex portions on the cylindrical convex portions at one end in the longitudinal direction;

FIG. 19 is a schematic diagram illustrating an example of the fixing device including two stays parallel to each other;

FIG. 20 is a schematic diagram illustrating an example of the fixing device having through holes in reflectors and the stays;

FIG. 21 is a schematic diagram illustrating an example of the through hole formed in an elliptical shape;

FIG. 22 is a comparative diagram comparing a rectangular through hole with the elliptical through hole;

FIG. 23 is a cross-sectional view of the reflectors, the stays, and the halogen heater as viewed from above or below in FIG. 20;

FIG. 24 is a schematic diagram illustrating an example of the fixing device including two stays inclined to each other;

FIG. 25 is a schematic diagram illustrating an example of the fixing device in FIG. 24 including two halogen heaters;

FIG. 26 is a schematic diagram illustrating an example in which two stays are integrated;

FIG. 27 is a schematic diagram illustrating an example of the fixing device in which the opening of the stay is directed upward;

FIG. 28 is a schematic diagram illustrating an example of the fixing device in which the opening of the stay is directed downward; and

FIG. 29 is a schematic diagram illustrating an example of a configuration of the image forming apparatus including a fixing device which conveys a sheet in the vertical direction.

[0008] 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

[0009] 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.

[0010] Although the embodiments are described with technical limitations with reference to the attached draw-

ings, 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.

[0011] Referring now to the drawings, embodiments of the present disclosure are described below. In the drawings illustrating the following embodiments, the same reference numbers are allocated to elements having the same function or shape and redundant descriptions thereof are omitted below.

[0012] 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.

[0013] An 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.

[0014] 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.

[0015] 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.

[0016] As an image forming operation start is instructed, in the image forming device 2, the photoconductors 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 photoconductors 7.

[0017] 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.

[0018] 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 the fixing belt 21 and the pressing roller 22 fixes the toner image to 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.

[0019] With reference to FIGS. 2 to 6, a description is provided of a construction of the fixing device 5 in detail.

[0020] FIG. 2 is a vertical cross-sectional view of the fixing device 5 viewed from a lateral side of the fixing device 5, FIG. 3 is a perspective view of the fixing device 5 with the vertical cross-sectional view of the fixing device 5, and FIG. 4 is a vertical cross-sectional view of the fixing device 5 viewed from a front side of the fixing device 5. In addition, FIG. 5 is a perspective view of a belt holder 30 to support the fixing belt 21, and FIG. 6 is a perspective view of the belt holder 30 according to a variation.

[0021] As illustrated in FIG. 2, the fixing device 5 includes the fixing belt 21, the pressing roller 22, a halogen heater 23, a nip formation pad 24, a stay 25, a reflector 26, guides 27, and temperature sensors 28.

[0022] The fixing belt 21 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 is held. The fixing belt 21 in the present embodiment is an endless belt or film including a base layer formed inner side of the fixing belt 21 and made of metal such as nickel and SUS stainless steel or resin such as polyimide and a release layer formed outer side of the fixing belt 21 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 21 and the pressing roller 22 pressingly sandwich the unfixed toner image on the sheet P to fix the toner image on the sheet P, the elastic layer having a thickness of about 100 micrometers elastically deforms to absorb slight surface asperities of the

fixing belt 21, preventing variation in gloss of the toner image on the sheet P. Additionally, in the present embodiment, the fixing belt 21 is thin and has a small loop diameter to decrease the thermal capacity of the fixing belt 21. For example, the fixing belt 21 is constructed of the base layer having a thickness in a range of from 20 micrometers to 50 micrometers and the release layer having a thickness in a range of from 10 micrometers to 50 micrometers. Thus, the fixing belt 21 has a total thickness not greater than 1 mm. In addition, when the fixing belt 21 includes the elastic layer, the thickness of the elastic layer may be set to 100 to 300 μm . In order to decrease the thermal capacity of the fixing belt 21 further, the fixing belt 21 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 21 may have a loop diameter from 20 to 40 mm and preferably 30 mm or less.

[0023] The pressing roller 22 is an opposed rotator disposed opposite an outer surface of the fixing belt 21. The pressing roller 22 is constructed of a core, an elastic layer coating the core, and a release layer coating the elastic layer. The elastic layer is made of rubber such as silicone rubber and fluororubber. The release layer is made of PFA or PTFE. According to the present embodiment, the pressing roller 22 is a solid roller. Alternatively, the pressing roller 22 may be a hollow roller. When the pressing roller 22 is a hollow roller, a heat source such as a halogen heater may be disposed inside the pressing roller 22. The elastic layer of the pressing roller 22 may be made of solid rubber. Alternatively, if no heater is disposed inside the pressing roller 22, the elastic layer of the pressing roller 22 is preferably made of sponge rubber to enhance thermal insulation of the pressing roller 22. This reduces heat conduction from the fixing belt 21 to the pressing roller 22 and improves heating efficiency of the fixing belt 21.

[0024] A driver disposed inside the image forming apparatus 1 drives and rotates the pressing roller 22 in a direction indicated by an arrow A in FIG. 2. The rotation of the pressing roller 22 drives the fixing belt 21 to rotate in a direction B in FIG. 2 due to frictional force therebetween. After the toner image is transferred onto the sheet P, the sheet P bearing the unfixed toner image is conveyed to a nip N between the fixing belt 21 and the pressing roller 22. The rotating fixing belt 21 and the rotating pressing roller 22 conveys the sheet P, and the sheet P passes through the nip N. When the sheet P passes through the nip N, heat and pressure applied to the sheet P fixes the unfixed image T to the sheet P.

[0025] The pressing roller 22 and the fixing belt 21 are configured to be able to contact and separate each other. If the sheet is jammed in the nip N, separating the pressing roller 22 and the fixing belt 21 from each other and opening the nip N enables maintenance work such as removing the jammed sheet. The pressing roller 22 and the fixing belt 21 may be configured so that one is fixed and the other moves to be able to contact and separate

from the one, or both the pressing roller 22 and the fixing belt 21 may be configured to move, contact, and separate from each other.

[0026] The halogen heater 23 is a heater disposed inside a loop of the fixing belt 21 and emitting infrared light, and radiant heat from the halogen heater 23 heats the fixing belt 21 from the inside. Alternatively, instead of the halogen heater 23, a carbon heater, a ceramic heater or the like may be employed as the heater. In the present embodiment, only one halogen heater 23 is disposed in the loop of the fixing belt 21, but a plurality of halogen heaters 23 having different heat generation areas may be used according to the width size of the sheet.

[0027] The nip formation pad 24 and the pressing roller 22 sandwiches the fixing belt 21 to form the nip N. Specifically, the nip formation pad 24 extends in a longitudinal direction thereof parallel to a width direction of the fixing belt 21 and has a nip formation portion 24a that is a plate and in contact with an inner circumferential surface of the fixing belt 21 and a pair of bent portions 24b that are bent from both end portions of the nip formation portion 24a in a belt rotation direction B to the opposite side to the pressing roller 22. A pressure member such as a spring presses the pressing roller 22 against the nip formation pad 24, which causes the pressing roller 22 to contact the fixing belt 21 and forms the nip N therebetween.

[0028] A nip formation surface 24c on the nip formation portion 24a in the fixing belt 21 side directly contacts the inner circumferential surface of the fixing belt 21. Therefore, when the fixing belt 21 rotates, the fixing belt 21 slides on the nip formation surface 24c. In order to improve the abrasion resistance and the slidability of the nip formation surface 24c, the nip formation surface 24c may be coated with an alumite treatment layer or a fluorocarbon resin material. Furthermore, a lubricant such as a fluorine-based grease may be applied to the nip formation surface 24c in order to secure the slidability over time. In the present embodiment, the nip formation surface 24c is planar. Alternatively, the nip formation surface 24c may define a recess or other shapes. For example, the nip formation surface 24c having a concave shape recessed to the side opposite to the pressing roller 22 leads the outlet of the sheet in the nip N to be closer to the pressing roller 22, which improves separation of the sheet from the fixing belt 21.

[0029] The nip formation pad 24 is made of a material having a thermal conductivity larger than that of the stay 25. For example, the material of the nip formation pad 24 is preferably copper (thermal conductivity: 398 W / mk) or aluminum (thermal conductivity: 236 W / mk). The nip formation pad 24 made of the material having the large thermal conductivity absorbs the radiant heat from the halogen heater 23 and effectively transmits heat to the fixing belt 21. For example, setting a thickness of the nip formation pad 24 to 1 mm or less shortens a heat transfer time in which the heat transfers from the nip formation pad 24 to the fixing belt 21, which is advantageous

in shortening a warm-up speed of the fixing device 5. In contrast, setting the thickness of the nip formation pad 24 to be larger than 1 mm and 5 mm or less improves a heat storage capability of the nip formation pad 24.

[0030] The stay 25 is a support member to support the nip formation pad 24 against pressure from the pressing roller 22. Similar to the nip formation pad 24, the stay 25 extends in a longitudinal direction thereof parallel to the width direction of the fixing belt 21 and inside the loop of the fixing belt 21. In the present embodiment, the stay 25 is formed in a U-shaped cross section including a pair of side wall portions 25a and a connecting wall portion (or referred to as a bottom wall portion) 25b that couples the pair of side wall portions 25a. The pair of side wall portions 25a of the stay 25 supports both ends of the nip formation pad 24 in the belt rotation direction B. The side wall portions 25a extending in a pressure direction in which the pressing roller 22 presses the nip formation pad 24 that is a vertical direction in FIG. 2 strengthens the rigidity of the stay 25 in the pressure direction and reduces the bend of the nip formation pad 24 caused by the pressure force of the pressing roller 22. This results in a uniform width of the nip in the longitudinal direction. The stay 25 is preferably made of an iron-based metal such as SUS or SECC to secure its rigidity.

[0031] The reflector 26 is disposed opposite the halogen heater 23 inside the loop of the fixing belt 21 to reflect radiant heat that is infrared light emitted from the halogen heater 23 to the nip formation pad 24. In the present embodiment, the reflector 26 includes a reflector portion 26a formed as an ellipse cross-section and a pair of bent portions 26b bent from both ends of the reflector portion 26a in a direction in which the bent portions separate from each other in the belt rotation direction B. Each of the bent portions 26b is sandwiched by the nip formation portion 24a of the nip formation pad 24 and each of the side wall portions 25a of the stay 25 to hold the reflector 26.

[0032] An opening of an ellipse concave surface of the reflector portion 26a that opens toward the nip formation pad 24 causes the radiant heat from the halogen heater 23 to reflect to the nip formation pad 24. That is, the halogen heater 23 directly irradiates the nip formation pad 24 with the infrared light, and, additionally, the nip formation pad 24 is also irradiated with the infrared light reflected by the reflector portion 26a. Therefore, the nip formation pad 24 is effectively heated.

[0033] Since the reflector portion 26a is interposed between the halogen heater 23 and the stay 25, the reflector portion 26a has a function to block the infrared light from the halogen heater 23 to the stay 25. This function eliminates wasteful energy use to heat the stay 25. Additionally, in the present embodiment, thermal insulation of the air layer in a gap between the stay 25 and the reflector portion 26a blocks heat transfer to the stay 25.

[0034] The surface on the halogen heater 23 side of the reflector portion 26a of the reflector 26 is subjected to surface treatment such as mirror finishing to increase

the reflectance. In the present embodiment, the reflectance is measured using the spectrophotometer that is the ultraviolet visible infrared spectrophotometer UH4150 manufactured by Hitachi High-Tech Science Co., Ltd. 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 26 used in the present embodiment is preferably 70% or more in the wavelength of high emission intensity in the halogen heater 23 that is specifically the wavelength of 900 to 1600 nm and more preferably 70% or more in the wavelength of 1000 to 1300 nm.

[0035] Alternatively, the stay 25 may have the function of reflection and thermal insulation of the reflector 26. For example, performing the thermal insulation treatment or the mirror finishing on the inner surface of the stay 25 in the halogen heater 23 side enables the stay 25 to have the function of the reflector 26. In this case, the reflector 26 that is a separate part from the stay 25 can be removed. The reflectance of the stay 25 subjected to the mirror finishing is preferably equal to or higher than the reflectance of the reflector 26.

[0036] The guides 27 are disposed inside the loop of the fixing belt 21 to guide the rotating fixing belt 21. In the present embodiment, the guides 27 are disposed on both the upstream side and the downstream side of the nip N in the belt rotational direction B. The guide 27 includes an attachment portion 27a fixed to the stay 25 and a curved guide portion 27b in contact with the inner peripheral surface of the fixing belt 21. As illustrated in FIG. 3, the guide portion 27b includes a plurality of ribs 27c that are projections provided at equal intervals in the belt width direction on a guide surface of the guide portion 27b that is the surface of the guide portion 27b in the fixing belt 21 side. Guiding the fixing belt 21 along the guide surface having the plurality of ribs 27c enables smooth rotation of the fixing belt 21 without large deformation of the fixing belt 21.

[0037] The temperature sensors 28 are disposed outside the loop of the fixing belt 21 and detect temperatures of the fixing belt 21. In the present embodiment, the temperature sensors 28 are disposed at two positions, one is the central position of the fixing belt 21 in the belt width direction, and the other is one end position of the fixing belt 21 in the belt width direction. Output of the halogen heater 23 is controlled based on the temperature of the outer circumferential surface of the fixing belt 21 detected by the temperature sensor 28. Thus, the temperature of the fixing belt 21 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 such as a thermopile, a thermostat, a thermistor, a non-contact (NC) sensor.

[0038] As illustrated in FIG. 4, a pair of belt holder 30 is inserted into both lateral ends of the fixing belt 21 in the axial direction thereof, respectively, to rotatably support the fixing belt 21. As described above, the belt hold-

ers 30 inserted into the inner periphery of the fixing belt 21 support the fixing belt 21 in which no tension in the circumferential direction is basically applied when the fixing belt 21 does not rotate, that is, using a so-called free belt method.

[0039] As illustrated in FIGS. 3 to 5, the belt holder 30 includes a C-shaped supporter 30a inserted into the inner periphery of the fixing belt 21 to support the fixing belt 21 and a flange 30b that contacts an end face of the fixing belt 21 to stop a movement of the fixing belt 21 in the width direction that is a shift of the fixing belt 21 in the width direction. As illustrated in FIG. 6, the supporter 30a may have a cylindrical shape which is continuous over the entire circumference. As illustrated in FIG. 4, each of belt holders 30 is fixed on a pair of side plates 31 that are frames of the fixing device 5. The belt holder 30 has an opening 30c as illustrated in FIG. 5, and both ends of the halogen heater 23 and the stay 25 are fixed to the side plates 31 through the openings 30c. The halogen heater 23 and the stay 25 may be fixed to the belt holder 30.

[0040] By the way, when the sheet passes through the fixing device to fix the image on the sheet, fixing image mainly consumes the heat stored in a part corresponding to a sheet conveyance span in the nip formation pad, hereinafter referred to as the heat corresponding to the sheet conveyance span, among the heat stored in the nip formation pad. On the other hand, the heat stored in a part corresponding to outside the sheet conveyance span in the nip formation pad, hereinafter referred to as the heat outside the sheet conveyance span, is generally less likely to be consumed than the heat corresponding to the sheet conveyance span. The heat outside the sheet conveyance span is not used for the image fixing and merely dissipated. This is not preferable from the viewpoint of thermal energy efficiency. In addition, less heat consumption in the part corresponding to outside the sheet conveyance span in the nip formation pad causes an excessive temperature to rise in the part corresponding to outside the sheet conveyance span in the nip formation pad, particularly in continuous printing. Such excessive temperature rise can be reduced by slowing down a print speed or stopping fixing process, but this lowers productivity. Therefore, avoiding the temperature rise in the part corresponding to outside the sheet conveyance span is desired.

[0041] In view of the above-described circumstances, to actively use the heat outside the sheet conveyance span and avoid the excessive temperature rise, the fixing device according to the present embodiment has a configuration described below. Hereinafter, the configuration regarding the fixing device 5 according to the present embodiment to effectively use the heat and avoid the excessive temperature rise is described.

[0042] FIG. 7 is a top view of the nip formation pad 24 viewed from a halogen heater, and FIG. 8 is a perspective view illustrating a configuration of the nip formation pad 24 at one end in a longitudinal direction.

[0043] As illustrated in FIGS. 7 and 8, in the present embodiment, the nip formation pad 24 includes convex portions 33 having a plurality of slopes 24e that are inclined with respect to a light receiving surface 24d that is a heater-side surface of the nip formation portion 24a facing the heater (23). The plurality of slopes 24e are disposed on both end portions of the nip formation pad 24 in the longitudinal direction and in an area outside a maximum sheet conveyance span W. As illustrated in FIG. 7, the maximum sheet conveyance span W as a maximum recording medium conveyance span in the present embodiment means a span on the nip formation pad that is defined when the center of the largest sheet used in the image forming apparatus passes through a conveyance center M. The conveyance center M is the axis of symmetry of conveyance guide ribs 35 arranged in the sheet width direction and line symmetry in the fixing device. For example, when the largest sheet used in the image forming apparatus is A3 size (297 mm × 420 mm), the maximum sheet conveyance span W is the area of 148.5 mm from the conveyance center M to the left and right as illustrated in FIG. 7. Therefore, the slopes 24e are provided outside the area.

[0044] Each of the slopes 24e is inclined to face the center side of the fixing belt 21 in the belt width direction as illustrated by arrows C in FIGS. 7 and 8. Thus, as illustrated in FIG. 9, the slopes 24e inclined to face the center side of the fixing belt 21 in the belt width direction reflect the infrared light R emitted from the halogen heater 23 towards the center side of the fixing belt 21 in the belt width direction. That is, the slope 24e works as a reflection face 50 that reflects the infrared light R emitted from the halogen heater 23 towards the center side of the fixing belt 21 in the belt width direction. The reflected light is further reflected by the reflector 26 and is irradiated to the light receiving surface 24d on the center side of the nip formation pad 24 in the belt width direction with respect to the slope 24e of the nip formation pad 24. In particular, in the present embodiment, since the slopes 24e are disposed in the area outside the maximum sheet conveyance span W in the nip formation pad 24, the reflected light is irradiated to the area inside the maximum sheet conveyance span W in the nip formation pad 24.

[0045] As described above, according to the configuration of the present embodiment, a part of the infrared light (that is the radiant heat) radiated to the area outside the maximum sheet conveyance span W in the nip formation pad 24 is reflected by the slope 24e and irradiates the area inside the maximum sheet conveyance span W in the nip formation pad 24. This enables the reflected light to be used as the thermal energy for heating the area of the nip formation pad 24 inside the maximum sheet conveyance span W. That is, a part of the thermal energy was not effectively used until now but, in the present embodiment, can be used as the thermal energy for the fixing process. Using the part of the thermal energy that was not effectively used reduces the consumption of unnecessary thermal energy and improves the thermal

energy efficiency. Especially, in the fixing device 5 according to the present embodiment including the heat generation portion 23a of the halogen heater 23 longer than the maximum sheet conveyance span W, that is, when a heat length is longer than the maximum sheet conveyance span W, as illustrated in FIG. 9, the halogen heater 23 irradiates the area outside the maximum sheet conveyance span W in the nip formation pad with a large amount of infrared light. The slopes 24e reflect a part of the infrared light to the center side of the nip formation pad in the belt width direction. The part of the infrared light is effectively used as the thermal energy to heat the area inside the maximum sheet conveyance span W in the nip formation pad. As a result, the thermal energy efficiency is improved.

[0046] In addition, the reflection of the infrared light by the slopes 24e reduces the heat absorbed by the area outside the sheet conveyance span W in the nip formation pad 24. This reduces the excessive temperature rise in the area outside the maximum sheet conveyance span W in the nip formation pad 24 during continuous printing and a possibility of failure of the fixing device and maintains productivity, that is, a fixing speed.

[0047] Additionally, in the present embodiment, to improve the thermal energy efficiency, an area inside the maximum sheet conveyance span W on the light receiving surface 24d of the nip formation pad 24 is painted in black as illustrated in FIG. 7. On the other hand, the slopes 24e and an area outside the maximum sheet conveyance span W on the light receiving surface 24d are not painted in black and have glossy surfaces that are metal surfaces. As a result, since the reflectance of the area outside the maximum sheet conveyance span W on the light receiving surface 24d becomes larger than the reflectance of the area inside the maximum sheet conveyance span W on the light receiving surface 24d, heat absorption in the area outside the maximum sheet conveyance span on the nip formation pad 24 reduces, and, in contrast, heat absorption in the area inside the maximum sheet conveyance span W on the nip formation pad 24 increases.

[0048] In addition, coating fine particles that may be a black paint by using a coating method such as spray may set surface roughness of the area inside the maximum sheet conveyance span W on the light receiving surface 24d of the nip formation pad 24 to be larger than surface roughness of the area outside the maximum sheet conveyance span W on the light receiving surface 24d of the nip formation pad 24. Coating fine particles also improves the thermal energy efficiency because the heat absorptivity of the area inside the maximum sheet conveyance span W on the light receiving surface 24d becomes larger than that of the area outside the maximum sheet conveyance span W on the light receiving surface 24d. To increase the heat absorptivity of the area inside the maximum sheet conveyance span W on the light receiving surface 24d, the surface roughness Ra is preferably set, for example, 0.5 μm or more. The surface roughness Ra

is an arithmetic mean roughness and can be measured, for example, using a surface roughness measuring device manufactured by Mitutoyo Corporation.

[0049] As illustrated in FIG. 7, when the slopes 24e are arranged in a symmetrical pattern with respect to the center in the width direction of the sheet passing through the nip N that is the conveyance center M of the sheet, or with respect to the center in the width direction of the fixing belt 21, and when the slopes 24e are arranged substantially in parallel along the longitudinal direction of the nip formation pad 24, placing any one of both end portions extending in the longitudinal direction of the nip formation pad 24 on upstream side or downstream side in a sheet conveyance direction results in the same arrangement of the slopes 24e. That is, since assembling the nip formation pad 24 into the fixing device does not need to consider how to place the upstream end and the downstream end of the nip formation pad 24 in the sheet conveying direction, the above-described arrangement improves assembly efficiency about the nip formation pad 24.

[0050] Although the slopes 24e may be configured separately from the nip formation pad 24, making the slopes 24e and the nip formation pad 24 as one component is desirable from the viewpoint of manufacturing cost. Therefore, in the present embodiment, the slopes 24e and the nip formation pad 24 are made from the same material by drawing process using a press. When forming the slope 24e by drawing process, it is desirable to set a depth T of drawing process that is a height T of the slope 24e illustrated in FIG. 9 to about 0.5 mm to 2 mm. Changing a length L of the drawing process that is a length L in the belt width direction of the slope 24e illustrated in FIG. 9 under the constant depth T of drawing process allows appropriately adjusting the inclination angle θ of the slope 24e.

[0051] For example, as in the example illustrated in FIG. 10, adjusting the inclination angle θ_1 of the slope 24e disposed on the outer side that is a left side in FIG. 10 in the belt width direction larger than the inclination angle θ_2 of the slope 24e disposed on the inner side that is a right side in FIG. 10 causes the infrared light R to reflect toward the area inside the maximum sheet conveyance span W on the nip formation pad.

[0052] As illustrated in FIGS. 9 and 10, the drawing process forms the slopes 24e to project from the light receiving surface 24d of the nip formation pad 24 and forms recesses 24f on the nip formation surface 24c that is the back side of the surface on which the slopes 24e are formed. Storing the lubricant such as grease in the recesses 24f can interpose the lubricant between the nip formation pad 24 and the fixing belt 21 for a long time, which lengthens the life of the fixing belt 21 and the nip formation pad 24 and a maintenance cycle.

[0053] Additionally, as in the example illustrated in FIG. 11, the longitudinal direction of the recess 24f may be inclined toward the downstream side in the belt rotation direction B so that a portion of the recesses 24f down-

stream side is toward the central portion of the nip formation pad 24 in the belt width direction. In this case, rotations of the fixing belt 21 moves the lubricant contained in the recesses 24f in directions of arrows D in FIG. 11 along the longitudinal direction of the recess 24f. This results in supplying the lubricant toward the central portion of the fixing belt in the belt width direction. That is, since this prevents the lubricant from flowing out of the fixing belt 21 in the belt width direction, the lubricant can be interposed between the nip formation pad 24 and the fixing belt 21 for a long time.

[0054] Additionally, as illustrated in FIG. 7, when the plurality of slopes 24e is close to each other, a shape between slopes 24e next to each other is preferably a flat surface 24g and not the slope 24e. This forms flat surfaces 24h between the recesses 24f on the back sides of the slopes 24e as illustrated in FIG. 9. The flat surfaces 24h can support the fixing belt 21 sliding thereon. Supporting the fixing belt 21 on the flat surface 24h avoids large deformation of the fixing belt 21 at the recesses 24f and prevents the fixing belt 21 from buckling failure (e.g., kink).

[0055] Additionally, as illustrated in FIG. 12, slopes 24e disposed inside the inner end portions 300 of the belt holders 30 in the belt width direction can prevent the belt holder 30 from being irradiated with the infrared light. That is, since a part of the infrared light emitted from the halogen heater 23 is reflected to inside from the belt holder 30 in the belt width direction by the slopes 24e, an amount of the reflected light irradiated to the belt holder 30 reduces. This prevents the belt holder 30 from being heated and deforming by heat.

[0056] As illustrated in FIG. 12, when the heater is the halogen heater 23 having the sealing portions 39 at both end portions in the longitudinal direction, slopes 24e are preferably disposed inside inner end portions 390 of the sealing portions 39 in the belt width direction.

[0057] The configuration of the halogen heater 23 is described below. As illustrated in FIG. 12, the halogen heater 23 includes a cylindrical glass tube 40 made of quartz glass or the like, a filament 41 as a heat generator accommodated in the glass tube 40, thin metal foils 42 made of molybdenum or the like, inner leads 43, and outer leads 44.

[0058] The filament 41 includes coils made of a metal wire such as a tungsten wire and is accommodated in the glass tube 40 along the longitudinal direction. The glass tube 40 is filled with an inert gas such as a halogen gas. At both ends in the longitudinal direction of the glass tube 40, sealing portions 39 are formed that are flattened to prevent the internal gas from leaking out. Each sealing portion 39 accommodates a metal foil 42. Metal foils 42 are connected to both ends of the filament 41 via the inner leads 43. Additionally, the outer lead 44 is connected to the metal foil 42 at the side opposite to the side where the inner lead 43 is connected. A part of the outer lead 44 is out of the sealing portion 39 and connected to a power supply via a terminal such as a metal plate 45

or a harness. Since the filament 41 is connected to the power supply via the outer lead 44, the metal foil 42, and the inner lead 43, power supplied from the power supply causes the filament 41 to heat and emit infrared light.

[0059] The glass tube 40 used for the halogen heater 23 is generally made of a heat-resistant material, but high temperature may cause a crack such as a micro crack in the sealing portion 39 because of its structure. That is, the filament 41 generates heat, and the sealing portion becomes high temperature. The high temperature oxidizes the metal foil 42 and causes the metal foil 42 to expand in volume. The volumetric expansion of the metal foil 42 generates a force to expand the sealing portion 39 from the inside. The force may cause the crack in the sealing portion 39.

[0060] Therefore, as illustrated in FIG. 12, the slopes 24e are preferably disposed inside inner end portions 390 of the sealing portions 39 in the belt width direction. This structure reduces the amount of the reflected light irradiated to the sealing portion 39, which reduces occurrence of the crack and deterioration that are caused by the high temperature in the sealing portion 39.

[0061] FIGS. 13 (a) to 13 (d) are diagrams illustrating comparison of positional relations between positions of recesses 24f and axial end positions of a roller portion of the pressing roller 22 that is a portion having the elastic layer. In the following descriptions about the positional relation, "outside" means the end side of the nip formation pad 24 in the longitudinal direction and the end side of the pressing roller 22 in the axial direction, and "inside" means the side of the center of the nip formation pad 24 in the longitudinal direction and the side of the center of the pressing roller 22 in the axial direction. The "axial direction" means the width direction of the fixing belt 21 in the fixing device, the longitudinal direction of the pressing roller 22 in the fixing device, and a direction indicated by an arrow Z in FIG. 13.

[0062] In an example illustrated in FIG. 13 (a), both ends 220 of the roller portion of the pressing roller 22 are disposed outside the outer ends G1 of the outer recesses 24f1. In an example illustrated in FIG. 13 (b), both ends 220 of the roller portion of the pressing roller 22 are disposed inside the outer ends G1 of the outer recesses 24f1 and outside the inner ends G2 of the outer recesses 24f1. In an example illustrated in FIG. 13 (c), both ends 220 of the roller portion of the pressing roller 22 are disposed inside the inner ends G2 of the outer recesses 24f1 and outside the outer ends G3 of the inner recesses 24f2. In an example illustrated in FIG. 13 (d), both ends 220 of the roller portion of the pressing roller 22 are disposed inside the outer ends G3 of the inner recesses 24f2 and outside the inner ends G4 of the inner recesses 24f2.

[0063] In examples illustrated in FIG. 13, both ends 220 of the roller portion of the pressing roller 22 are disposed opposite a part of the outer recesses 24f1 or the inner recesses 24f2, or outside the inner ends G2 of the outer recesses 24f1 or the inner ends G4 of the inner

recesses 24f2. That is, in any of the examples, the roller portion of the pressing roller 22 is disposed to face (overlap) with at least a part of each recess 24f. The above-described positional relations prevent the lubricant from flowing out of the recess 24f facing the roller portion of the pressing roller 22 and, therefore, improve a function to hold the lubricant in the recess 24f.

[0064] The function to hold the lubricant in the recess 24f is further improved as the total area of the roller portion of the pressing roller 22 facing the recess 24f increases. In each of the examples illustrated in FIG. 13, the sum of the area of the roller portion facing the recesses 24f is the largest in the example illustrated in FIG. 13 (a) and becomes gradually smaller in the order of the examples illustrated in FIGS. 13 (b), 13 (c), and 13 (d). Therefore, the function to hold the lubricant in the recess 24f is the largest in the example illustrated in FIG. 13 (a) and becomes gradually smaller in the order of the examples illustrated in FIGS. 13 (b), 13 (c), and 13 (d).

[0065] The present disclosure is not limited to the details of the embodiments described above and various modifications and improvements are possible.

[0066] Although the four slopes 24e are each provided in the both end portions of the nip formation pad 24 in the above-described embodiments, a number of the slopes 24e may be changed suitably. One slope 24e may be provided on each end of the nip formation pad 24, or four or more slopes 24e may be provided on each end of the nip formation pad 24. The slope 24e may be an inclined curved surface, as well as the inclined plane surface in the above-described embodiment. In addition, the slope 24e may be provided in the area inside the maximum sheet conveyance span W on the nip formation pad 24.

[0067] As in the example illustrated in FIG. 14, a number of slopes 24e may be increased, and the slope 24e may be made smaller than the slope 24e in the example illustrated in FIG. 8. When a large number of small slopes 24e are provided as described above, the number of the slopes 24e is not particularly limited as long as the distance J between valleys (the most concave parts) of the recesses 24f adjacent to each other illustrated in FIG. 15 is 1 mm or more.

[0068] Instead of the above-described slope 24e, the nip formation pad 24 may include a cylindrical convex portion 33 as illustrated in FIG. 16, a hemispherical convex portion 33 as illustrated in FIG. 17, or a cylindrical and hemispherical convex portion 33 as illustrated in FIG. 18. The surface of the convex portion 33 may not be subject to the mirror finishing. By the surface of the convex portion 33 disposed as described above, a part of the infrared light emitted from the halogen heater 23 can be reflected toward the center side of the fixing belt 21 in the belt width direction. That is, similar to the above-described convex portion 33 as illustrated in FIG. 8, each of the convex portions 33 illustrated in FIGS. 16 to 18 has the reflection face 50 that reflects light or heat from the halogen heater 23 toward the center side of the fixing

belt 21 in the belt width direction. The hemispherical surface of the convex portion 33 as illustrated in FIGS. 17 and 18 has the slope 24e inclined with respect to the light receiving surface 24d of the nip formation pad 24.

[0069] Therefore, the present embodiment discloses the configuration of the fixing device including the fixing member, the opposed rotator disposed opposite the outer surface of the fixing member, the heater disposed inside the loop of the fixing member and heating the fixing member by the radiant heat, and the nip formation pad disposed inside the loop of the fixing member, and the nip formation pad sandwiches the fixing member with the opposed rotator to form the fixing nip and has the reflection surface that reflects the radiant heat toward the center in the width direction of the fixing member. The nip formation pad has the reflection surface on the heater side.

[0070] The fixing device to which the present disclosure is applied is not limited to the fixing device 5 as illustrated in FIG. 2. For example, the present disclosure may be applied to the fixing devices illustrated in FIGS. 19 to 28. The configurations of fixing devices illustrated in FIGS. 19 to 28 are described below. Description of identical components of the fixing device 5 illustrated in FIG. 2 is omitted.

[0071] In the fixing device 5 illustrated in FIG. 19, the connecting wall portion 25b of the stay 25 is removed from the fixing device 5 illustrated in FIG. 2, and two flat stays 25 corresponding to the side wall portions 25a are provided. The stays 25 are disposed in parallel with each other with the halogen heater 23 interposed therebetween. Removing the connecting wall portion 25b of the stay 25 as described above opens the upper side of the halogen heater 23 that is the side opposite to the nip N, and, through the opening, the halogen heater 23 can directly irradiate the fixing belt 21 with the infrared light.

[0072] In addition, as illustrated in FIG. 19, the reflector 26 is attached to each of the stays 25. The reflector 26 is formed into a convex-curved surface closest to the halogen heater 23 at a position facing the halogen heater 23. The reflectors 26 formed such the convex-curved surfaces reflect the infrared light emitted from the halogen heater 23 in various directions. Since the infrared light reflected by the reflectors 26 formed the convex-curved surfaces reaches the nip formation pad 24 or the fixing belt 21 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 26 formed the convex-curved surfaces can effectively heats the nip formation pad 24 or the fixing belt 21. Additionally, also in the example illustrated in FIG. 19, the air layer in the gap between the stay 25 and the reflector 26 blocks heat transfer to the stay 25. This can reduce wasteful heat energy consumption.

[0073] As described above, the infrared light reflected by the reflectors 26 formed the convex-curved surfaces reaches the nip formation pad 24 and the fixing belt 21

with a smaller number of reflections. However, among the infrared light emitted from the halogen heater 23, the infrared light emitted in the horizontal direction that is a lateral direction in FIG. 19 is incident at an angle close to the orthogonal direction to the reflection surface of the reflector 26 and tends to have a greater number of reflections than infrared light emitted in other directions. Therefore, the infrared light emitted in the horizontal direction is attenuated more when reaching the fixing belt 21 or the nip formation pad 24.

[0074] To avoid such attenuation of the infrared light, as illustrated in FIG. 20, each of the reflectors 26 and the stays 25 may have through holes 26c and 25c in portions near the halogen heater 23 of each of the reflectors 26 and the stays 25, respectively, so that the infrared light emitted in the horizontal direction pass through the through holes 26c and 25c. Since the fixing belt 21 is directly irradiated with the infrared light emitted in the horizontal direction, there is no attenuation by reflection, and the heating efficiency is improved.

[0075] As illustrated in FIG. 20, preferably, a diameter (or a width) d1 of the through hole 25c in the stay 25 is set larger than a diameter (or width) d2 of the through hole 26c in the reflector 26. The infrared light emitted from the halogen heater 23 spreads as the distance from the halogen heater 23 increases. Therefore, the diameter d1 of the through hole 25c of the stay 25 smaller than or equal to the diameter d2 of the through hole 26c of the reflector 26 causes irradiation to the edge of the through hole 25c of the stay 25 with the infrared light that results in wasteful heat energy supply to the stay 25. Therefore, making the diameter d1 of the through hole 25c of the stay 25 larger than the diameter d2 of the through hole 26c of the reflector 26 can avoid the irradiation to the stay 25 with the infrared light and reduce the wasteful heat energy consumption.

[0076] The through holes 26c and 25c disposed in the reflector 26 and the stay 25 may be, for example, elliptical as illustrated in FIG. 21. Since the pressing roller 22 presses the reflector 26 and the stay 25 in the direction of arrow E in FIG. 21, forming the through holes 26c and 25c largely in the pressing direction E is not preferable from the viewpoint of securing the strength of the reflector 26 and the stay 25 with respect to the pressing direction E. Therefore, as illustrated in FIG. 21, the elliptical through holes 26c and 25c is preferably formed such that the major axis thereof that is the longitudinal direction thereof intersects the pressing direction E.

[0077] The through holes 26c and 25c may be formed in a rectangular shape. However, as illustrated in FIG. 22, the rectangular through holes 26c and 25c secured the same opening widths as the elliptical through holes 26c and 25c have larger opening widths at the longitudinal end of the through holes 26c and 25c in the pressing direction E of the through holes 26c and 25c, that is, $h1 > h2$. Therefore, the ellipse is more preferable than the rectangular to secure the strength and the opening width to some extent.

[0078] FIG. 23 is a cross-sectional view of the reflectors 26, the stays 25, and the halogen heater 23 as viewed from above or below in FIG. 20.

[0079] As illustrated in FIG. 23, preferably, two pairs of the through holes 26c and 25c facing each other across the halogen heater 23 are provided at mutually offset positions in the belt width direction that is a vertical direction in FIG. 23. Offsetting the right pair of through holes 26c and 25c and the left pair of through holes 26c and 25c as illustrated in FIG. 23 prevents an area on the fixing belt 21 irradiated with the infrared light through the one pair of the through holes 26c and 25c and the other area on the fixing belt 21 irradiated with the infrared light through the other pair of the through holes 26c and 25c from overlapping in the belt width direction. This eliminates or reduces an area on the fixing belt 21 that is not directly irradiated with the infrared light in the belt width direction, and the fixing belt 21 can be heated substantially uniformly, which prevents fixing defects due to uneven temperature distribution on the fixing belt 21 from occurring.

[0080] Alternatively, as in the fixing device 5 illustrated in FIG. 24, the two stays 25 may be arranged not to be parallel to each other but to be inclined so that the distance between the two plates spreads upward from the halogen heater 23, that is, extends from the nip N to the opposite side. Arranging the stay 25 as described above can secure an area that the halogen heater 23 directly irradiates the fixing belt 21 with the infrared light, which is the area on an upper side in FIG 24, larger than an area that the halogen heater 23 directly irradiates the nip formation pad 24 with the infrared light, which is the area on a lower side in FIG 24. This increases the thermal energy directly applied to the fixing belt 21 and improves the thermal responsiveness of the fixing belt 21 to the halogen heater 23.

[0081] Additionally, as illustrated in FIG. 24, since the distance between the two stays 25 on the side of the nip formation pad 24 becomes narrow, the width X of the nip formation pad 24 in the belt rotation direction B can be reduced. This increases the rigidity of the nip formation pad 24 with respect to the pressure applied by the pressing roller 22 and effectively reduces the bending of the nip formation pad 24. This can also downsize the fixing device 5.

[0082] Alternatively, as in the fixing device 5 illustrated in FIG. 25, two halogen heaters 23 may be arranged in the vertical direction. These halogen heaters 23 may have different heating areas. For example, one halogen heater 23 may heat a central portion of the fixing belt 21 in the belt width direction, and the other halogen heater 23 may heat end portions of the fixing belt 21 in the belt width direction. The upper halogen heater 23 may be used mainly for directly heating the fixing belt 21, and the lower halogen heater 23 may be used mainly for heating the nip formation pad 24.

[0083] Alternatively, as illustrated in FIG. 26, the above-described pair of stays 25 may be made as one

component. That is, the stay 25 illustrated in FIG. 26 includes a pair of side wall portions 25a and a connecting wall portion 25b that couples ends of the pair of side wall portions 25a. The above-described stay 25 configured as one component does not need to set and position each of the two stays 25, which improves ease of assembling and maintenance. An opening 25d is formed between one end of the connecting wall portion 25b and the other end of the connecting wall portion 25b, and the halogen heater 23 can emit the infrared light through the opening 25d. To secure a sufficient irradiation width of infrared light, the width Y of the opening 25d is preferably larger than the maximum sheet conveyance span W.

[0084] The stay 25 illustrated in FIG. 26 may be set, for example, as illustrated in FIGS. 27 and 28.

[0085] In the example illustrated in FIG. 27, the opening 25d of the stay 25 is directed upward and on the side opposite to the nip N. On the other hand, in the example illustrated in FIG. 28, the opening 25d of the stay 25 is directed downward and on the nip N side. In both examples, the halogen heater 23 can directly irradiate both the fixing belt 21 and the nip formation pad 24 with infrared light.

The fixing device according to the present disclosure is not limited to the fixing device 5 that conveys the sheet in the horizontal direction as illustrated in FIG. 1. The location and construction of the fixing device 5 may be appropriately changed. For example, the present disclosure may be applicable to the fixing device 5 as illustrated in FIG. 29 that conveys the sheet in the vertical direction.

[0086] 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 member (21);
- an opposed rotator (22) disposed opposite an outer surface of the fixing member (21);
- a heater (23) disposed inside a loop of the fixing member (21) to heat the fixing member (21) by radiant heat; and
- a nip formation pad (24) disposed inside the loop of the fixing member (21) to sandwich the fixing member (21) with the opposed rotator (22) to

- form a nip, the nip formation pad (24) including a slope (24e) that inclines toward a center of the fixing member (21) in a width direction of the fixing member (21) and is disposed on a heater-side surface (24d) of the nip formation pad (24) facing the heater (23). 5
2. The fixing device (5) according to claim 1, wherein the slope (24e) is disposed in an area outside a maximum recording medium conveyance span on the heater-side surface of the nip formation pad (24). 10
 3. The fixing device (5) according to claim 2, wherein a reflectance of the area outside the maximum recording medium conveyance span on the heater-side surface (24d) on the nip formation pad (24) is larger than a reflectance of an area inside the maximum recording medium conveyance span on the heater-side surface (24d) on the nip formation pad (24). 15 20
 4. The fixing device (5) according to claim 2 or 3, wherein a surface roughness of an area inside the maximum recording medium conveyance span on the heater-side surface (24d) on the nip formation pad (24) is larger than a surface roughness of the area outside the maximum recording medium conveyance span on the heater-side surface (24d) on the nip formation pad (24). 25 30
 5. The fixing device (5) according to claim 4, wherein the surface roughness of the area inside the maximum recording medium conveyance span on the heater-side surface (24d) on the nip formation pad (24) satisfies an arithmetic mean roughness Ra of 0.5 μm or more. 35
 6. The fixing device (5) according to any one of claims 1 to 5, wherein the nip formation pad includes a recess (24f) on a back side of the slope (24e). 40
 7. The fixing device (5) according to claim 6, further comprising lubricant in the recess (24f). 45
 8. The fixing device (5) according to claim 6 or 7, wherein the nip formation pad (24) includes:
 - a plurality of slopes (24e) including the slope (24e); 50
 - a plurality of recesses (24f), including the recess (24f), on back sides of the plurality of slopes (24e); and
 - a flat surface (24h) between the plurality of recesses (24f). 55
 9. The fixing device (5) according to any one of claims 1 to 8, wherein the nip formation pad (24) includes a plurality of slopes (24e) including the slope (24e) and disposed symmetrically with respect to a center in a width direction of a recording medium passing through the nip.
 10. The fixing device (5) according to claim 7, wherein a part of the recess (24f) faces an end (220) of the opposed rotator (22).
 11. The fixing device (5) according to claim 7, wherein an end (220) of the opposed rotator (22) is outside an end of the recess (24f) in an axial direction of the opposed rotator.
 12. The fixing device (5) according to claim 7, wherein a longitudinal direction of the recess (24f) is inclined toward the center of the fixing member (21) in the width direction of the fixing member (21) and a downstream side in a direction of rotation of the fixing member (21).
 13. An image forming apparatus (1) comprising:
 - an image forming device (2) to form an image on a recording medium; and
 - a fixing device (5) according to any one of claims 1 to 12 to fix an image formed by the image forming device (2) onto the recording medium.

FIG. 1

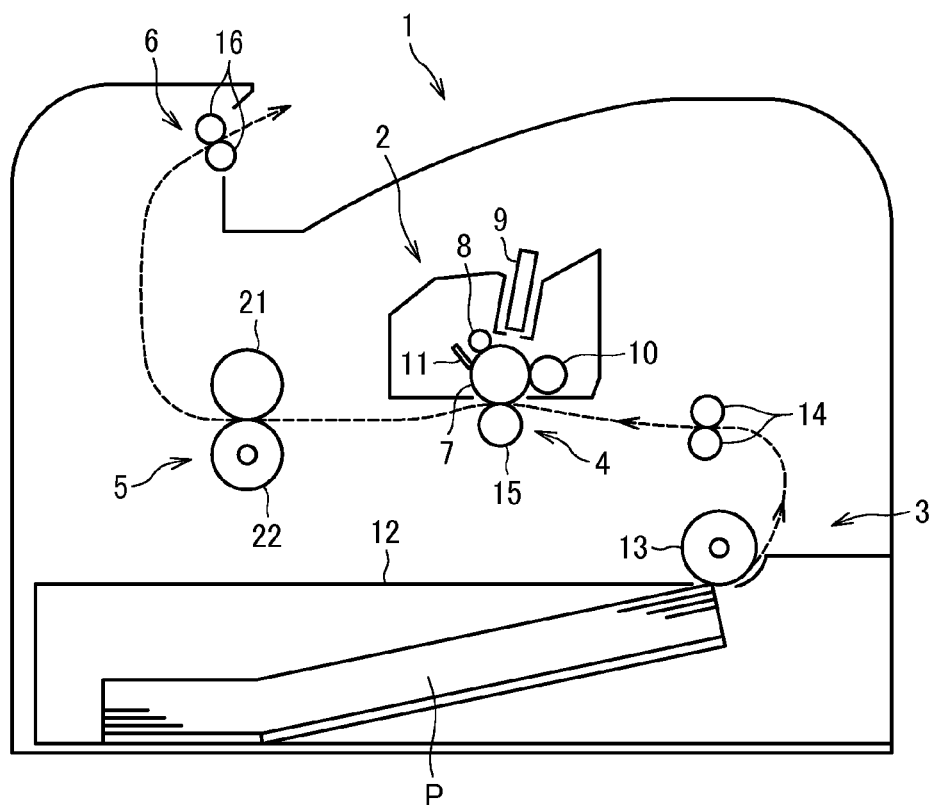


FIG. 2

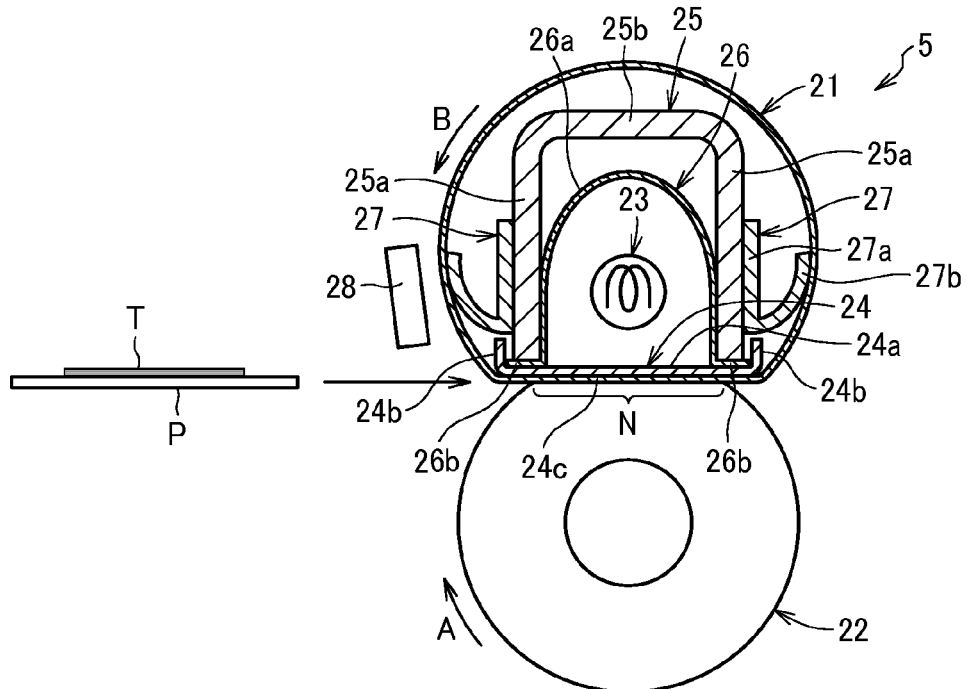


FIG. 3

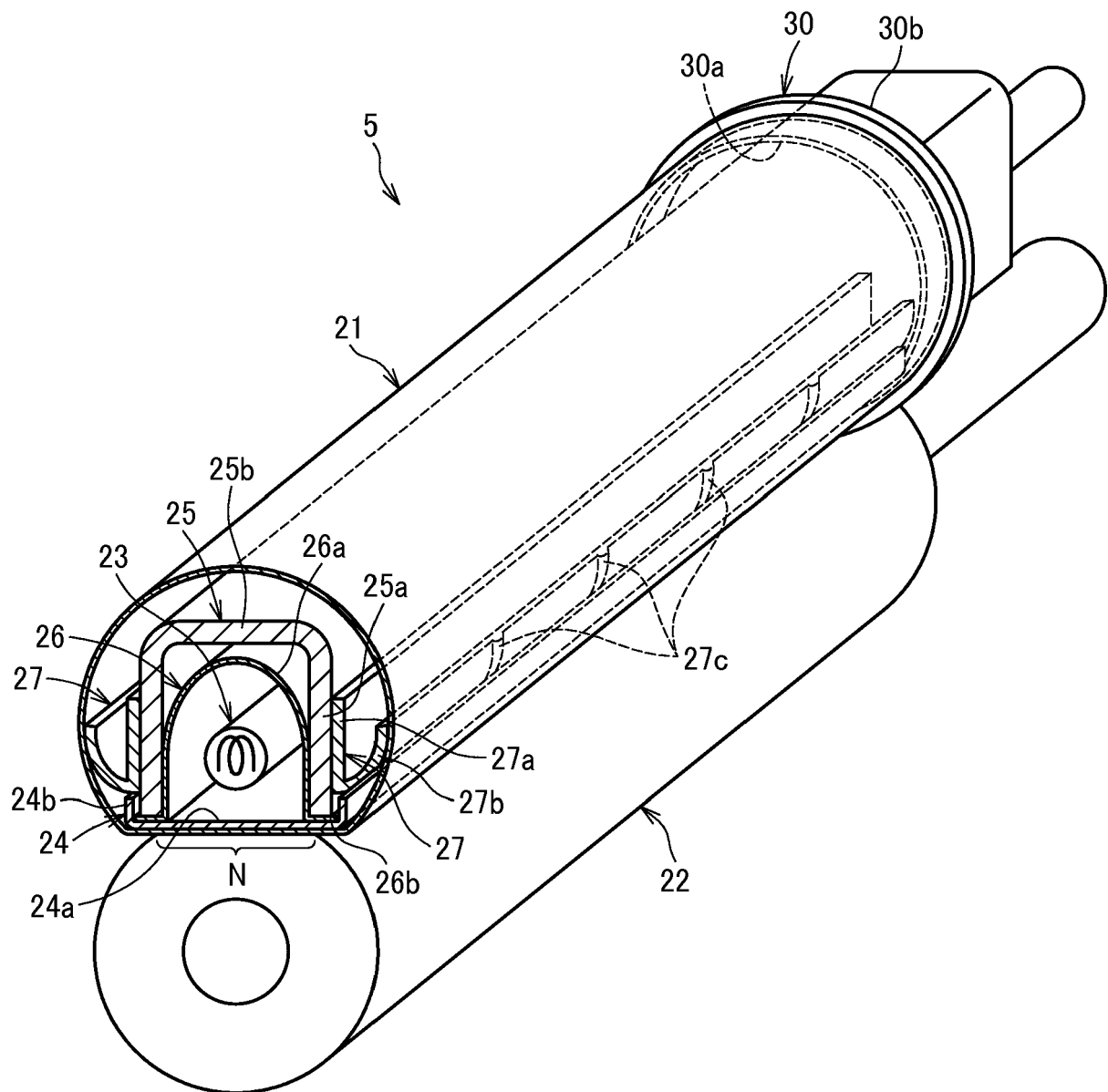


FIG. 4

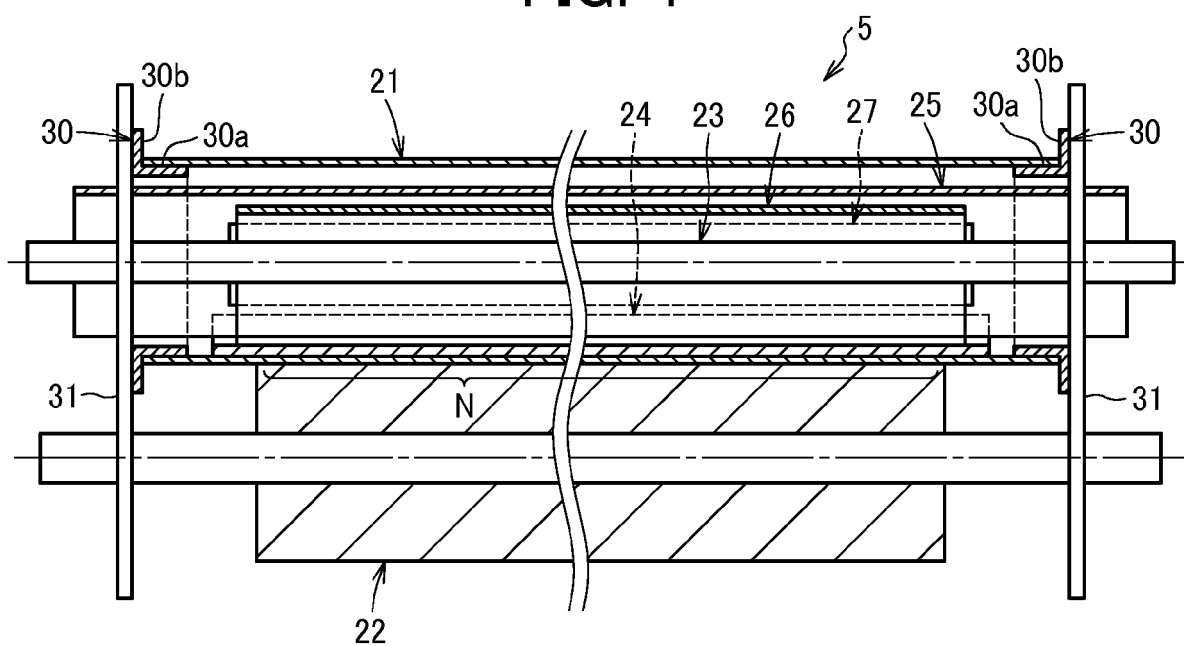


FIG. 5

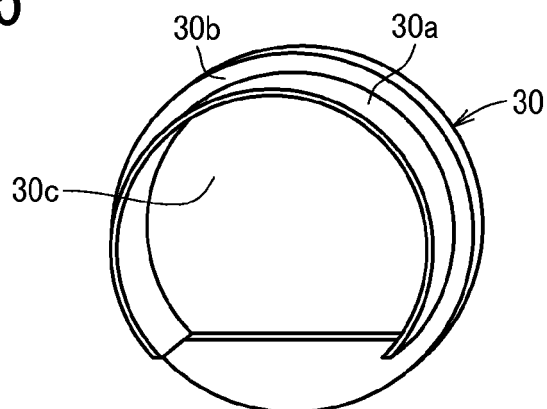


FIG. 6

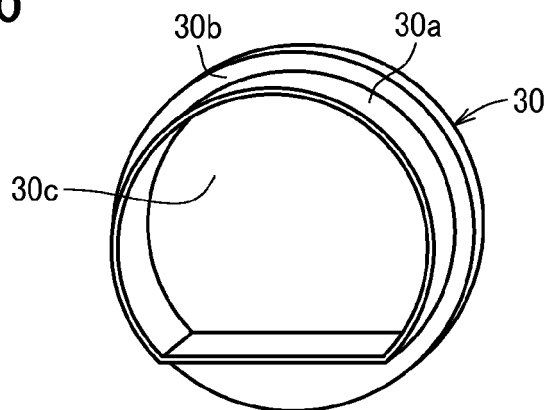


FIG. 7

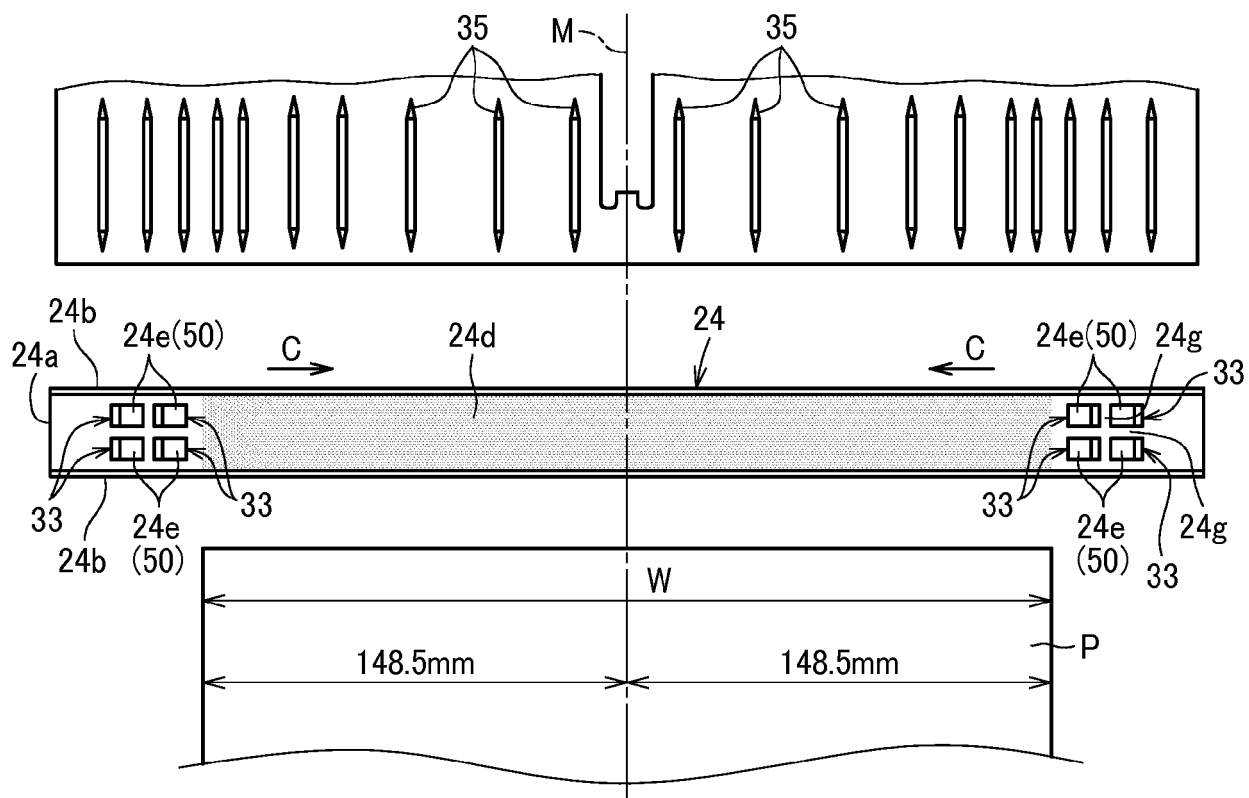


FIG. 8

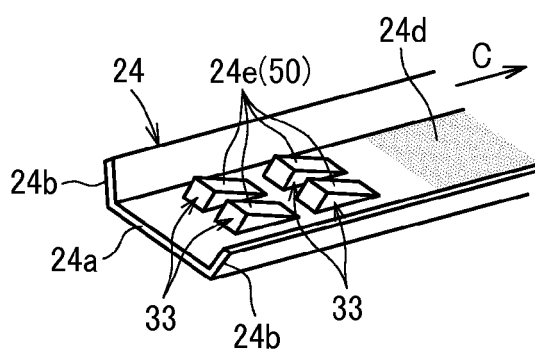


FIG. 9

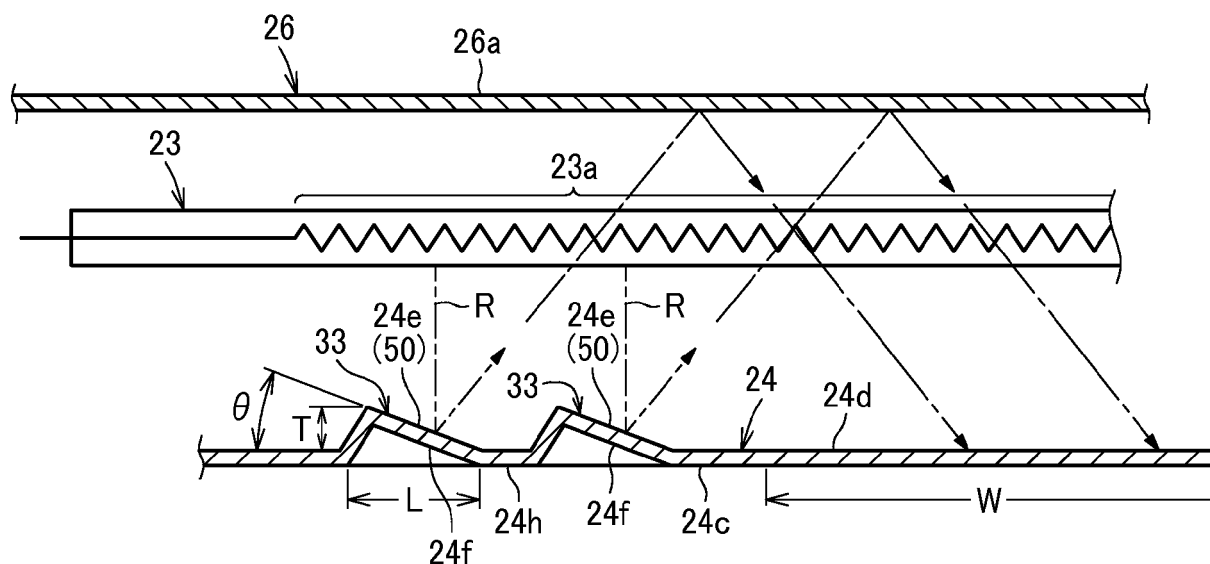


FIG. 10

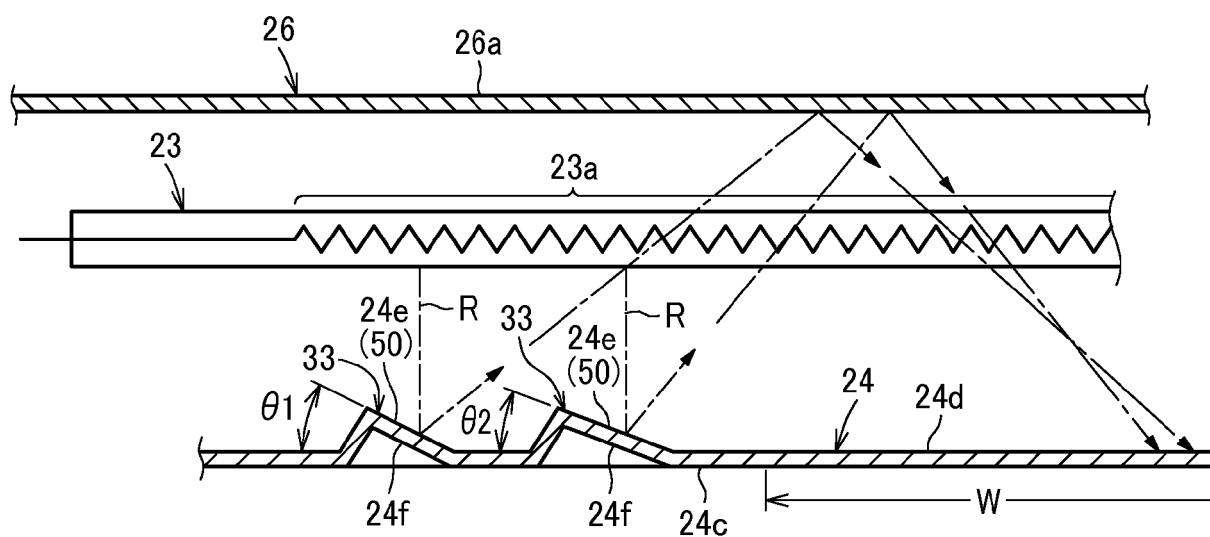


FIG. 11

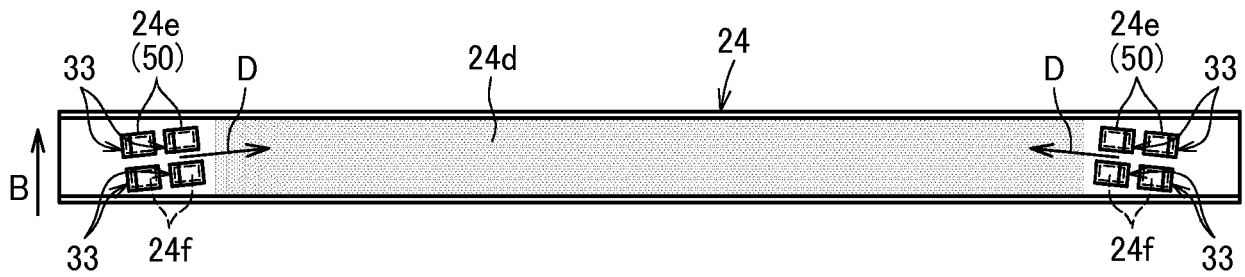


FIG. 12

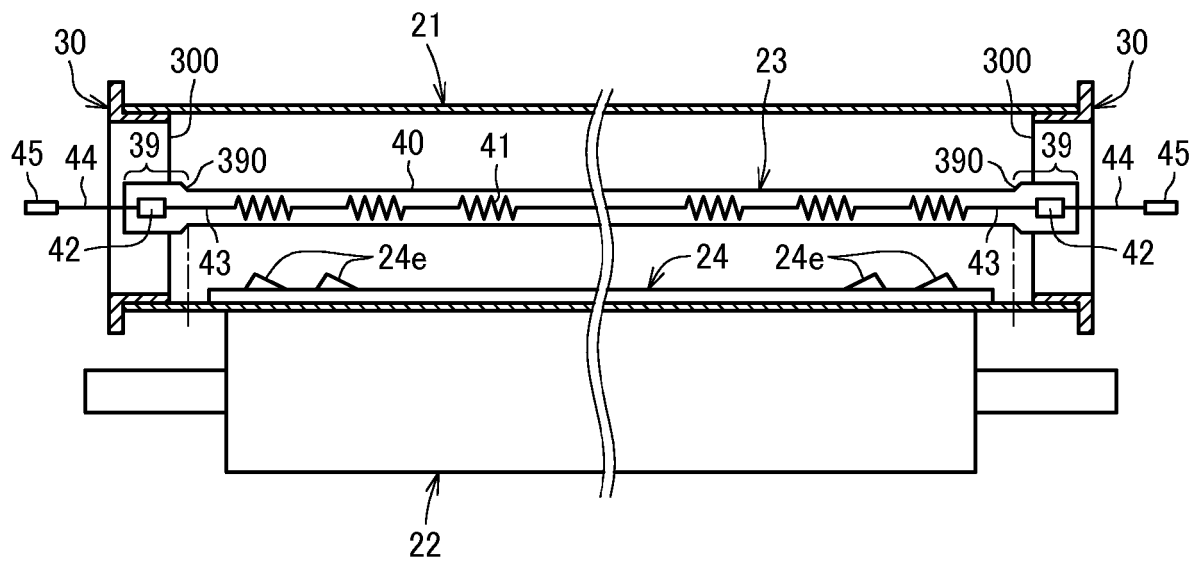


FIG. 13

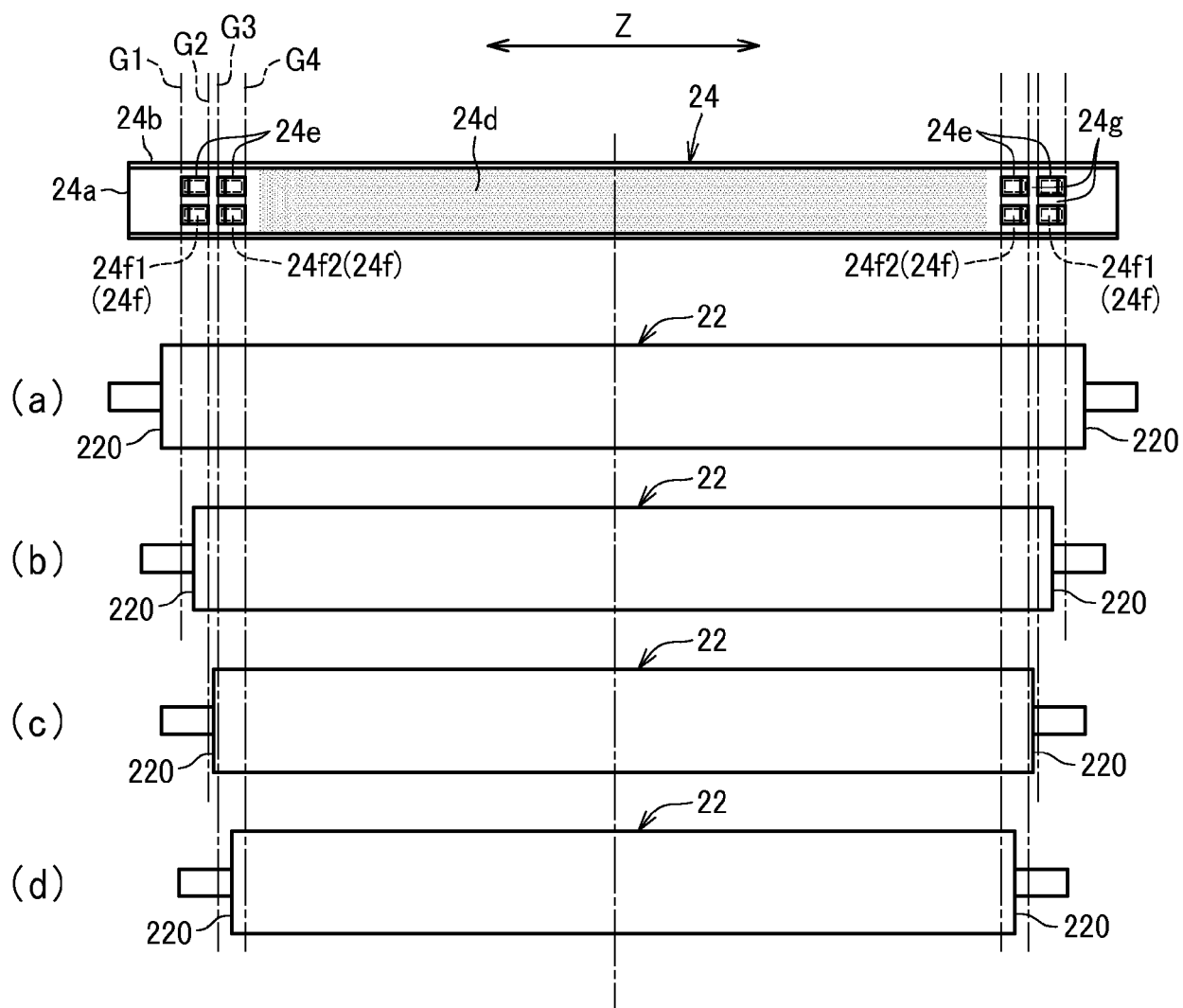


FIG. 14

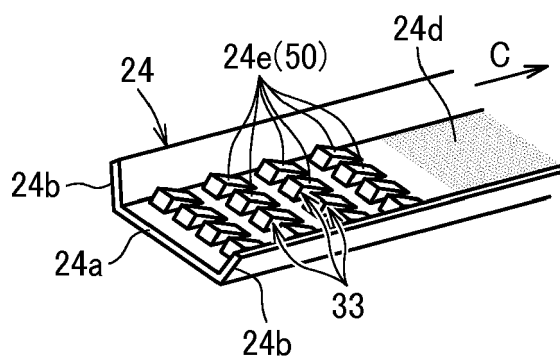


FIG. 15

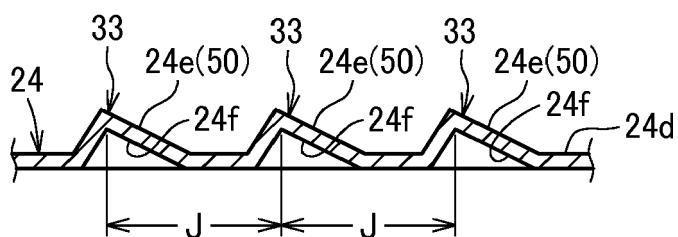


FIG. 16

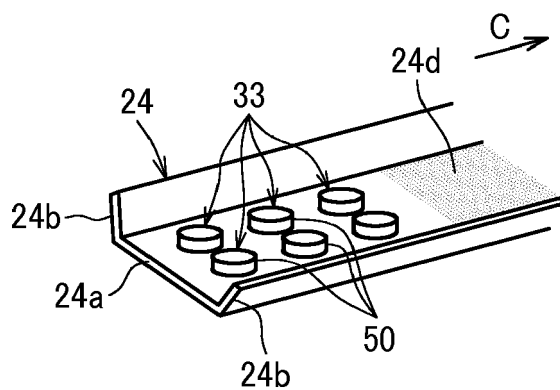


FIG. 17

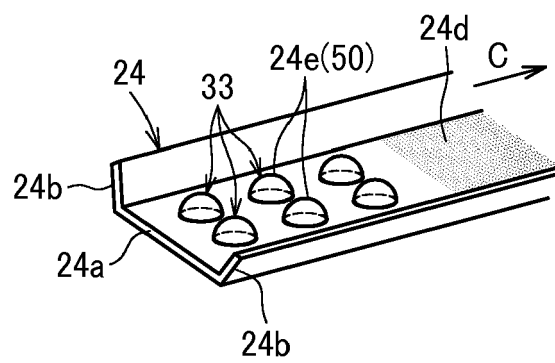


FIG. 18

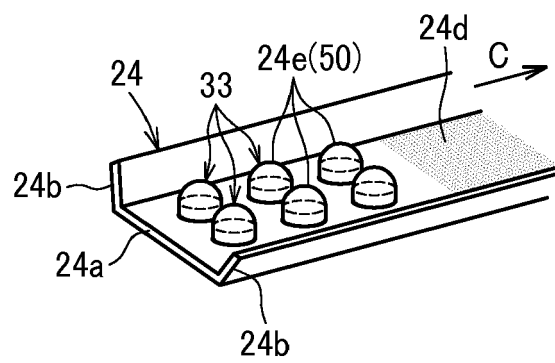


FIG. 19

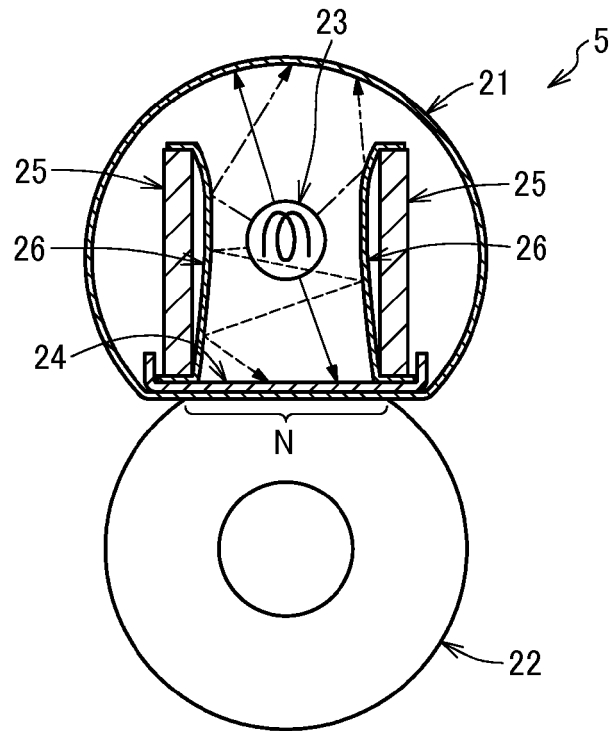


FIG. 20

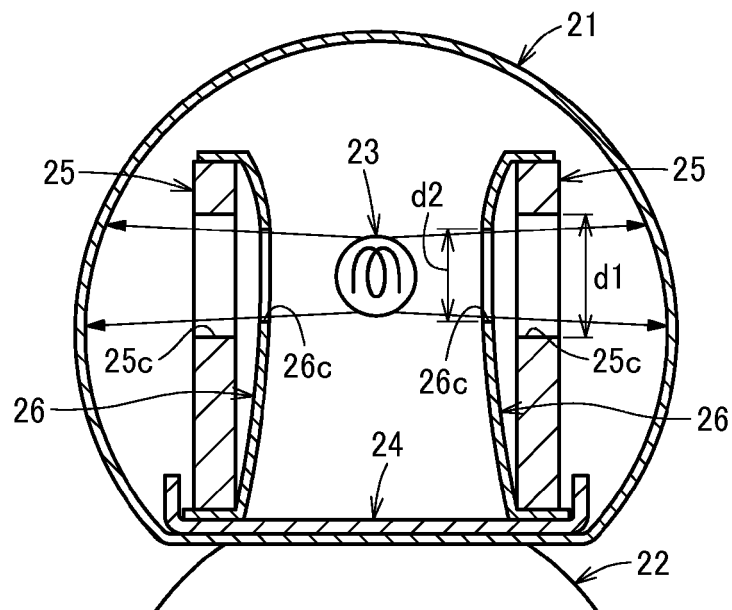


FIG. 21

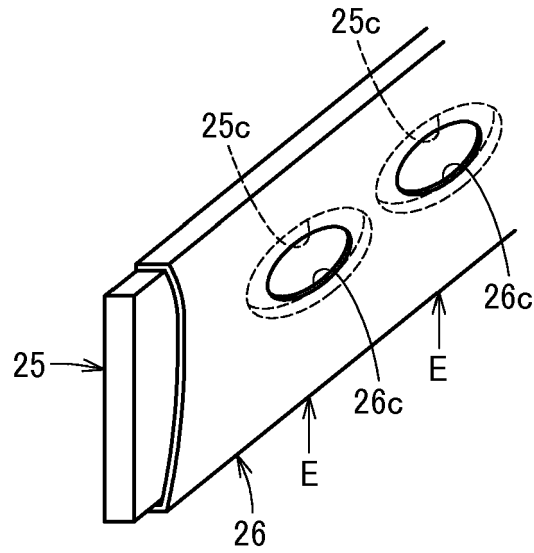


FIG. 22

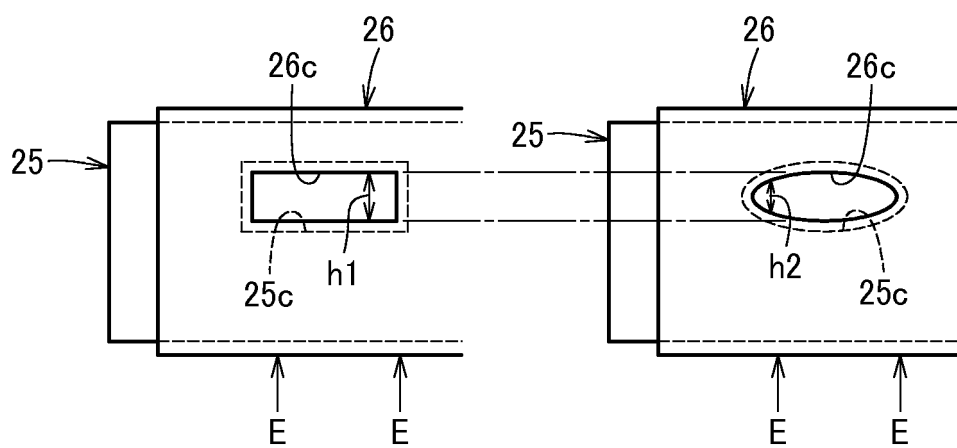


FIG. 23

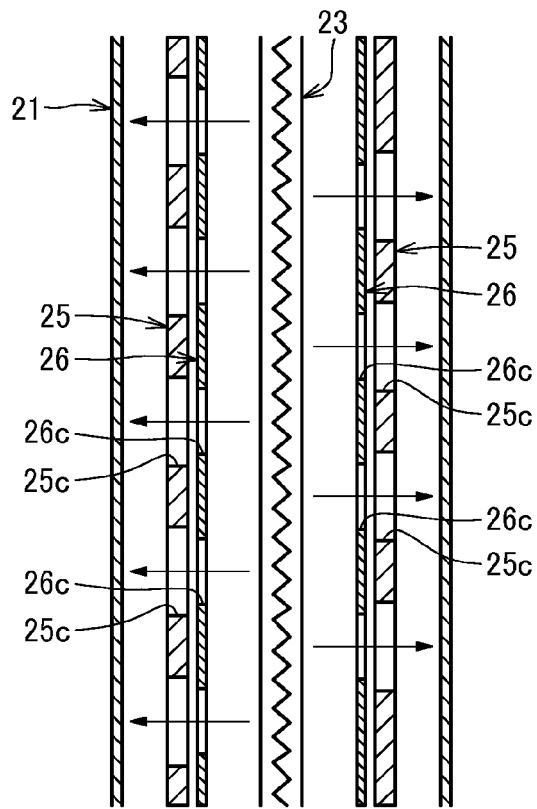


FIG. 24

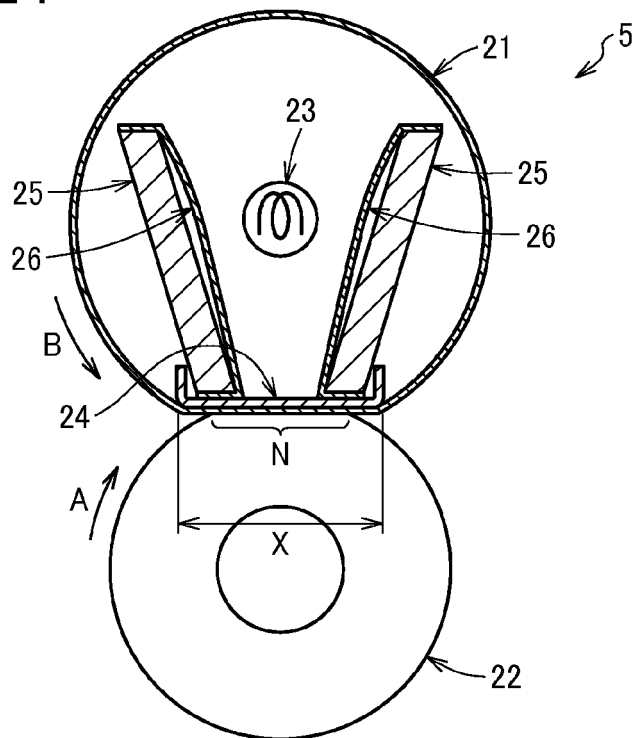


FIG. 25

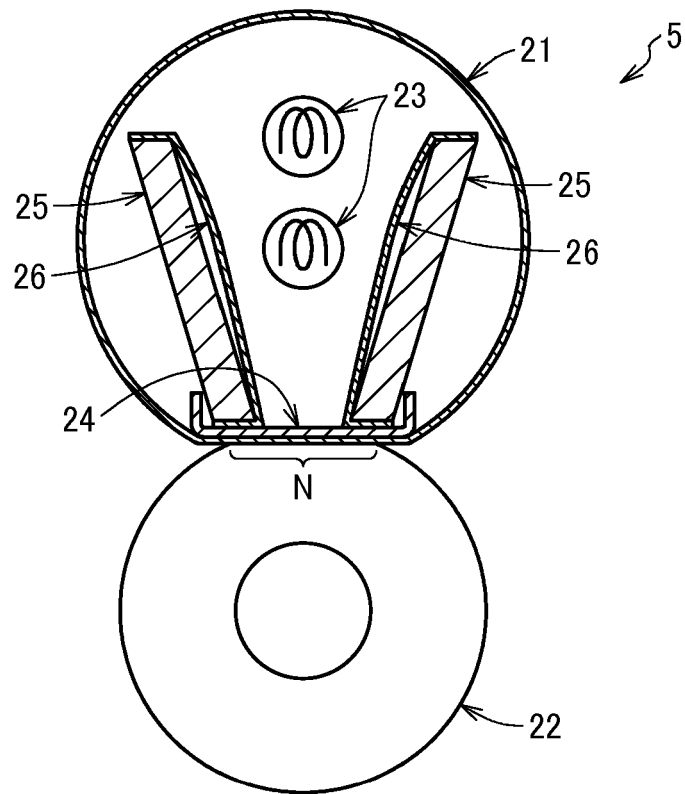


FIG. 26

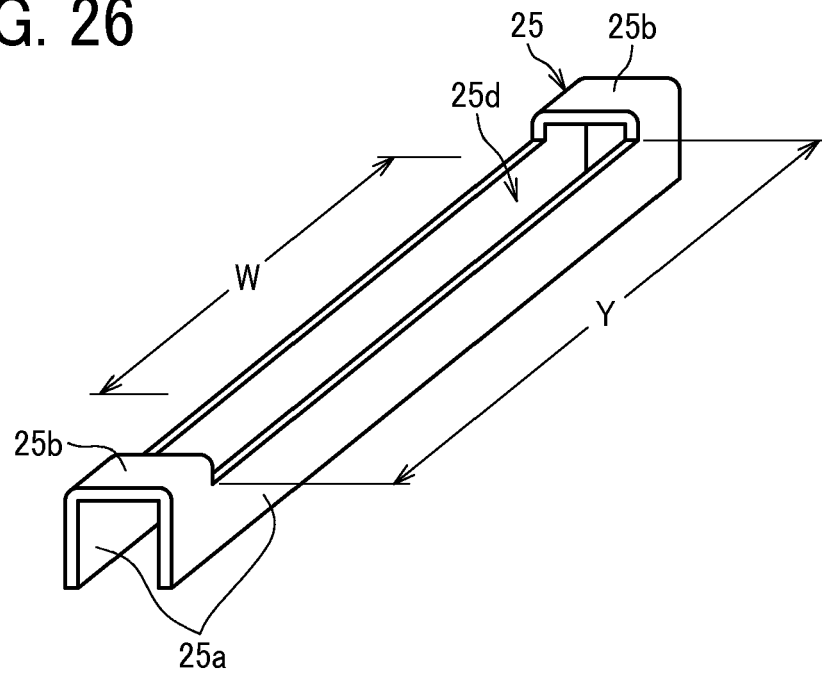


FIG. 27

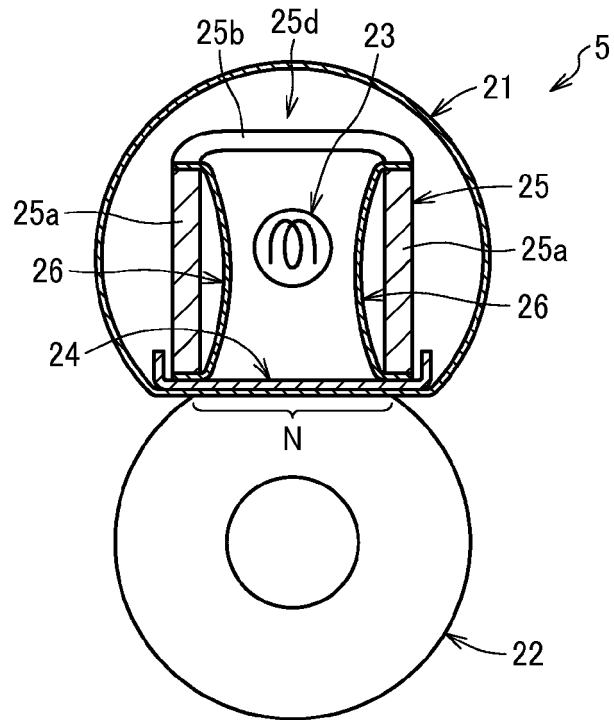


FIG. 28

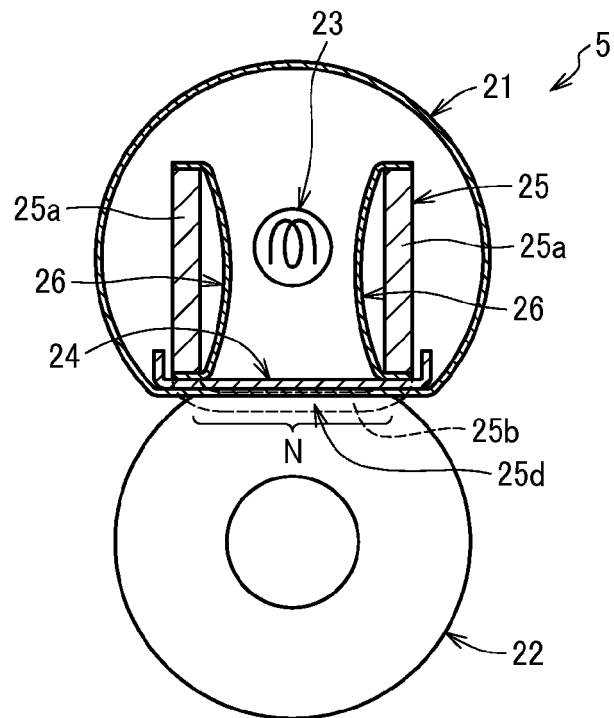
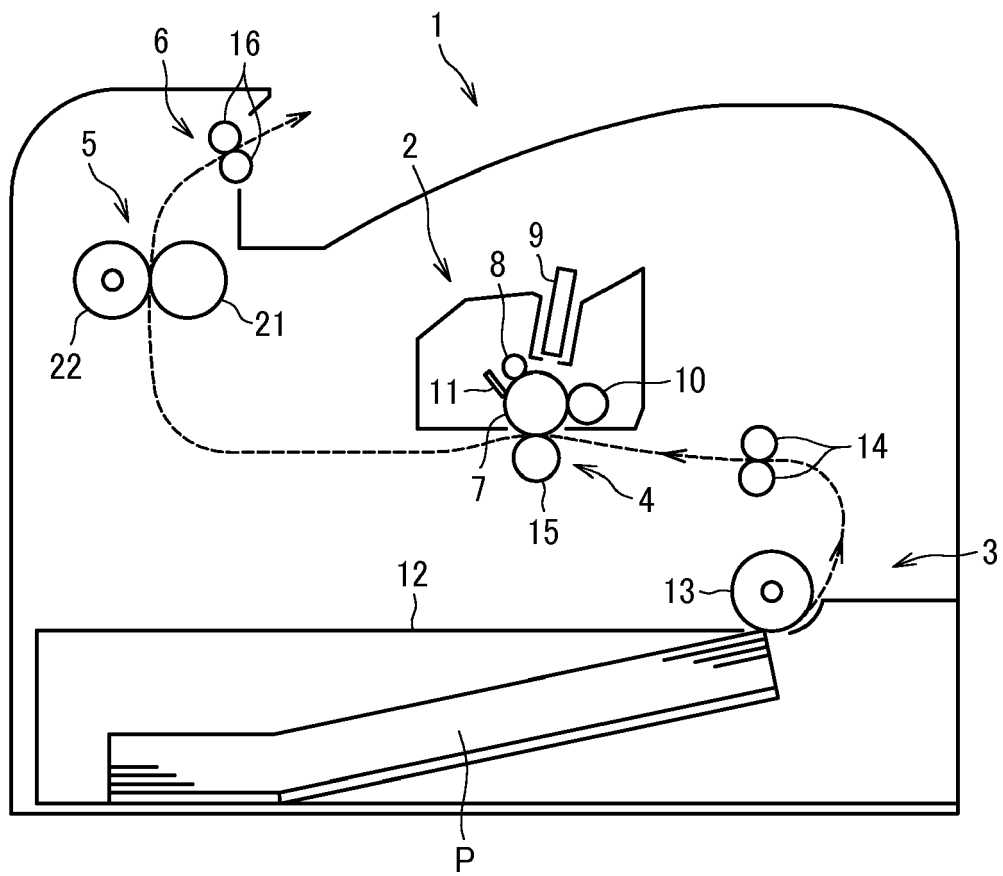


FIG. 29





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Application Number
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 February 2020	Examiner Urbaniec, Tomasz
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