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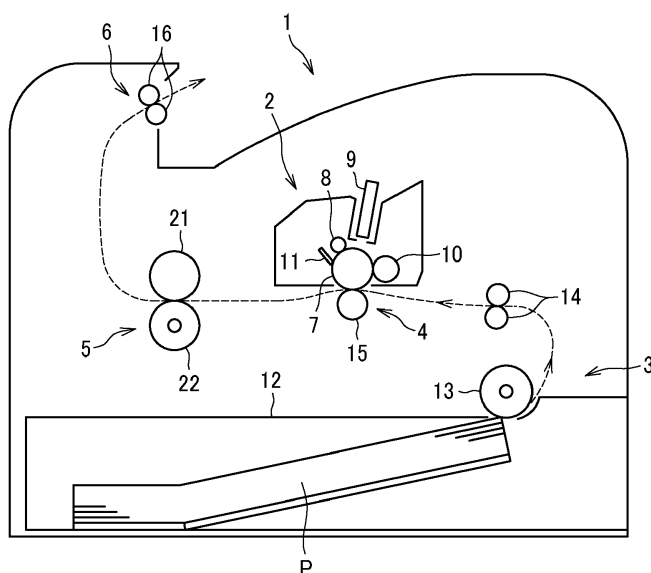
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(54) **FIXING DEVICE AND IMAGE FORMING APPARATUS INCORPORATING SAME**

(57) A fixing device (5) includes a fixing member (21), a pressing member (22) configured to press the fixing member (21), a heating member (23) inside the fixing member (21), a support (25), and a nip formation member (24) supported by the support (25). The nip formation member (24) is disposed inside the fixing member (21) and configured to receive a pressing force from the pressing member (22) and form a nip between the fixing member (21) and the pressing member (22). The nip formation

member (24) includes a pressed portion (24b) and another pressed portion (24b). When the pressing member (22) presses the nip formation member (24), the pressed portion (24b) is pressed by the support (25) toward a nip inlet from which a recording medium enters the nip, and another pressed portion (24b) is pressed by the support (25) toward a nip outlet from which the recording medium exits the nip.

FIG. 1



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 electrophotographic image forming apparatus such as a copier and a printer includes 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] For example, JP-2011-95549-A discloses such a fixing device including a cylindrical fixing film, a heater disposed inside a loop of the fixing film and configured to slide on an inner surface of the fixing film and receive radiant heat from the heater, a backup member (a pressure roller) that sandwiches the fixing film with the nip plate to form a nip between the nip plate and the backup member, and a stay to support both ends of the nip plate in a conveyance direction of a recording medium.

[0004] When a nip formation member such as the nip plate is supported at both ends in the conveyance direction of the recording medium, a pressing force from a pressing member such as the pressure roller may bend a central portion of the nip formation member because the central portion of the nip formation member is not supported. Increasing such a bend of the nip formation member prevents a nip width and a nip pressure from maintaining a desired nip width and nip pressure and may result in unsuitable image fixing ability.

SUMMARY

[0005] It is a general object of the present disclosure to provide an improved and useful fixing device in which the above-mentioned disadvantages are eliminated. In order to achieve the above-mentioned object, there is provided a fixing device according to claim 1. Advantageous embodiments are defined by the dependent claims.

[0006] Advantageously, the fixing device includes a fixing member in a cylindrical shape, a pressing member configured to press an outer circumferential surface of the fixing member, a heating member disposed inside a loop of the fixing member, a support, and a nip formation member supported by the support. The nip formation member is disposed inside the loop of the fixing member and configured to receive a pressing force from the pressing member and form a nip between the fixing member

and the pressing member. The nip formation member includes a pressed portion to be pressed by the support toward a nip inlet from which a recording medium enters the nip, when the nip formation member is pressed by the pressing member, and another pressed portion to be pressed by the support toward a nip outlet from which the recording medium exits the nip, when the nip formation member is pressed by the pressing member.

[0007] According to the present disclosure, the pressing member presses the nip formation member, and the pressed portion on the nip inlet side of the nip formation member and another pressed portion on the nip outlet side of the nip formation member apply force to the support. Reaction force in the opposite direction of the force is generated in the support. Therefore, a configuration according to the present disclosure can reduce a spread of the nip formation member in a direction in which the nip formation member presses the support and a bend of the nip formation member in a pressing direction of the pressing member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] 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 a first 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 an enlarged cross-sectional view illustrating a part of FIG. 2;

FIG. 4 is a perspective view of the fixing device with the vertical cross-sectional view of the fixing device; FIG. 5 is a vertical cross-sectional view of the fixing device viewed from a front side of the fixing device; FIG. 6 is a perspective view of a belt holder; FIG. 7 is a perspective view of a variation of the belt holder;

FIG. 8 is an explanatory diagram to describe a force generated in a nip formation member that receives a pressing force;

FIG. 9 is an enlarged cross-sectional view illustrating a part of an example of the fixing device having a clearance between a bent portion of the nip formation member and a side wall of a stay;

FIG. 10 is a perspective view illustrating the fixing device in which a fixing belt and a pressure roller are eliminated;

FIG. 11 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. 12 is an enlarged cross-sectional view illustrating

ing a part of the fixing device according to the second embodiment of the present disclosure;

FIG. 13 is a perspective view illustrating the fixing device according to the second embodiment of the present disclosure in which the fixing belt and the pressure roller are eliminated;

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

FIG. 15 is an enlarged cross-sectional view illustrating a part of the fixing device according to the third embodiment of the present disclosure;

FIG. 16 is a perspective view illustrating the fixing device according to the third embodiment of the present disclosure in which the fixing belt and the pressure roller are eliminated;

FIG. 17 is a perspective view illustrating the fixing device according to the fourth embodiment of the present disclosure in which the fixing belt and the pressure roller are eliminated;

FIG. 18 is a vertical cross-sectional view of a central portion of the fixing device in a longitudinal direction of the fixing device according to the fourth embodiment of the present disclosure viewed from a lateral side of the fixing device;

FIG. 19 is a vertical cross-sectional view of an end portion of the fixing device in the longitudinal direction of the fixing device according to the fourth embodiment of the present disclosure viewed from a lateral side of the fixing device;

FIG. 20 is a perspective view illustrating the fixing device according to a fifth embodiment of the present disclosure in which the fixing belt and the pressure roller are eliminated;

FIG. 21 is a vertical cross-sectional view of a central portion of the fixing device in the longitudinal direction of the fixing device according to the fifth embodiment of the present disclosure viewed from a lateral side of the fixing device;

FIG. 22 is a vertical cross-sectional view of an end portion of the fixing device in the longitudinal direction of the fixing device according to the fifth embodiment of the present disclosure viewed from a lateral side of the fixing device; and

FIG. 23 is a schematic diagram illustrating an example of a configuration of the image forming apparatus including a fixing device which conveys a sheet in a vertical direction.

[0009] 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

[0010] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this patent 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 operate in a similar manner and achieve similar results.

[0011] 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.

[0012] Referring now to the drawings, embodiments of the present disclosure are described below. In the drawings for explaining 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.

[0013] 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.

[0014] 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.

[0015] 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, 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.

[0016] 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.

[0017] As an image forming operation start is instructed, in the image forming device 2, the photoconductor 7

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

[0018] 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.

[0019] 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 pressure roller 22 fixes the toner image onto the sheet P. Subsequently, the sheet P is conveyed to the sheet ejection device 6, and an ejection roller pair 16 ejects the sheet P outside the image forming apparatus 1, and a series of print operations are completed.

[0020] With reference to FIGS. 2 to 6, a detailed description is provided of a construction of the fixing device 5 according to a first embodiment of the present disclosure.

[0021] 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 an enlarged cross-sectional view illustrating a part of FIG. 2, FIG. 4 is a perspective view of the fixing device 5 with the vertical cross-sectional view of the fixing device 5, and FIG. 5 is a vertical cross-sectional view of the fixing device viewed from a front side of the fixing device. In addition, FIG. 6 is a perspective view of a belt holder 30 to support the fixing belt 21, and FIG. 7 is a perspective view of a variation of the belt holder 30.

[0022] As illustrated in FIG. 2, the fixing device 5 includes the fixing belt 21, the pressure roller 22, a halogen heater 23, a nip formation member 24, a stay 25, a reflector 26, guides 27, and temperature sensors 28.

[0023] 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 on an

inner side of the fixing belt 21 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 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 pressure roller 22 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 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 base layer of the fixing belt 21 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 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 further decrease the thermal capacity of the fixing belt 21, 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. Preferably, the loop diameter of the fixing belt 21 may not be greater than 30 mm.

[0024] The pressure roller 22 is an opposed member pressed against an outer circumferential surface of the fixing belt 21. The pressure roller 22 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 22 is a solid roller. Alternatively, the pressure roller 22 may be a hollow roller. When the pressure roller 22 is the hollow roller, a heater such as a halogen heater may be disposed inside the pressure roller 22. The elastic layer of the pressure roller 22 may be made of solid rubber. Alternatively, if no heater is disposed inside the pressure roller 22, the elastic layer of the pressure roller 22 is preferably made of sponge rubber to enhance thermal insulation of the pressure roller 22. Such a configuration reduces heat conduction from the fixing belt 21 to the pressure roller 22 and improves heating efficiency of the fixing belt 21.

[0025] A driver disposed inside the image forming apparatus 1 drives and rotates the pressure roller 22 in a direction indicated by arrow A in FIG. 2. The rotation of the pressure roller 22 drives the fixing belt 21 to rotate in a direction of arrow B in FIG. 2 due to frictional force therebetween. As illustrated in FIG. 2, after the toner image is transferred onto the sheet P, the sheet P bearing the unfixed toner image T enters a nip N from a nip inlet that is a right end of the nip N illustrated in FIG. 2. The

rotating fixing belt 21 and the rotating pressure roller 22 convey the sheet P, and the sheet P passes through the 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. Thereafter, the rotating fixing belt 21 and the rotating pressure roller 22 ejects the sheet P from a nip outlet that is a left end of the nip N illustrated in FIG. 2.

[0026] The pressure 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 pressure roller 22 and the fixing belt 21 from each other and opening the nip N enables the jammed sheet to be removed. One of the pressure roller 22 and the fixing belt 21 may be configured to be fixed and the other may be configured to be movable so that the pressure roller 22 and the fixing belt 21 contact and separate each other. Alternatively, both the pressure roller 22 and the fixing belt 21 may be configured to move so that the pressure roller 22 and the fixing belt 21 contact and separate each other.

[0027] 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 and the nip formation member 24. Alternatively, instead of the halogen heater 23, a carbon heater, a ceramic heater or the like may be employed as the heater.

[0028] The nip formation member 24 is disposed inside a loop of the fixing belt 21 and extends in a width direction of the fixing belt 21. The nip formation member 24 and the pressure roller 22 sandwich the fixing belt 21 to form the nip N. As illustrated in FIG. 3, the nip formation member 24 has a nip formation portion 24a facing the pressure roller 22 via the fixing belt 21 and a pair of bent portions 24b that are bent in a direction from the pressure roller 22 to the nip formation portion 24a from both an end of the nip formation portion 24a in a nip inlet side that is a right end of the nip formation portion 24a illustrated in FIG. 3 and an end of the nip formation portion 24a in a nip outlet side that is a left end of the nip formation portion 24a illustrated in FIG. 3. The nip formation portion 24a is formed to be convex-curved surface that projects toward the pressure roller 22 and receives a pressing force from the pressure roller 22 to form the nip N. Each bent portion 24b is fitted in a step portion 25c provided on the stay 25. Fitting the bent portions 24b in the step portions 25c of the stay 25 makes the stay 25 to support the nip formation member 24 against the pressing force from the pressure roller 22 and prevents the nip formation member 24 from deforming toward the nip inlet side and the nip outlet side.

[0029] To improve the abrasion resistance and the slidability of the nip formation portion 24a when the fixing belt 21 rotates, the surface of the nip formation portion 24a that contacts the fixing belt 21 may be treated with alumite or coated with fluororesin material. Additionally, a lubricant such as a fluorine-based grease may be ap-

plied to the surface of the nip formation portion 24a that contacts the fixing belt 21 to ensure slidability over time.

[0030] The nip formation member 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 member 24 is preferably copper (thermal conductivity: 398 W/mK) or aluminum (thermal conductivity: 236 W/mK). The nip formation member 24 made of the material having such a large thermal conductivity absorbs the radiant heat from the halogen heater 23 and effectively transmits heat to the fixing belt 21. For example, setting the thickness of the nip formation member 24 to 1 mm or less can shorten a heat transfer time in which the heat transfers from the nip formation member 24 to the fixing belt 21, which is advantageous in shortening a warm-up time of the fixing device 5. In contrast, setting the thickness of the nip formation member 24 to be larger than 1 mm and 5 mm or less can improve a heat storage capacity of the nip formation member 24.

[0031] The stay 25 is a support member to support the nip formation member 24 against the pressing force from the pressure roller 22. Similar to the nip formation member 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. As illustrated in FIG. 2, in the present embodiment, the stay 25 has a concave cross-section including a pair of side wall portions 25a arranged in parallel with each other with the halogen heater 23 interposed therebetween and a bottom wall portion 25b that connects upper ends of the pair of side wall portions 25a. As illustrated in FIG. 3, an end portion of the side wall portion 25a that contacts the nip formation member 24 has the step portion 25c that fits with each bent portion 24b of the nip formation member 24. The side wall portions 25a extending in a pressing direction in which the pressure roller 22 presses against the nip formation member 24 that is a vertical direction in FIG. 2 strengthens the rigidity of the stay 25 in the pressing direction. The material of the stay 25 is preferably an iron-based metal such as stainless steel (SUS) or Steel Electrolytic Cold Commercial (SECC) that is electrogalvanized sheet steel to ensure rigidity.

[0032] 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 member 24. As illustrated in FIG. 2, in the present embodiment, the reflector 26 includes a reflector portion 26a formed in a curved surface such as an ellipse surface or an arc surface and a pair of bent portions 26b bent from both ends of the reflector portion 26a, that is, the end in the nip inlet side and the end in the nip outlet side, in a direction in which the bent portions separate from each other. As illustrated in FIG. 3, each bent portion 26b of the reflector 26 is sandwiched between each step portion 25c of the side wall portion 25a of the stay 25 and the bent portion 24b of the nip formation member 24 to hold the reflector 26.

[0033] The infrared light reflected by the reflector 26 is

emitted to the nip formation member 24 and heats the nip formation member 24. As described above, the halogen heater 23 directly irradiates the nip formation member 24 with the infrared light, and, additionally, the nip formation member 24 is also irradiated with the infrared light reflected by the reflector portion 26a. Therefore, the nip formation member 24 is effectively heated. Since the reflector 26 is interposed between the halogen heater 23 and the stay 25, the reflector 26 functions to block the infrared light emitted from the halogen heater 23 to the stay 25. This function reduces wasteful energy use to heat the stay 25. Additionally, in the present embodiment, thermal insulation of the layer of air in a gap between the stay 25 and the reflector portion 34a blocks heat transfer to the stay 25.

[0034] The surface of the reflector 26 facing the halogen heater 23 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 26 is preferably 70% or more with wavelengths of high emission intensity in the halogen heater 23, that is, specifically the wavelengths of 900 to 1600 nm and more preferably 70% or more with the wavelengths 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 function as the reflector 26. Such a configuration can obviate the reflector 26 that is a separate component from the stay 25. The reflectance of the stay 25 subjected to the mirror finishing is preferably similar to the reflectance of the reflector 26.

[0036] The guides 27 contacts the inner circumferential surface of the fixing belt 21 to guide the rotating fixing belt 21. As illustrated in FIG. 2, in the present embodiment, the guides 27 are disposed on both the nip inlet side of the stay 25 and the nip outlet side of the stay 25. The guide 27 includes an attachment portion 27a fixed to the stay 25 and a curved guide portion 27b in contact with the inner circumferential surface of the fixing belt 21. As illustrated in FIG. 4, 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 face the outer circumferential surface of the fixing belt 21 and detect tem-

peratures of the fixing belt 21. In the present embodiment, the temperature sensors 28 are disposed at two positions, the central position of the fixing belt 21 in the belt width direction, and one end position of the fixing belt 21 in the belt width direction. The temperature sensor 28 detects the temperature of the outer circumferential surface of the fixing belt 21, and output of the halogen heater 23 is controlled based on the detected temperatures so that the temperature of the fixing belt 21 becomes a desired temperature that is a 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.

[0038] As illustrated in FIG. 5, each cylindrical belt holder 30 is inserted in both lateral ends of the fixing belt 21. As described above, the belt holders 30 inserted into the both lateral ends of the fixing belt 21 support the fixing belt 21 in a state in which the fixing belt 21 is not basically applied with tension in a circumferential direction thereof while the fixing belt 21 does not rotate, that is, by a free belt system.

[0039] As illustrated in FIGS. 4 to 6, the belt holders 30 include 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, walking of the fixing belt 21 in the width direction. As illustrated in FIG. 7, the supporter 30a may have a cylindrical shape which is continuous over its entire circumference. As illustrated in FIG. 5, 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. 6, 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] As described above, in the fixing device 5 according to the present embodiment, the stay 25 supports both ends of the nip formation member 24 in a width direction of the nip formation member 24, that is, the end in the nip inlet side and the end in the nip outlet side. Therefore, at the both ends of the nip formation member 24 supported by the stay 25, the stay 25 greatly reduces a bend and deformation of the nip formation member 24 caused by the pressing force of the pressure roller 22. However, since the stay 25 does not support a central portion of the nip formation member 24 in the width direction, the stay 25 cannot reduce the bend at the central portion as much as the bend at the both ends.

[0041] Therefore, in the fixing device 5 according to the present embodiment, as described above, the nip formation member 24 has the bent portions 24b, at both ends in the width direction of the nip formation member 24, that contact the side wall portions 25a of the stay 25 or are disposed near the side wall portions 25a of the stay 25. Since each of the bent portions 24b of the nip

formation member 24 is in contact with or close to each of the side wall portions 25a of the stay 25 as described above, when the nip formation member 24 receives the pressing force from the pressure roller 22, a force with which the side wall portion 25a of the stay 25 presses the bent portion 24b in the nip inlet side and a force with which the side wall portion 25a of the stay 25 presses the bent portion 24b in the outlet side can reduce the bend of the nip formation member 24.

[0042] Specifically, when the pressure roller 22 presses the nip formation member 24 with the pressing force F as illustrated in FIG. 8, the pressing force F presses the nip formation member 24 upward as illustrated in FIG. 8 and generates a force K that causes deformation of the nip formation member 24 in a lateral direction as illustrated in FIG. 8. That is, since the nip formation portion 24a of the nip formation member 24 is formed as a projection toward the pressure roller 22, the pressing force from the pressure roller 22 elastically and slightly deforms the nip formation portion 24a in the pressing direction and additionally and elastically deforms the nip formation portion 24a so that the nip formation portion 24a spreads toward the nip inlet side and the nip outlet side. When the nip formation portion 24a spreads toward the nip inlet side and the nip outlet side, the pair of side wall portions 25a of the stay 25 presses the bent portions 24b of the nip formation member 24 from the outside of the nip formation member 24 to the inside of the nip formation member 24. When each bent portion 24b presses the stay 25, a reaction force J in a direction opposite to a pressing force from the bent portion 24b acts on the nip formation member 24. Thereby, the spread of the nip formation member 24 in the lateral direction in FIG. 8, that is, a direction in which the nip formation member presses the stay 25, is restricted.

[0043] As described above, in the fixing device 5 according to the present embodiment, when the nip formation member 24 receives the pressing force from the pressure roller 22, each bent portion 24b of the nip formation member 24 functions as a pressed portion that is pressed by the each side wall portion 25a of the stay 25, and the reaction force J is generated in the direction opposite to the pressing force from the nip formation member 24 and can restrict the spread of the nip formation member 24 in the direction in which the nip formation member presses the stay 25. This reduces the bend of the nip formation member 24 that is the deformation in the pressing direction of the pressure roller 22 and, even in the configuration in which the central portion of the nip formation member 24 in the width direction is not supported, enables obtaining a desired nip width (that is a width in a sheet conveyance direction) and a desired nip pressure.

[0044] As illustrated in FIG. 9, there may be a clearance S in the sheet conveyance direction between the step portion 25c of the side wall portion 25a of the stay 25 and the bent portion 24b of the nip formation member 24 in a state in which the nip formation member 24 does not receive the pressing force from the pressure roller 22.

Designing the clearance S described above facilitates setting the nip formation member 24 in the stay 25. Even if there is the clearance S described above, a mechanism similar to the above described mechanism can work so as to reduce the bend of the nip formation member 24 because, when the nip formation member 24 receives the pressing force from the pressure roller 22, the nip formation member 24 elastically and slightly deforms in the pressing direction of the pressure roller 22 and spreads in the lateral direction as illustrated in FIG. 9, and the side wall portions 25a of the stay 25 presses the bent portions 24b. On the other hand, the fixing device 5 not having the clearance S as illustrated in FIG. 9 in the state in which the nip formation member 24 does not receive the pressing force from the pressure roller 22 can surely reduce the bend of the nip formation member 24 when the nip formation member 24 receives the pressing force from the pressure roller 22 and loss of the nip pressure and loss of the nip width that are caused by the bend of the nip formation member 24.

[0045] Preferably, as illustrated in FIG. 10, each bent portion 24b of the nip formation member 24 that functions as the pressed portion is disposed along at least an entire sheet conveyance span W through which the sheet passes in the nip N. When a plurality of sizes of the sheets pass through the nip, the entire sheet conveyance span is the largest one in the plurality of sizes. Designing the bent portions 24b along the entire sheet conveyance span W gives the above-described effect that reduces the bend in the sheet conveyance span W and, therefore, gives excellent fixing properties over the entire sheet.

[0046] From a similar point of view, the nip formation member 24 is preferably formed to project toward the pressure roller 22 along at least the entire sheet conveyance span W. Such a configuration gives the above-described effect that reduces the bend because, when the nip formation member 24 receives the pressing force from the pressure roller 22, the nip formation member 24 elastically deforms, and the side wall portions 25a of the stay 25 presses the bent portions 24b.

[0047] The nip formation member 24 may not be convex toward the pressure roller 22 when the nip formation member 24 receives the pressing force from the pressure roller 22, and it is enough for the nip formation member 24 to be convex toward the pressure roller 22 at least when the nip formation member 24 does not receive the pressing force from the pressure roller 22. That is, the nip formation member 24 that is convex toward the pressure roller 22 when the nip formation member 24 does not receive the pressing force from the pressure roller 22 can generate the above-described elastic deformation that causes the side wall portions 25a of the stay 25 to press the bent portions 24b. Therefore, the nip formation member 24 may not be convex toward the pressure roller 22 when the nip formation member 24 receive the pressing force from the pressure roller 22 and may be, for example, flat.

[0048] Other embodiments different from the above-

described first embodiment is described below. The differences from the first embodiment are described below, in which only the differences with the first embodiment are described.

[0049] FIGS. 11 to 13 illustrate a configuration according to a second embodiment of the present disclosure.

[0050] As illustrated in FIG. 11, the fixing device 5 according to the second embodiment of the present disclosure includes curved sections 25d each of which is disposed on an end portion of the side wall portion 25a of the stay 25 opposite the pressure roller 22, that is, a lower end portion of the side wall portion 25a in FIG. 11. The curved sections 25d contacts the inner circumferential surface of the fixing belt 21 at the nip inlet side and the nip outlet side, respectively.

[0051] As illustrated in FIG. 12, the curvature radius r of each curved section 25d is set to be smaller than the curvature radius R of the nip formation member 24 at the nip N ($r < R$). In other words, each curved section 25d is bent with a curvature larger than the curvature of the nip formation member 24 in the nip N .

[0052] As described above, in the second embodiment of the present disclosure, since each curved section 25d having the large curvature contacts the fixing belt 21 at the nip inlet side or the nip outlet side, the curvature of the fixing belt 21 at the nip inlet side or the nip outlet side becomes the large curvature of the curved section 25d. As a result, the large curvature of the fixing belt 21 at the nip outlet side facilitates separation of the sheet from the surface of the fixing belt 21 and efficiently avoids disadvantages such as a conveyance error and a sheet jam that are caused by the sheet wrapped around the fixing belt 21.

[0053] Preferably, the curved section 25d is made of perfluoro alkoxy alkane (PFA), polytetrafluoroethylene (PTFE), ceramic, or a composite material thereof in order to ensure heat resistance and slidability. Preferably, as illustrated in FIG. 13, the curved sections 25d are disposed along at least the entire sheet conveyance span W to facilitate the separation of the sheet from the fixing belt 21 over the entire sheet. When a plurality of sizes of the sheets pass through the nip, the entire sheet conveyance span is the largest one in the plurality of sizes. Instead of the above described curved sections 25d disposed at both the nip inlet side and the nip outlet side, the curved section 25d may be disposed at one side of the nip inlet side and the nip outlet side. In the present embodiment, the curved section 25d is configured as a part separated from the stay 25 but may be configured as one unit with the stay 25.

[0054] FIGS. 14 to 16 illustrate a configuration according to a third embodiment of the present disclosure.

[0055] As illustrated in FIG. 14, the nip formation member 24 according to the third embodiment of the present disclosure has first bent portions 24b that are bent from both ends of the nip formation portion 24a, that is, the end in the nip inlet side and the end in the nip outlet side, in the direction opposite to the pressure roller 22 and

second bent portions 24c that extend from the first bent portions 24b toward outside of the stay 25 and are bent in the direction opposite to the pressure roller 22. As illustrated in FIG. 16, the first bent portion 24b and the second bent portion 24c are alternately arranged over a longitudinal direction of the nip formation member 24 that is the width direction of the fixing belt 21.

[0056] As illustrated in FIG. 15, when the nip formation member 24 receives the pressing force from the pressure roller 22, the pair of the first bent portions 24b press the inner surfaces of the side wall portions 25a of the stay 25 with the forces K generated toward the nip inlet side and the nip outlet side, and the mechanism similar to the above-described mechanism reduces the bend of the nip formation member 24. That is, in the present embodiment, the first bent portions 24b function as pressed portions that are similar to the bent portions 24b in the above-described embodiments.

[0057] In the present embodiment, the first bent portions 24b are partially provided at three locations across the sheet conveyance span W as illustrated in FIG. 16. However, the number, the arrangement, and the length of the first bent portions 24b may be appropriately changed according to various design reasons. In the present embodiment, the clearance S in the sheet conveyance direction as illustrated in FIG. 9 may be disposed between the first bent portion 24b and the side wall portion 25a of the stay 25. Whether or not to provide such a clearance S may be arbitrarily selected in consideration of the balance between the effect that reduces the bend and ease of assembling, like the above-described embodiments.

[0058] As described above, similar to the bent portions 24b in the above-described embodiments, the first bent portions 24b in the third embodiment function as pressed portions that are pressed at the nip inlet side and the nip outlet side by the stay 25. However, unlike the above-described embodiments, since the first bent portions 24b are not pressed against the stay 25 in the pressing direction of the pressure roller 22, the first bent portions 24b do not function as positioning parts that position the nip formation member 24 in the pressing direction. In the present embodiment, the second bent portions 24c function as the positioning parts in the pressing direction.

[0059] Specifically, as illustrated in FIG. 15, each of the second bent portions 24c has a first positioning part 24d extending in a direction intersecting the side wall portion 25a of the stay 25 and a second positioning part 24e extending along the outer surface of the side wall portion 25a of the stay 25 from the first positioning part 24d in the opposite direction to the pressure roller 22. The first positioning parts 24d are fitted into recesses 25e provided at end portions of the side wall portions 25a opposite the pressure roller 22. Additionally, the bent portions 26b of the reflector 26 are also fitted in the recesses 25e, and the first positioning parts 24d are engaged with the bottom surface of the recesses 25e via the bent portions 26b of the reflector 26. Since the first positioning

parts 24d are engaged with the recesses 25e, the first positioning parts 24d position the nip formation member 24 with respect to the pressing force F of the pressure roller 22.

[0060] As illustrated in FIG. 16, the recesses 25e are provided at intervals over the longitudinal direction of the stay 25 corresponding to the second bent portions 24c. Therefore, since the first positioning part 24d is set into the recesses 25e and coupled to the recesses 25e in the longitudinal direction of the stay 25, the nip formation member 24 is positioned in the longitudinal direction of the stay 25.

[0061] As illustrated in FIG. 15, each second positioning part 24e is fitted on the outer surface of the side wall portion 25a corresponding to the second positioning part 24e to position the nip formation member 34 in a short-side direction of the stay 25 that is a lateral direction in FIG. 15. In addition, in areas in which the second positioning parts are not provided in the longitudinal direction of the nip formation member 24, the inner surfaces of the side wall portions 25a press the first bent portions 24b to position the nip formation member 24 in the short-side direction of the stay 25.

[0062] As described above, in the present embodiment, the first bent portions 24b and the second positioning parts 24e of the second bent portions 24c position the nip formation member 24 with respect to the inner surfaces of the side wall portions 25a and the outer surfaces of the side wall portions 25a. Such a configuration surely prevents occurrence of a backlash of the nip formation member 24 in the stay 25 in the sheet conveyance direction. In the present embodiment, the stay 25 not having the step portion 25c as illustrated in FIG. 9 does not need a cutting process to form the step portion 25c, which reduces the manufacturing cost of the stay 25.

[0063] In the present embodiment, similarly to the above-described embodiments, the curved sections 25d having the large curvature as illustrated in FIGS. 11 to 13 may be disposed on the stay 25 to facilitate the separation of the sheet from the fixing belt 21.

[0064] Next, with reference to FIGS. 17 to 19, a configuration according to a fourth embodiment of the present disclosure is described.

[0065] FIG. 17 is a perspective view illustrating the fixing device including the halogen heater 23, the nip formation member 24, the stay 25, and the reflector 26 and eliminating the fixing belt 21 and the pressure roller 22. FIG. 18 is a vertical cross-sectional view of a central portion of the fixing device in the longitudinal direction of the fixing device illustrated in FIG. 17 viewed from the lateral side of the fixing device, and FIG. 19 is a vertical cross-sectional view of an end portion of the fixing device in the longitudinal direction of the fixing device illustrated in FIG. 17 viewed from the lateral side of the fixing device.

[0066] As illustrated in FIGS. 17 to 19, in the fourth embodiment of the present disclosure, a projection amount Hc at the central portion of the nip formation member 24 in the longitudinal direction that is the width

direction of the fixing belt 21 from the stay 25 to a surface of the nip formation member 24 facing the pressure roller 22 is different from projection amounts He at end portions of the nip formation member in the longitudinal direction from the stay 25 to the surfaces of the nip formation member 24 facing the pressure roller 22. Therefore, the cross-sectional shape of the nip formation member 24 according to the present embodiment is different between the central portion and the end portions in the longitudinal direction.

[0067] When the pair of side plates 31 supports both ends of the stay 25 in the longitudinal direction of the stay 25 as described above, the stay 25 is more likely to bend at the central portion in the longitudinal direction than at the end portions. Therefore, the nip formation member 24 supported by the stay 25 tends to have a larger bend at the central portion in the longitudinal direction. Additionally, to prevent occurrence of creases in the sheet, the pressure roller 22 may be formed so that the outer diameter of the pressure roller 22 gradually increases from an axial end portion to an axial central portion. When the above-described pressure roller 22 is used, the pressure roller 22 presses the central portion of the nip formation member 24 with a large pressing amount, and, therefore, the nip formation member 24 is also likely to bend at the central portion in the longitudinal direction. As described above, when the support structure of the stay 25 or the shape of the pressure roller 22 cause the bend of the nip formation member 24 at the central portion in the longitudinal direction to be larger than the bends of the nip formation member 24 at the end portions, the nip width and the nip pressure may not be uniform in the longitudinal direction.

[0068] In the present embodiment, to reduce the bend of the nip formation member 24 at the central portion in the longitudinal direction, the projection amount Hc at the central portion of the nip formation member 24 in the longitudinal direction that is the width direction of the fixing belt 21 from the nip formation member 24 to a surface of the nip formation member 24 facing the pressure roller 22 is set different from the projection amount He at the end portion of the nip formation member in the longitudinal direction from the stay 25 to the surface of the nip formation member 24 facing the pressure roller 22, that is, $H_c > H_e$. The above described structure can effectively reduce the bend of the nip formation member 24 at the central portion in the longitudinal direction and give a uniform nip width and a uniform nip pressure even when the stay 25 largely bends at the central portion in the longitudinal direction, or even when the pressure roller 22 presses the nip formation member 24 with the large pressing amount at the central portion in the longitudinal direction.

[0069] Contrary to the present embodiment, in consideration of the balance of various factors such as sheet conveyance at the nip N, sheet separation, and toner fixing strength, the projection amount Hc at the central portion of the nip formation member 24 in the longitudinal

direction may be set smaller than the projection amount H_e at the end portion of the nip formation member in the longitudinal direction, that is, $H_c < H_e$.

[0070] Next, with reference to FIGS. 20 to 22, a configuration according to a fifth embodiment of the present disclosure is described.

[0071] FIG. 20 is a perspective view illustrating the fixing device in which the fixing belt 21 and the pressure roller 22 are eliminated. FIG. 21 is a vertical cross-sectional view of the central portion of the fixing device in the longitudinal direction of the fixing device illustrated in FIG. 20 viewed from the lateral side of the fixing device, and FIG. 22 is a vertical cross-sectional view of the end portion of the fixing device in the longitudinal direction of the fixing device illustrated in FIG. 20 viewed from the lateral side of the fixing device.

[0072] The fifth embodiment of the present disclosure illustrated in FIGS. 20 to 22 employs another structure to reduce the bend at the central portion of the nip formation member 24 caused by the support structure of the stay 25 or the shape of the pressure roller 22 described above. In the present embodiment, a curvature radius R_c of the surface of the nip formation member 24 projecting toward the pressure roller 22 at the central portion in the longitudinal direction that is the width direction of the fixing belt 21 is set smaller than a curvature radius R_e of the surface of the nip formation member 24 at the end portion in the longitudinal direction, that is, $R_c < R_e$. That is, a curvature of the surface of the nip formation member 24 projecting toward the pressure roller 22 at the central portion in the longitudinal direction is set larger than a curvature of the surface of the nip formation member 24 at the end portion in the longitudinal direction. As a result, the nip formation member 24 becomes hard to bend at the central portion having the large curvature, which results in the uniform nip width and the uniform nip pressure.

[0073] Similar to the above-described embodiment illustrated in FIGS. 17 to 19, in consideration of the various factors such as the sheet conveyance at the nip N, the sheet separation at the nip N, and the sheet fixing strength of toner, contrary to the present embodiment, the curvature of the central portion of the nip formation member 24 in the longitudinal direction may be set smaller than the curvature of the end portion of the nip formation member 24 in the longitudinal direction, that is, $R_c > R_e$.

[0074] The present disclosure is not limited to the details of the embodiments described above and various modifications and improvements are possible.

[0075] 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. 23 that conveys the sheet in the vertical direction.

[0076] 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 (5) comprising:

a fixing member (21) in a cylindrical shape;
a pressing member (22) configured to press an outer circumferential surface of the fixing member (21);
a heating member (23) disposed inside a loop of the fixing member (21);
a support (25); and
a nip formation member (24) supported by the support (25), disposed inside the loop of the fixing member (21), and configured to receive a pressing force from the pressing member (22) and form a nip between the fixing member (21) and the pressing member (22),
the nip formation member (24) including:

a pressed portion (24b) to be pressed by the support (25) toward a nip inlet from which a recording medium enters the nip, when the nip formation member (24) is pressed by the pressing member (22); and
another pressed portion (24b) to be pressed by the support (25) toward a nip outlet from which the recording medium exits the nip, when the nip formation member (24) is pressed by the pressing member (22).

2. The fixing device (5) according to claim 1, wherein the nip formation member (24) is configured to project toward the pressing member (22) when the pressing member (22) does not press the nip formation member (24).

3. The fixing device (5) according to claim 1 or 2, wherein, in a width direction of the fixing member (21), a cross-sectional shape of a central portion of the nip formation member (24) is different from a cross-sectional shape of an end portion of the nip formation member (24).

4. The fixing device (5) according to claim 2, wherein, in a width direction of the fixing member (21), a projection amount of a central portion of the nip formation member (24) is different from a projec-

tion amount of an end portion of the nip formation member (24).

5. The fixing device (5) according to claim 2,
wherein, in a width direction of the fixing member (21), a projection amount of a central portion of the nip formation member (24) is greater than a projection amount of an end portion of the nip formation member (24). 5
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6. The fixing device (5) according to claim 2,
wherein, in a width direction of the fixing member (21), a curvature of a central portion of a projecting surface of the nip formation member (24) is different from a curvature of an end portion of the projecting surface of the nip formation member (24). 15
7. The fixing device (5) according to claim 2,
wherein, in a width direction of the fixing member (21), a curvature of a central portion of a projecting surface of the nip formation member (24) is larger than a curvature of an end portion of the projecting surface of the nip formation member (24). 20
8. The fixing device (5) according to any one of claims 1 to 7,
wherein the pressed portion (24b) and said another pressed portion (24b) are disposed across at least an entire sheet conveyance span through which a recording medium passes in the nip. 25
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9. The fixing device (5) according to any one of claims 1 to 8, further comprising a curved section (25d) disposed near at least one of the nip inlet and the nip outlet and configured to bend at a curvature larger than a curvature of the nip formation member (24) in the nip and come into contact with an inner circumferential surface of the fixing member (21). 35
10. An image forming apparatus (1) comprising: 40
an image forming device (2) to form an image on a recording medium; and
the fixing device (5) according to any one of claims 1 to 9 to fix the image formed by the image forming device (2) onto the recording medium. 45

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FIG. 1

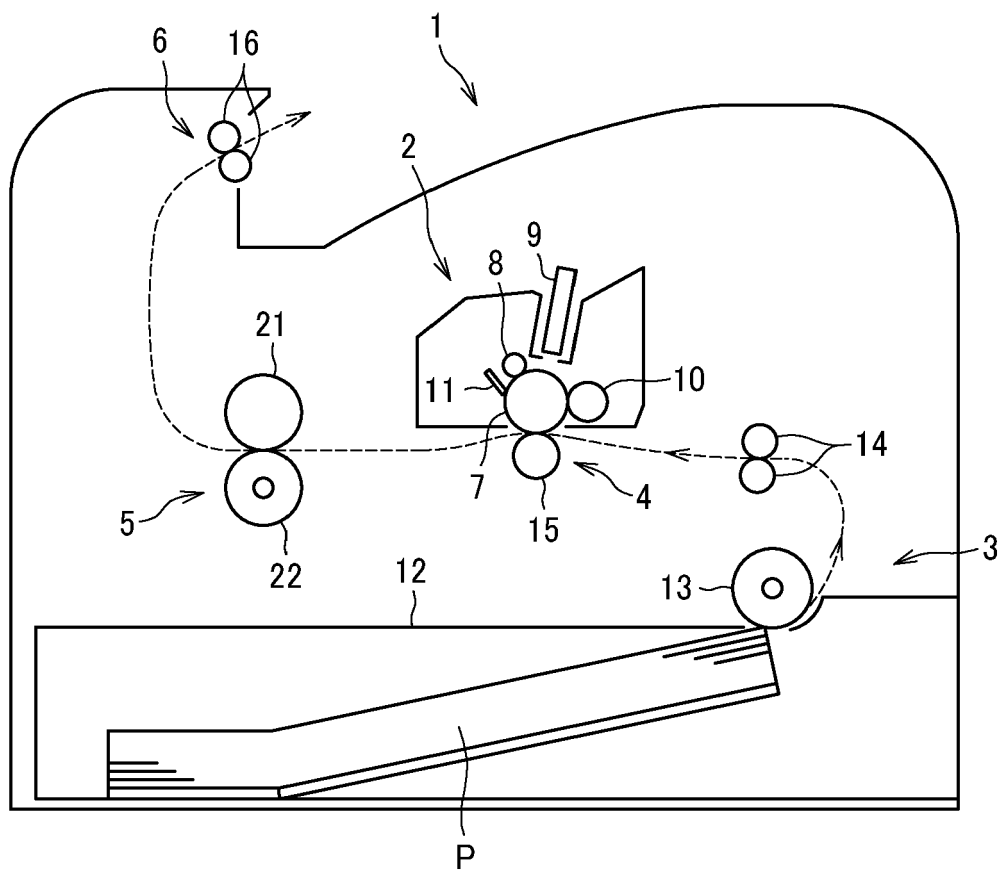


FIG. 2

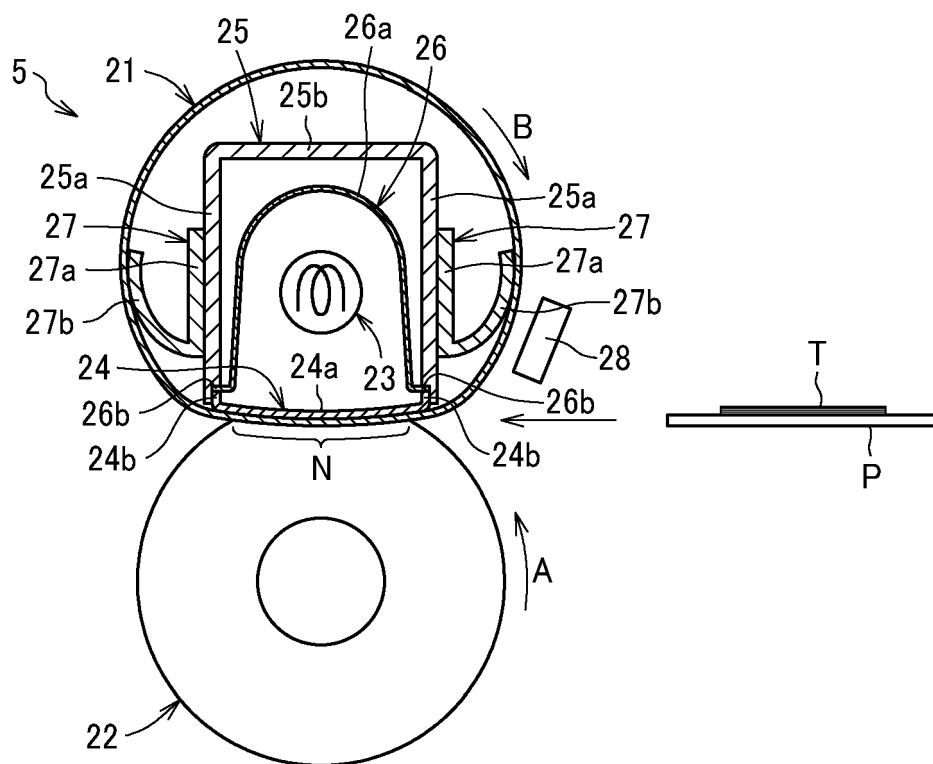


FIG. 3

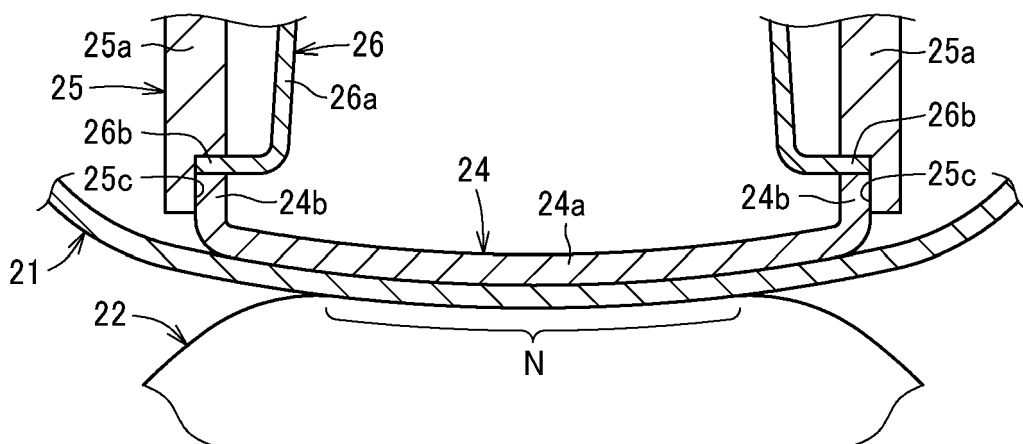


FIG. 4

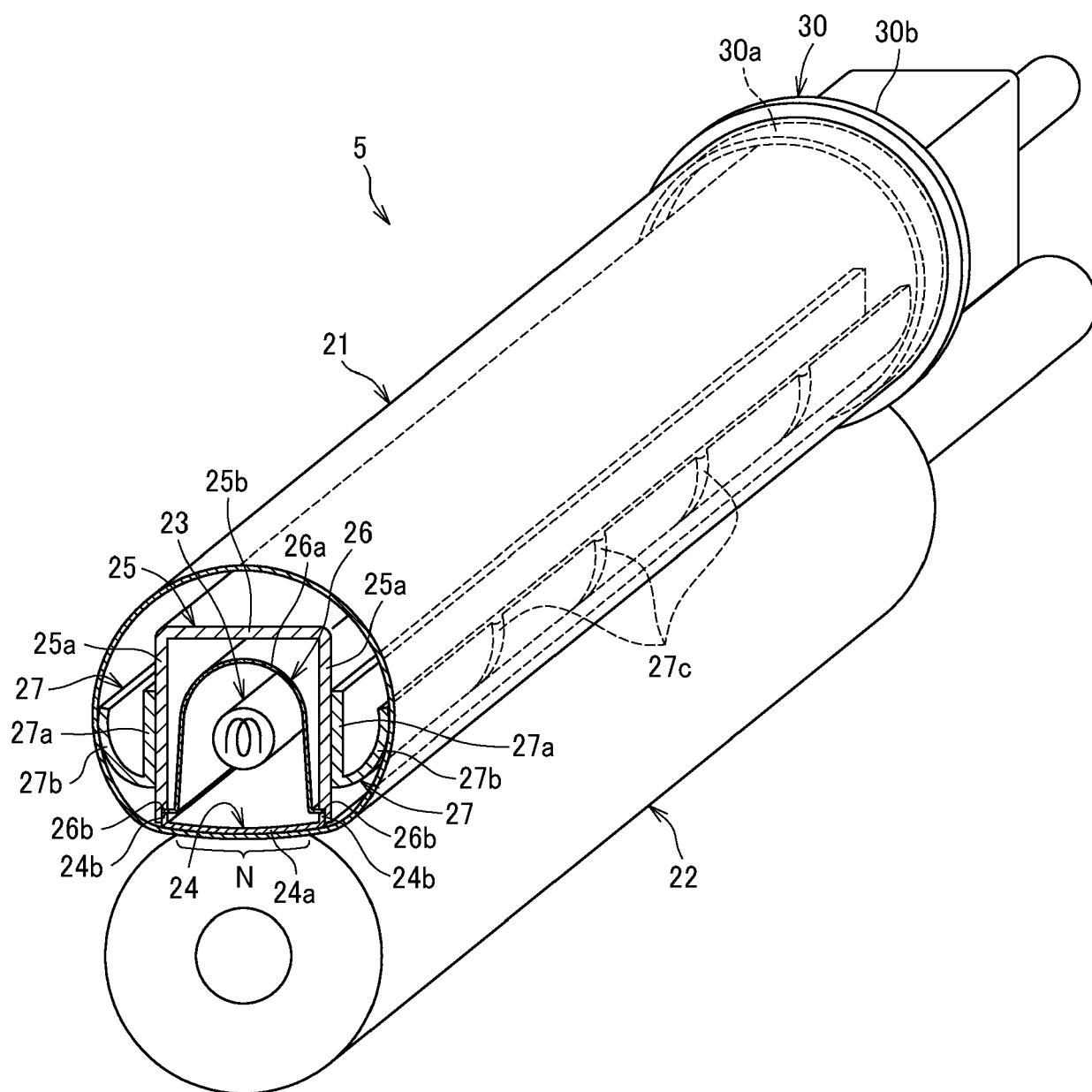


FIG. 5

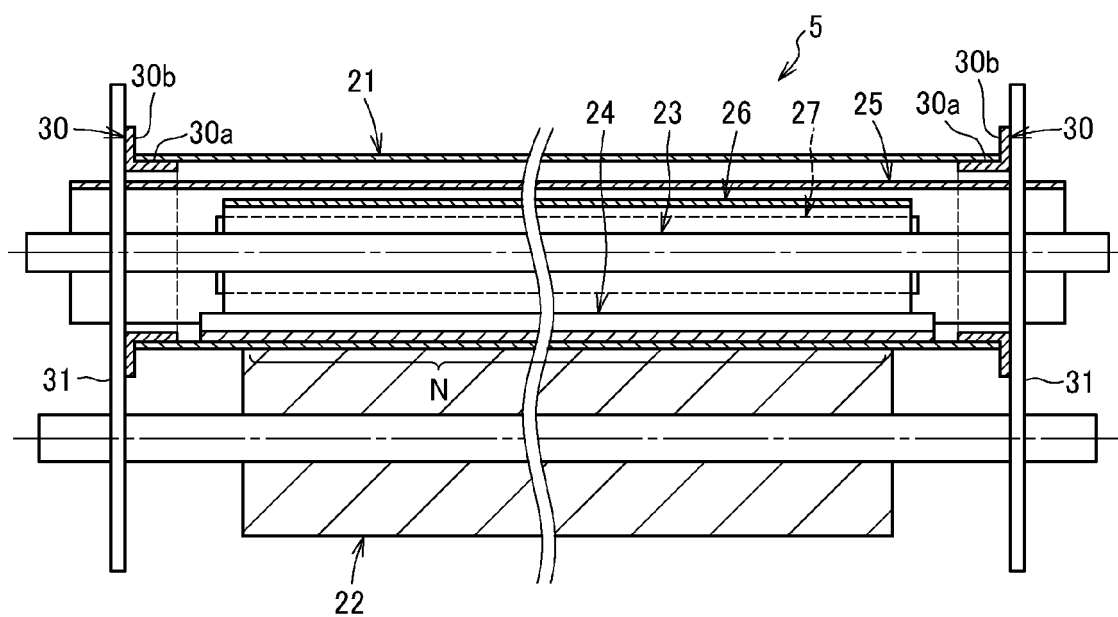


FIG. 6

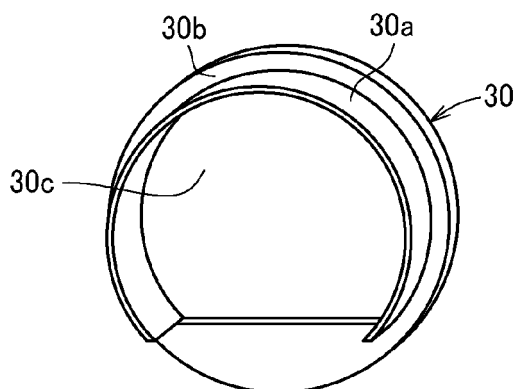


FIG. 7

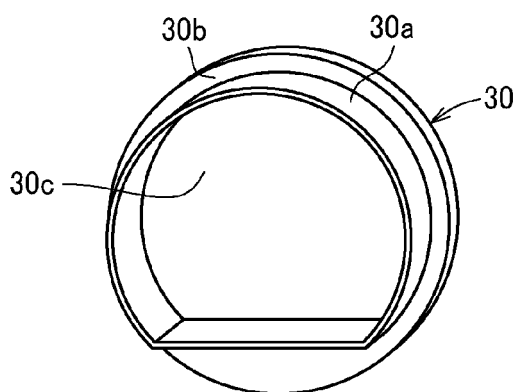


FIG. 8

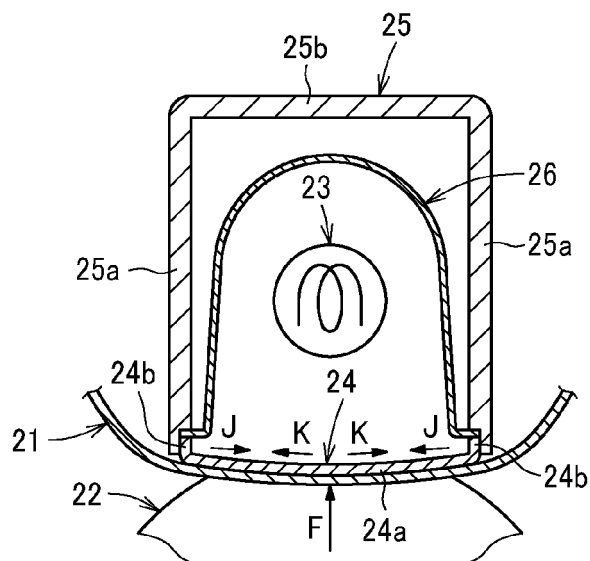


FIG. 9

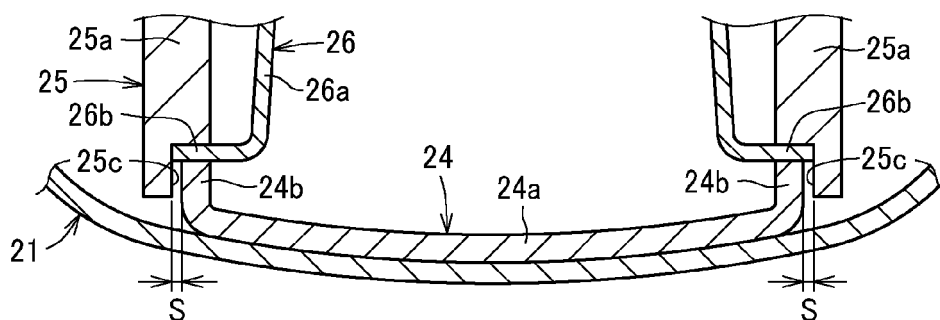


FIG. 10

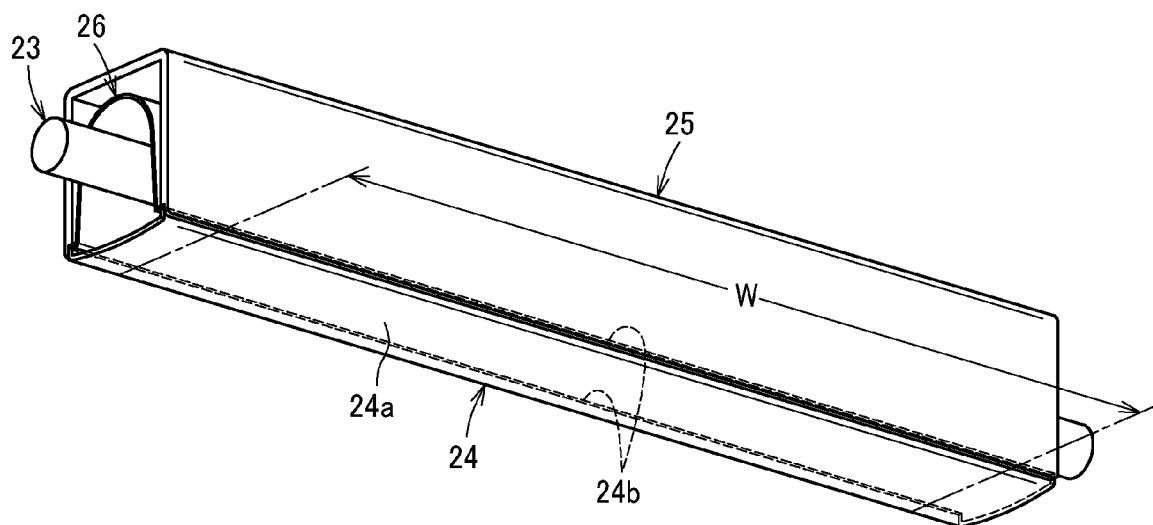


FIG. 11

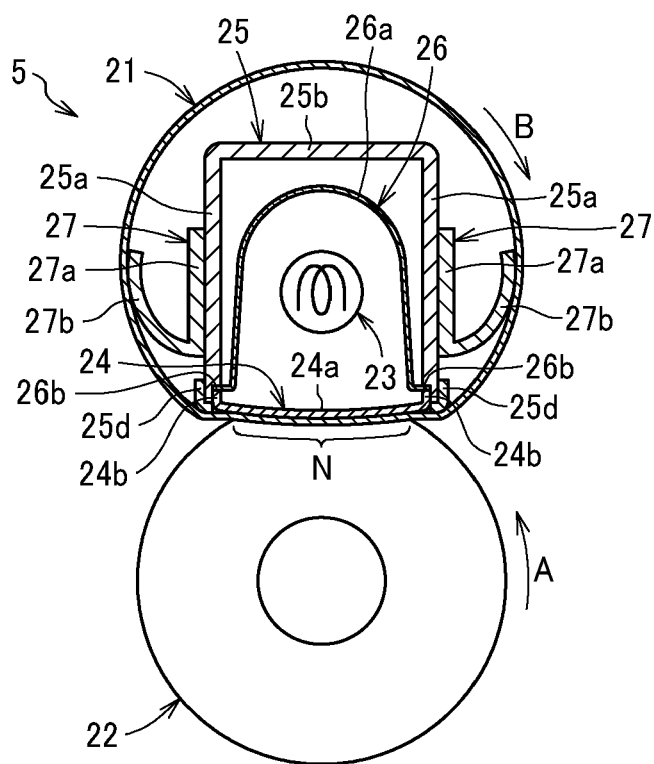


FIG. 12

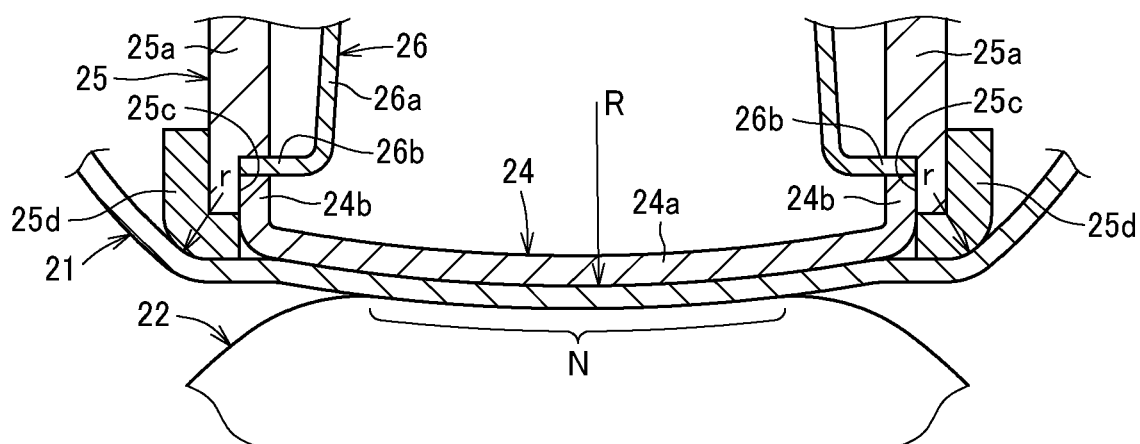


FIG. 13

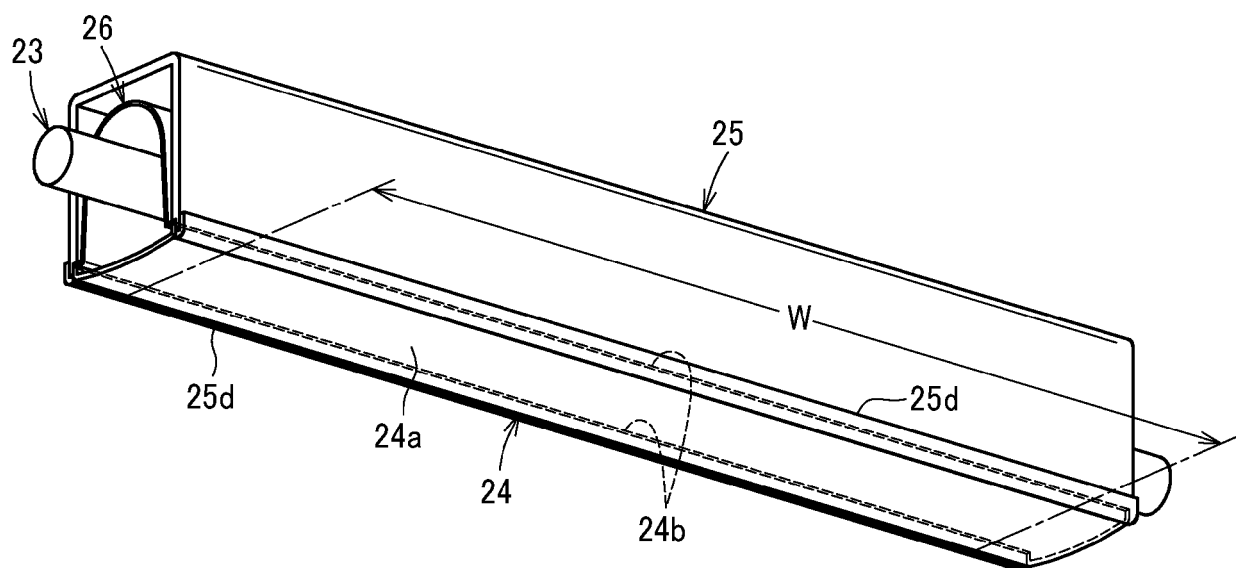


FIG. 14

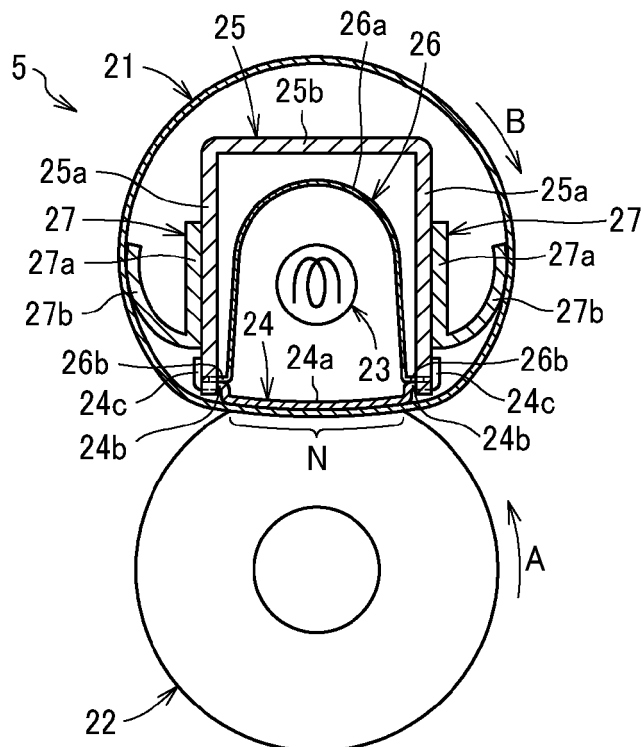


FIG. 15

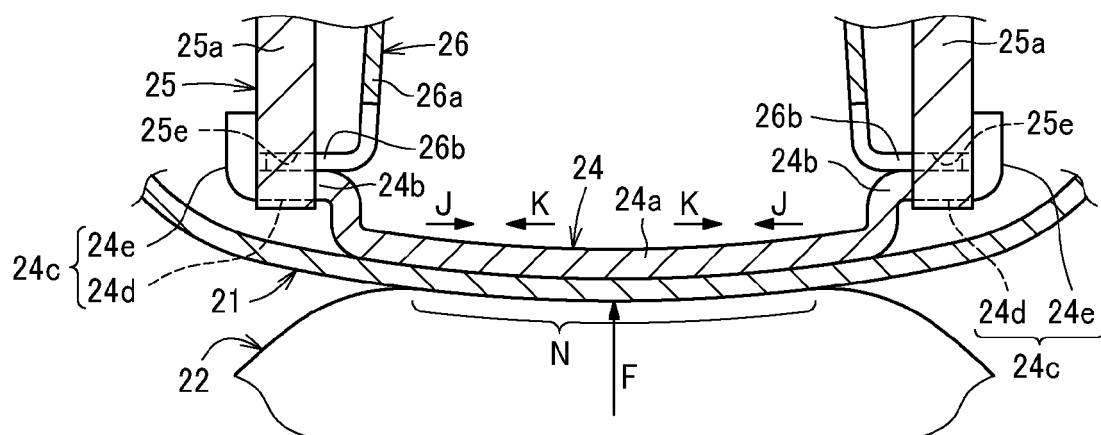


FIG. 16

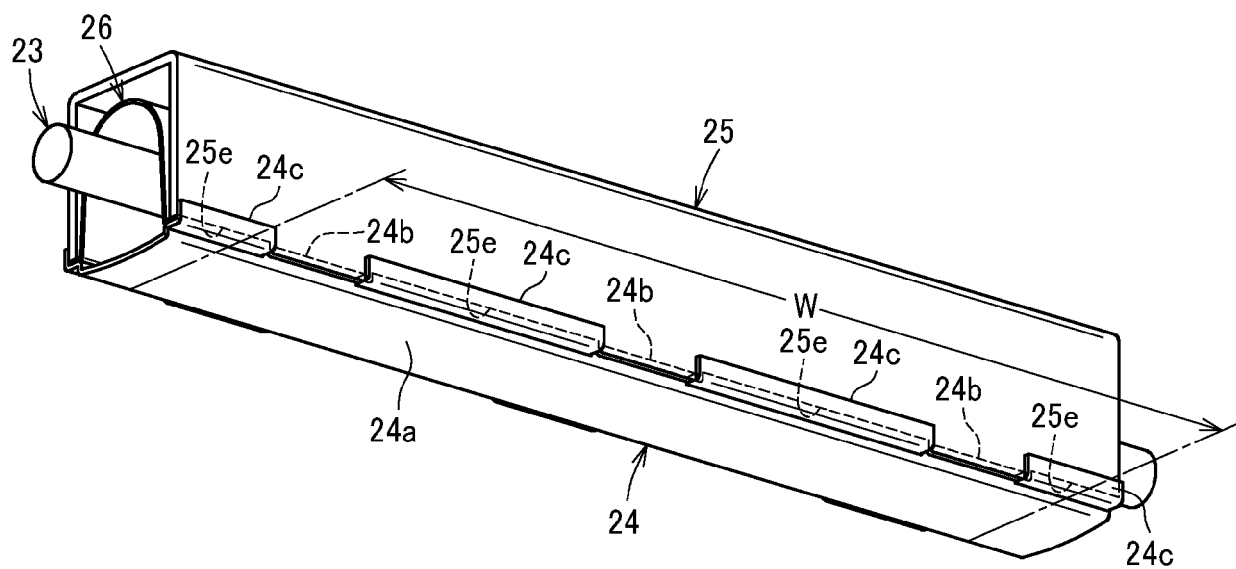


FIG. 17

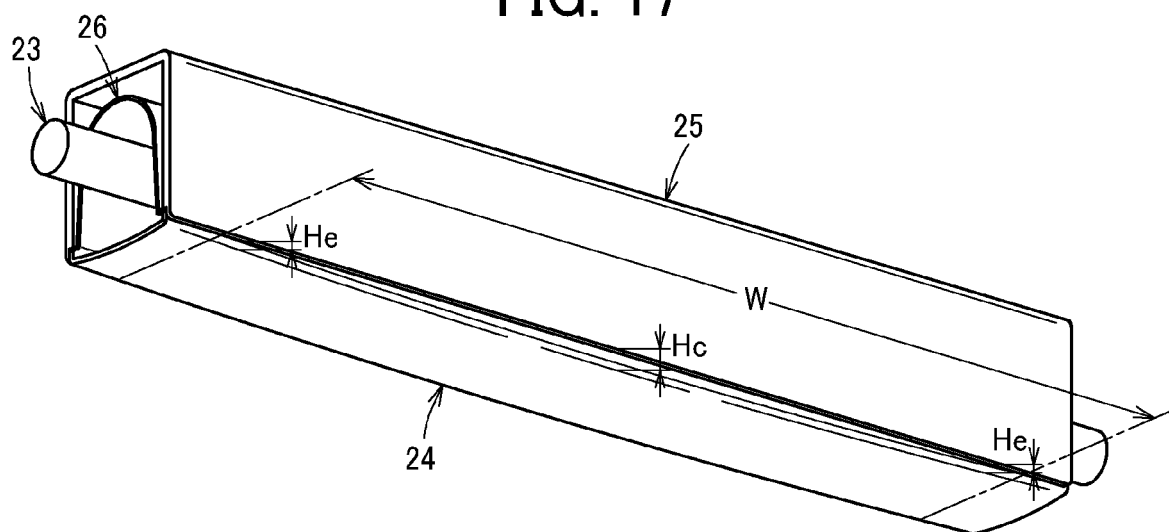


FIG. 18

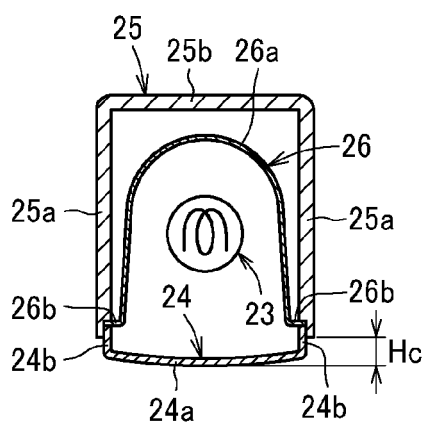


FIG. 19

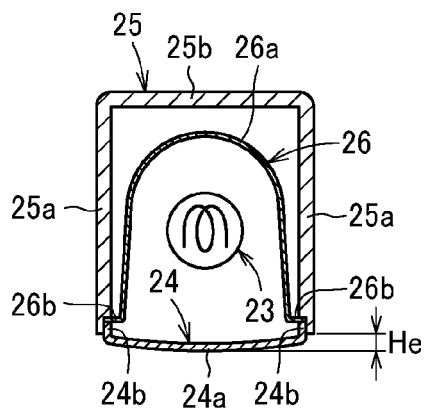


FIG. 20

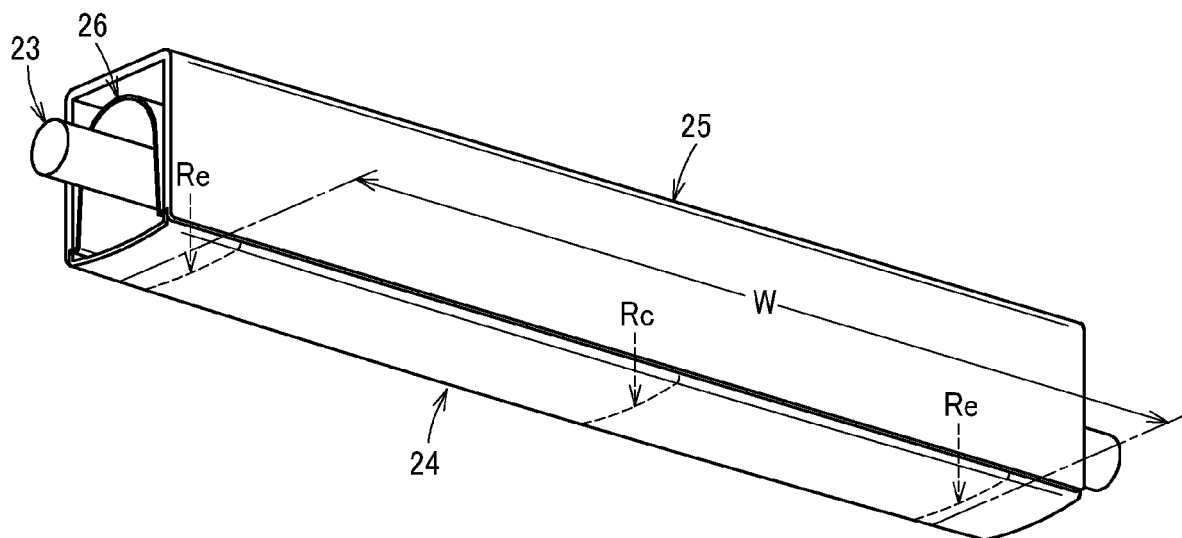


FIG. 21

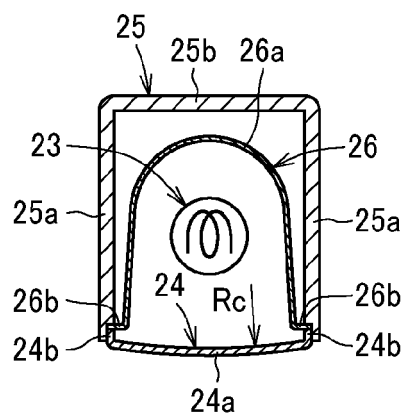


FIG. 22

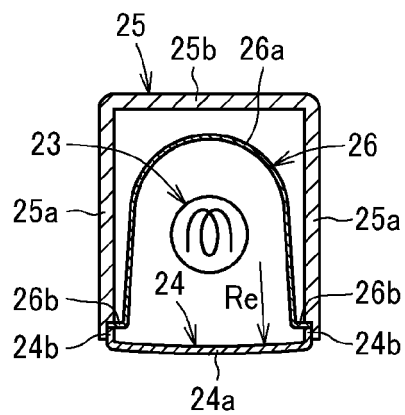
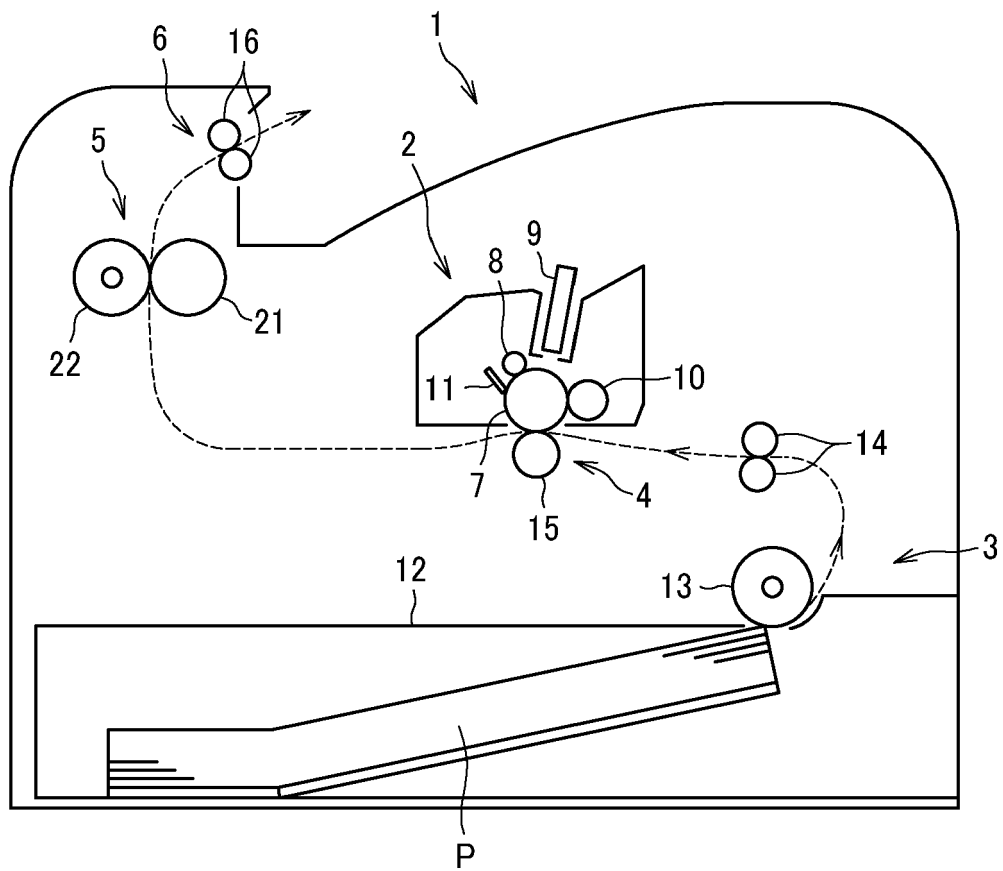


FIG. 23





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 Application Number
 EP 20 15 0267

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Y	* paragraphs [0006], [0024] - [0069] * * figures 1-5 *	4-7,9	
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			G03G
Place of search		Date of completion of the search	Examiner
Munich		9 June 2020	Scarpa, Giuseppe
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