(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 693 802 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.08.2020 Bulletin 2020/33

(51) Int Cl.:
G03G 15/20 *(2006.01)*

(21) Application number: **20154150.5**

(22) Date of filing: **28.01.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **07.02.2019 JP 2019020538**
04.03.2019 JP 2019038475
28.06.2019 JP 2019121360

(71) Applicant: **Ricoh Company, Ltd.**
Tokyo 143-8555 (JP)

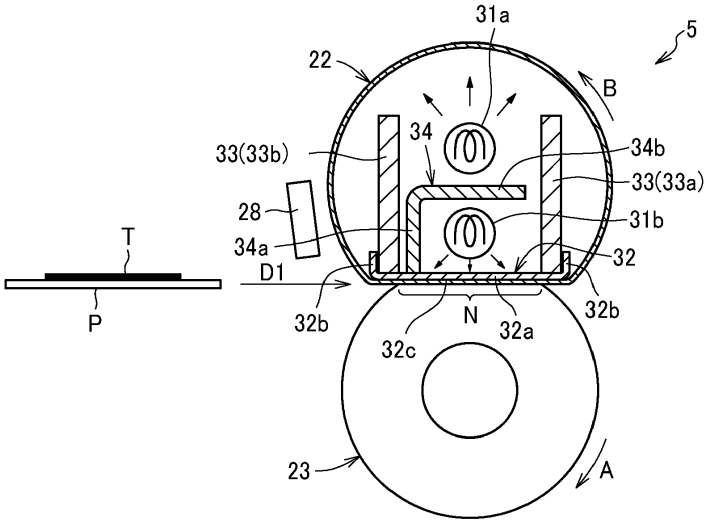
(72) Inventors:
- **KAWABATA, Keisuke**
  Tokyo, 143-8555 (JP)
- **SETO, Takashi**
  Tokyo, 143-8555 (JP)
- **SUGANO, Mitsuko**
  Tokyo, 143-8555 (JP)
- **SUGIYAMA, Ryohhei**
  Tokyo, 143-8555 (JP)
- **SEO, Hiroshi**
  Tokyo, 143-8555 (JP)

(74) Representative: **J A Kemp LLP**
14 South Square
Gray's Inn
London WC1R 5JJ (GB)

(54) FIXING DEVICE AND IMAGE FORMING APPARATUS INCORPORATING SAME

(57) A fixing device (5) includes a fixing member (22), a pressing member (23), a nip formation member (32) pressed by the pressing member (23) via the fixing member (22), a plurality of heat generators (31a, 31b), and a shield (34) inside the fixing member (22) to block heat from the heat generators (31a, 31b). The plurality of heat generators (31a, 31b) includes one heat generator (31b) close to the nip formation member (32) and the other heat generator (31a) farther from the nip formation member (32) than the one heat generator (31b) in a direction that is perpendicular to a recording medium conveyance direction and is not a width direction of the fixing member (22). The shield (34) has a part disposed between the one heat generator (31b) and the other heat generator (31a) in a cross section that intersects the width direction of the fixing member (22).

FIG. 2



EP 3 693 802 A1

Description

BACKGROUND

Technical Field

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

Description of the Related Art

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

[0003] The fixing device includes a fixing belt as a cylindrical fixing member and a heat generator such as a halogen heater disposed inside a loop of the fixing belt to heat the fixing belt. The heat generator heats the fixing belt via a nip formation member disposed inside the loop of the fixing belt and raises a temperature of the fixing belt to a fixing temperature that enables fixing an image onto a recording medium. In the above-described fixing device, preferably, the heat generator quickly heats the fixing belt to make the high speed fixing device.

[0004] For example, JP-2016-35601-A discloses the fixing device including two halogen lamps arranged inside a loop of a fixing film and along a direction perpendicular to a sheet conveyance direction. Including two halogen lamps in the fixing device can increase an amount of heat applied to the fixing film and quickly raise the temperature of the fixing film to the fixing temperature.

[0005] The fixing device including a plurality of heat generators inside the loop of the fixing member as described in JP-2016-35601-A has a disadvantage that one heat generator heats the other heat generator, and the temperature of the other heat generator exceeds a heat-proof temperature of material of the other heat generator.

SUMMARY

[0006] Under the above-described circumstances, an object of the present disclosure is to prevent a plurality of heat generators from heating each other.

[0007] 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.

[0008] Advantageously, the fixing device includes a fixing member in a cylindrical form, a pressing member configured to press an outer surface of the fixing member, a nip formation member disposed inside a loop of the fixing member, a plurality of heat generators disposed inside the loop of the fixing member and configured to heat the fixing member, and a shield disposed inside the loop of the fixing member and configured to block heat from the heat generators. The nip formation member is configured to be pressed by the pressing member via the fixing member to form a fixing nip. The plurality of heat generators includes one heat generator disposed close to the nip formation member and the other heat generator disposed farther from the nip formation member than the one heat generator in a direction that is perpendicular to a recording medium conveyance direction and is not a width direction of the fixing member. The shield has a part disposed between the one heat generator and the other heat generator in a cross section that intersects the width direction of the fixing member.

[0009] According to the present disclosure, providing the shield between the one heat generator disposed near the nip formation member and the other heat generator disposed apart from the nip formation member can prevent the heat generators from heating each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

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

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

FIG. 3 is a perspective view of the fixing device 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 a variation of the belt holder;

FIG. 7 is a vertical cross-sectional view of a fixing device according to a second embodiment of the present disclosure viewed from a lateral side of the fixing device;

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

FIG. 9 is a vertical cross-sectional view of a fixing device according to a fourth embodiment of the present disclosure viewed from a lateral side of the

fixing device;
FIG. 10 is a vertical cross-sectional view of a fixing device according to a fifth embodiment of the present disclosure viewed from a lateral side of the fixing device;
FIG. 11 is a vertical cross-sectional view of a fixing device according to a sixth embodiment of the present disclosure viewed from a lateral side of the fixing device;
FIGS. 12A and 12B are explanatory diagrams each illustrating a shape of one stay having a larger contact area with a nip formation member than the other stay;
FIG. 13 is a vertical cross-sectional view of a fixing device according to a seventh embodiment of the present disclosure viewed from a lateral side of the fixing device;
FIGS. 14A and 14B are perspective views each illustrating an example of a shape of a heat shield partially having an opening in an upright portion in a longitudinal direction of the heat shield illustrated in FIG. 2;
FIG. 15 is a vertical cross-sectional view of a fixing device according to an eighth embodiment of the present disclosure viewed from a lateral side of the fixing device; and
FIG. 16 is a vertical cross-sectional view of a fixing device viewed from a lateral side of the fixing device, which includes a modified heat shield different from the heat shield illustrated in FIG.15.

[0011] The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

DETAILED DESCRIPTION OF EMBODIMENTS

[0012] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that have a similar function, operate in a similar manner, and achieve a similar result.

[0013] Although the embodiments are described with technical limitations with reference to the attached drawings, such description is not intended to limit the scope of the disclosure and all of the components or elements described in the embodiments of this disclosure are not necessarily indispensable.

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

[0015] 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.

[0016] 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 printer, a copier, a facsimile machine or a multifunction peripheral (MFP) having at least two of copying, printing, scanning, facsimile, and plotter functions. The image forming apparatus 1 is not limited to a monochrome image forming apparatus and may be a color image forming apparatus.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] The sheet P bearing the toner image is conveyed to the fixing device 5. In the fixing device 5, heat and pressure when the sheet P passes through between a fixing belt 22 and a pressure roller 23 fixes the toner image onto the sheet P. Subsequently, the sheet P is conveyed to the sheet ejection device 6, and an ejection roller pair 16 ejects the sheet P outside the image forming apparatus 1, and a series of print operations are completed.

[0022] With reference to FIGS. 2 to 6, a detailed description is provided of a construction of the fixing device 5.

[0023] 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 35 to support the fixing belt 22, and FIG. 6 is a perspective view of a variation of the belt holder 35.

[0024] As illustrated in FIG. 2, the fixing device 5 includes the fixing belt 22 as a fixing member, the pressure roller 23 as a pressing member, a halogen heaters 31a and 31b as heat generators, a nip formation member 32, a stay 33 as a contact member, and a heat shield 34. The halogen heaters 31a and 31b, the nip formation member 32, the stay 33, and the heat shield 34 are members extending along a width direction of the fixing belt 22 that is a direction perpendicular to a surface of a sheet of FIG. 2 and a lateral direction in FIG. 4. In the following description, the width direction of the fixing belt 22 is simply referred to as the width direction.

[0025] As illustrated in FIG. 2, the fixing belt 22 is a cylindrical fixing member to fix an unfixed image T to the sheet P and is disposed on the side of the sheet P on which the unfixed image T is held. The fixing belt 22 in the present embodiment is an endless belt or film, including a base layer formed on an inner side of the fixing belt 22 and made of a metal such as nickel and stainless steel (SUS) or a resin such as polyimide, and a release layer formed on the outer side of the fixing belt 22 and made of tetrafluoroethylene-perfluoroalkylvinylether copolymer (PFA), polytetrafluoroethylene (PTFE), or the like. Optionally, an elastic layer made of rubber such as silicone rubber, silicone rubber foam, and fluoro rubber may be interposed between the base layer and the release layer. While the fixing belt 22 and the pressure roller 23 press the unfixed toner image against the sheet P to fix the toner image onto the sheet P, the elastic layer having a thickness of about 100 micrometers elastically deforms to absorb slight surface asperities of the fixing belt 22, preventing variation in gloss of the toner image on the sheet P. In the present embodiment, the fixing belt 22 is thin and has a small loop diameter to decrease the thermal capacity of the fixing belt 22. For example, the base layer of the fixing belt 22 has a thickness of from 20 μm to 50 μm and the release layer has a thickness of from 10 μm to 50 μm. Thus, the fixing belt 22 has a total thickness not greater than 1 mm. When the fixing belt 22 includes the elastic layer, the thickness of the elastic layer may be set to 100 to 300 μm. In order to further decrease the thermal capacity of the fixing belt 22, the fixing belt 22 may have the total thickness not greater than 0.20 mm and preferably not greater than 0.16 mm. In the present embodiment, the fixing belt 22 may have a loop diameter from 20 to 40 mm and preferably 30 mm or less.

[0026] The pressure roller 23 is an opposed member disposed opposite an outer circumferential surface of the fixing belt 22. The pressure roller 23 includes a cored bar; an elastic layer coating the cored bar and being made of silicone rubber foam, fluoro rubber, or the like; and a release layer coating the elastic layer and being made of PFA, PTFE, or the like. According to the present embodiment, the pressure roller 23 is a solid roller. Alternatively, the pressure roller 23 may be a hollow roller. When the pressure roller 23 is the hollow roller, a heater such as a halogen heater may be disposed inside the pressure roller 23. The elastic layer of the pressure roller 23 may be made of solid rubber. Alternatively, if no heater is disposed inside the pressure roller 23, the elastic layer of the pressure roller 23 is preferably made of sponge rubber to enhance thermal insulation of the pressure roller 23. Such a configuration reduces heat conduction from the fixing belt 22 to the pressure roller 23 and improves heating efficiency of the fixing belt 22.

[0027] A driver disposed inside the image forming apparatus 1 drives and rotates the pressure roller 23 in a direction indicated by arrow A in FIG. 2. The rotation of the pressure roller 23 drives the fixing belt 22 to rotate in a direction indicated by arrow B in FIG. 2 (hereinafter, belt rotation direction B) due to frictional force therebetween.

[0028] The pressure roller 23 and the fixing belt 22 are configured to be able to contact and separate from each other. If the sheet is jammed in the nip N, separating the pressure roller 23 and the fixing belt 22 from each other and opening the nip N enables the jammed sheet to be removed. One of the pressure roller 23 and the fixing belt 22 may be configured to be fixed and the other may be configured to be movable so that the pressure roller 23 and the fixing belt 22 contact and separate from each other. Alternatively, both the pressure roller 23 and the fixing belt 22 may be configured to move so that the pressure roller 23 and the fixing belt 22 contact and separate from each other.

[0029] The halogen heaters 31a and 31b are heat generators disposed inside a loop of the fixing belt 22 and emitting infrared light, and radiant heat from the halogen heaters 31a and 31b heats the fixing belt 22 from the inside. In the present embodiment, one heater 31a is

positioned near the nip formation member 32, and the other heater 31b is positioned farther from the nip formation member 32 than the heater 31a. The heaters 31a and 31b are arranged side by side in the vertical direction in FIG. 2, that is, in a direction perpendicular to the fixing nip N. In the present embodiment, the halogen heaters 31a and 31b may have different heating areas, for example, the heater 31a heats a central portion of the fixing belt 22 in the width direction of the fixing belt 22, and the heater 31b heats end portions of the fixing belt 22 in the width direction.

[0030] The nip formation member 32 sandwiches the fixing belt 22 together with the pressure roller 23, to form the fixing nip N. Specifically, the nip formation member 32 is disposed inside the loop of the fixing belt 22 and extends in the longitudinal direction thereof parallel to the width direction of the fixing belt 22. The nip formation member 32 has a planar nip formation portion 32a that is in contact with an inner circumferential surface of the fixing belt 22 and a pair of curved portions 32b that are bent from both end portions of the nip formation portion 32a in a belt rotation direction B to the opposite side to the pressure roller 23.

[0031] A pressing member such as a spring presses the pressure roller 23 against the nip formation member 32, which causes the pressure roller 23 to contact the fixing belt 22 and form the fixing nip N between the pressure roller 23 and the fixing belt 22. When the sheet P is conveyed through the nip N, heat and pressure in the fixing nip N fixies the unfixed image T onto the surface of the sheet P. The conveyance direction of the sheet P in the fixing device 5 is a direction from the left to the right in FIG. 2 (see a direction indicated by arrow D1 in FIG. 2).

[0032] A nip formation surface 32c on the nip formation portion 32a facing the fixing belt 22 directly contacts the inner circumferential surface of the fixing belt 22. Therefore, when the fixing belt 22 rotates, the fixing belt 22 slides along the nip formation surface 32c. In order to improve the abrasion resistance and the slidability of the nip formation surface 32c, preferably the nip formation surface 32c is treated with an alumite or a fluororesin material coating. Additionally, a lubricant such as a fluorine-based grease may be applied to the nip formation surface 32c to ensure slidability over time. In the present embodiment, the nip formation surface 32c is planar. Alternatively, the nip formation surface 32c may define a recess or other shape. For example, the nip formation surface 32c having a concave shape recessed to the side opposite to the pressure roller 23 leads the outlet of the sheet in the fixing nip N to be closer to the pressure roller 23, which improves separation of the sheet from the fixing belt 22.

[0033] The nip formation member 32 is made of a material having a thermal conductivity larger than a thermal conductivity of the stay 33. For example, the material of the nip formation member 32 is preferably copper (thermal conductivity: 398 W / mK) or aluminum (thermal conductivity: 236 W / mK). The nip formation member 32 made of the material having such a large thermal conductivity absorbs the radiant heat from the halogen heater 31b and effectively transfers heat to the fixing belt 22. For example, setting the thickness of the nip formation member 32 to 1 mm or less can shorten a heat transfer time in which the heat transfers from the nip formation member 32 to the fixing belt 22, which is advantageous in shortening a warm-up time of the fixing device 5. In contrast, setting the thickness of the nip formation member 32 to be larger than 1 mm but not larger than 5 mm can improve a heat storage capacity of the nip formation member 32.

[0034] The stay 33 is the contact member that contacts a rear side surface of the nip formation member 32 to support the nip formation member 32 against the pressure of the pressure roller 23. In the present embodiment, the stays 33 are a pair of members provided on both sides of the nip formation member 32 in a sheet conveyance direction and extend in a direction perpendicular to the sheet conveyance direction that is a pressing direction of the pressure roller 23 (a vertical direction in FIG. 2), and one end of each stay 33 contacts the nip formation member 32. The stays 33 are provided on both sides of the halogen heaters 31a and 31b in the sheet conveyance direction. In other words, the halogen heaters 31a and 31b are sandwiched between the pair of stays 33.

[0035] When the stay 33 supports the nip formation member 32, this means that a surface of the nip formation member 32 opposite the pressure roller 23 that is an upper surface in FIG. 2 contacts the stay 33 having a portion extending in the pressing direction of the pressure roller 23 (the vertical direction in FIG. 2) or a certain thick portion. Such a configuration reduces a bend of the nip formation member 32 caused by the pressing force from the pressure roller 23, in particular, the bend in the longitudinal direction of the nip formation member 32 in the present embodiment. The term "extending in the pressing direction" is not limited to "extending in the same direction as the pressing direction of the pressure roller 23" but includes "extending in a direction with a certain angle from the pressing direction of the pressure roller 23". Even in such cases, the stay 33 can reduce the bend of the nip formation member 32 against the pressing force from the pressure roller 23.

[0036] Extending the stays 33 in the pressing direction of the pressure roller 23 strengthens the rigidity of the stay 33 in the pressing direction and reduces the bend of the nip formation portion 32a caused by the pressing force of the pressure roller 23. Such a configuration results in a uniform width of the nip in the longitudinal direction. In particular, when the stays 33 extending in the pressing direction as described above are disposed on both end portions of the nip formation portion 32a in the sheet conveyance direction, that is, right and left end portions of the nip formation portion 32a in FIG. 2, the stays 33 can support both end portions of the nip formation portion 32a and efficiently reduce the bend of the nip formation portion 32a. The stay 33 is preferably made of

an iron-based metal such as stainless steel (SUS) or Steel Electrolytic Cold Commercial (SECC) that is electrogalvanized sheet steel to ensure rigidity. In addition, the stay 33 is made with a suitable thickness to ensure the rigidity and is thicker than the heat shield 34.

[0037] The heat shield 34 is a member that blocks heat transfer between two halogen heaters 31a and 31b. The heat shield 34 has an upright portion (a contact portion) 34a that extends in a direction perpendicular to the sheet conveyance direction and contacts the nip formation member 32 at one end of the upright portion 34a and a bent portion (a shield portion) 34b that is continuously bent from the upright portion 34a toward downstream in the sheet conveyance direction. The bent portion 34b is disposed between the halogen heaters 31a and 31b in a cross-section perpendicular to the width direction of the fixing belt 22 that is a sheet surface in FIG. 2 and is the shield portion to block the heat transfer between the halogen heaters 31a and 31b. For example, the heat shield 34 may be made by bending a metal plate.

[0038] When the above-described fixing device 5 fixes the unfixed image T onto the sheet P, a driver disposed inside the image forming apparatus 1 drives and rotates the pressure roller 23 in a direction indicated by arrow A in FIG. 2. The fixing belt 22 is driven and rotated by the pressure roller 23 as the pressure roller 23 rotates. At this time, the radiant heat from the halogen heaters 31a and 31b heats the fixing belt 22 to a fixing temperature. After the toner image is transferred onto the sheet P, the sheet P bearing the unfixed toner image T is conveyed to a fixing nip N between the fixing belt 22 and the pressure roller 23. The rotating fixing belt 22 and the rotating pressure roller 23 conveys the sheet P, and the sheet P passes through the fixing nip N. When the sheet P passes through the fixing nip N, heat and pressure applied to the sheet P fix the unfixed toner image T onto the sheet P.

[0039] As illustrated in FIG. 4, a pair of belt holders 35 is inserted in both lateral ends of the fixing belt 22 in the axial direction of the fixing belt 22 to rotatably support the fixing belt 22. As described above, the belt holders 35 inserted into the inner periphery of the fixing belt 22 support the fixing belt 22 in a state in which the fixing belt 22 is not basically applied with tension in a circumferential direction thereof while the fixing belt 22 does not rotate, that is, by a free belt system.

[0040] As illustrated in FIGS. 3 to 5, the belt holders 35 include a C-shaped supporter 35a inserted into the inner periphery of the fixing belt 22 to support the fixing belt 22 and a flange 35b that contacts an end face of the fixing belt 22 to stop a movement of the fixing belt 22 in the width direction, that is, walking of the fixing belt 22 in the width direction. As illustrated in FIG. 6, the supporter 35a may have a cylindrical shape which is continuous over its entire circumference. As illustrated in FIG. 4, each of belt holders 35 is fixed on a pair of side plates 36 that are frames of the fixing device 5. The belt holder 35 has an opening 35c as illustrated in FIG. 5, and both ends of the halogen heaters 31a and 31b and the stay 33 are fixed to the side plates 36 through the openings 35c. The halogen heaters 31a and 31b and the stay 33 may be fixed to the belt holder 35.

[0041] Next, a description is provided of heating the fixing belt 22 by the halogen heaters 31a and 31b in the present embodiment.

[0042] As illustrated in FIG. 2, the halogen heaters 31a and 31b radiate radiant heat when a start of an image formation allows a current to flow the halogen heaters 31a and 31b.

[0043] The halogen heater 31a is sandwiched by the stays 33 in a lateral direction of FIG. 2, and the bent portion 34b of the heat shield 34 blocks downward heat transfer in FIG. 2. Therefore, as indicated by arrows near the halogen heater 31a in FIG. 2, the halogen heater 31a mainly heats an upper part of the fixing belt 22 in FIG.2. The halogen heater 31b is sandwiched by the stays 33 in the lateral direction of FIG. 2, and the bent portion 34b blocks upward heat transfer in FIG. 2. Therefore, as indicated by arrows near the halogen heater 31b in FIG. 2, the halogen heater 31b mainly heats the fixing belt 22 in the fixing nip N via the nip formation member 32.

[0044] As described above, the bent portion 34b disposed between the two halogen heaters 31a and 31b blocks the heat transfer between the two heaters and prevents the radiant heat of one heater from heating the other heater. Therefore, for example, when the halogen heaters 31a and 31b generate heat for a long time, the bent portion 34b can prevent the halogen heaters 31a and 31b themselves from becoming a high temperature and exceeding the heat resistance temperature of the halogen heaters 31a and 31b. Additionally, the bent portion 34b prevents the halogen heaters 31a and 31b from heating each other, which can prevent increase of an unnecessary amount of heat that does not contribute to heating the fixing belt 22.

[0045] In addition, in the present embodiment, contact between the nip formation member 32 and an end of the upright portion 34a that is one portion of the heat shield 34 can transfer heat of the heat shield 34 to the fixing belt 22 via the nip formation member 32. In particular, the bent portion 34b is disposed between the heaters 31a and 31b as described above, receives the radiant heat of both heaters, and can transfer the heat to the fixing belt 22 via the nip formation member 32 to efficiently heat the fixing belt 22. Transferring the heat received by the heat shield 34 to the nip formation member 32 can prevent the heat shield 34 from being heated to a high temperature when the heaters 31a and 31b generate heat for a long time. Therefore, when the heat shield 34 functions as a reflector that reflects radiant heat, the above-described structure can prevent a decrease in reflectance of the heat shield 34 caused by high-temperature discoloration of the heat shield 34.

[0046] The heat shield 34 extends in the longitudinal direction that is the direction perpendicular to the surface of the sheet of FIG. 2, and a part of the heat shield 34 in the longitudinal direction may be cut out. For example,

as illustrated in FIG. 14A, the heat shield 34 may have an opening 34c in a central portion of the upright portion 34a in the longitudinal direction. Providing the opening 34c in a portion of the heat shield 34 other than a portion disposed between the heaters 31a and 31b, for example, the bent portion 34b does not impair the shielding function of the heat shield 34 and can reduce the thermal capacity of the heat shield 34. Reducing the thermal capacity causes the heat shield 34 to easily heat, and an amount of heat in the heat shield 34 is efficiently transferred to the nip formation member 32 via the upright portion 34a. In particular, in the present embodiment, the heater 31b heats a longitudinal end portion of the nip formation member as a heating region, and providing the opening 34c in the portion of the heat shield 34 other than a portion corresponding to the heating region enables the heater 31b to efficiently heat the upright portion 34a.

[0047] Alternatively, as a configuration different from that of the present embodiment, when the heater 31b heats a longitudinal center portion as the heating region, as illustrated in FIG. 14B, the heat shield 34 may have the upright portion 34a disposed in the longitudinal center portion of the heat shield 34 and reduce the thermal capacity of the heat shield 34. Note that each of the heat shields 34 illustrated in FIGS. 14A and 14B has a second bent portion 34d extending in the sheet conveyance direction from one end of the upright portion 34a.

[0048] Hereinafter, other embodiments of the fixing device 5 according to the present disclosure are described that have the stay and the heat shield different from the above-described embodiments. Redundant descriptions concerning the configurations similar to that of the above-described embodiments are omitted, focusing on the different configurations.

[0049] As illustrated in FIG. 7, in the present embodiment, among the pair of stays 33a and 33b disposed in the fixing device 5, the stay 33b disposed upstream in the sheet conveyance direction is bent in the middle. Specifically, the stay 33b has an upright portion (a contact portion) 33b1 that extends in the direction perpendicular to the sheet conveyance direction and different from the width direction of the fixing belt 22 and contacts the nip formation member 32 at one end of the upright portion 33b1 and a bent portion 33b2 that is continuously bent from the upright portion 33b1 toward upstream in the sheet conveyance direction.

[0050] The bent portion 33b2 is disposed between the heaters 31a and 31b. That is, the bent portion 33b2 is the shield portion to block the heat transfer between the heaters 31a and 31b, and, in the present embodiment, the stay 33b also functions as the heat shield.

[0051] Thus, in the present embodiment, the bent portion 34b of the heat shield 34 and the bent portion 33b2 of the stay 33 are disposed between the heaters 31a and 31b. An air layer exists between the bent portion 34b and the bent portion 33b2. That is, between the heaters 31a and 31b, there are the bent portion 34b, the air layer, and the bent portion 33b2. Providing two shield portions with two different members between the heaters 31a and 31b can improve the blocking effect of heat transfer between the heaters 31a and 31b.

[0052] In the present embodiment, since the stay 33 is bent in the middle so that the upper end of the stay 33b, that is, the upper end surface of the bent portion 33b2 is under the halogen heater 31a in FIG. 7, the radiant heat of the heater 31a reaches a larger area on the fixing belt 22 than that of the above-described embodiments.

[0053] Alternatively, as illustrated in FIG. 8, the stay 33 may be bent in a direction away from the halogen heater 31a. In the present embodiment, the stays 33a and 33b have the upright portions 33a1 and 33b1 and the curved portions 33a3 and 33b3 continuously provided on the upright portions 33a1 and 33b1 and bent outward in the radial direction of the fixing belt 22 in a direction away from the heater 31a, respectively. The above-described structure can increase the area on the fixing belt 22 that the radiant heat of the heater 31a reaches because the upper end of the stays 33a and 33b and the heat shield 34 is under the heater 31a. In the present embodiment, both the stays 33a and 33b have the curved portions 33a3 and 33b3, respectively, but either one of the stays 33a and 33b may have the bent portion.

[0054] As illustrated in FIG. 9, a coated surface 40 may be provided on the surface of the heat shield 34. Coating the coated surface 40 with a black coating agent having a higher absorption coefficient of heat or light, which is the infrared light in the present embodiment, than the surface of the heat shield 34 enables the heat shield 34 to efficiently absorb the heat from the heaters 31a and 31b and transfer a large amount of heat to the nip formation member 32. Therefore, the above-described structure can efficiently heat the fixing belt 22 in the fixing nip N.

[0055] In contrast, the coated surface 40 may be coated with a coating agent having a higher reflectance for heat or light, which is the infrared light in the present embodiment, than the surface of the heat shield 34. The above-described structure can increase an amount of heat reflected from the heat shield 34 to the fixing belt 22 and the nip formation member 32 among the heat radiated from the heaters 31a and 31b to the heat shield 34. Increasing the amount of heat reflected from the heat shield 34 prevents the heat shield 34 from overheating. In particular, in the present embodiment, since the heat shield 34 is in contact with the nip formation member 32 and transfers heat to the nip formation member 32 as described above, the heat shield 34 is unlikely to reach a high temperature. Therefore, even if the heaters 31a and 31b generates heat for a long time, the above-described structure can prevent the decrease in the reflectance of the heat shield 34 caused by the high temperature discoloration of the heat shield 34.

[0056] These coating agents may be combined and applied. For example, among the coated surfaces 40 of the heat shield 34, a coated surface 40a facing the heater 31a may be coated with the coating agent having the

high reflectance for the infrared light, and a coated surface 40b facing the heater 31b may be coated with the black coating agent having high absorption coefficient for the infrared light. As a result, the infrared light reflected by the heat shield 34 increases the radiant heat that reaches the fixing belt 22 from the heater 31a, which enables the heater 31a to efficiently heat an upper portion of the fixing belt 22 in FIG. 9. In addition, increase in the amount of radiant heat of the heater 31b absorbed by the coated surface 40b of the heat shield 34 increases the amount of heat transferred from the heat shield 34 to the nip formation member 32.

[0057] Additionally, as illustrated in FIG. 10, a coated surface 41 may be provided on the surfaces facing the heater 31a of the curved portions 33a3 and 33b3 of the stays 33. The coated surface 41 may be coated with the coating agent having the higher reflectance for heat or light, which is the infrared light in the present embodiment, than the surfaces facing the heater 31a of the curved portions 33a3 and 33b3. The above-described structure reduces the radiant heat radiated from the heater 31a and absorbed by the stay 33 and can efficiently heat the fixing belt 22. Of course, as described above, the different types of coating agents may be combined and applied to such coated surfaces 40 and 41. Furthermore, the stays 33a and 33b illustrated in FIG. 9 or the like may have the coated surface.

[0058] The coated surface described above may be disposed over the entire portion of the stay and the heat shield in the longitudinal direction or may be disposed on a part of the stay or the heat shield. An area of the coated surface may be set corresponding to heat generation areas of the heaters 31a and 31b. For example, the coating agent is applied to a central portion of the surface facing the heater 31a in the longitudinal direction, that is, the width direction of the fixing belt, and an end portion facing the heater 31b in the longitudinal direction. The above-described structure can obviate unnecessary coating and reduce cost of coating.

[0059] Alternatively, the stay 33b (or stay 33a) may function as the heat shield, and the heat shield 34 may be obviated. For example, in the fixing device 5 illustrated in FIG. 11, the stay 33b that is downstream in the sheet conveyance direction out of the pair of stays 33a and 33b has a upright portion 33b1 as the contact portion that contacts the nip formation member 32 and a bent portion 33b2 as the heat shield that is bent downstream in the sheet conveyance direction and continuously disposed on the upright portion 33b1, and the stay 33b functions as the heat shield.

[0060] The bent portion 33b2 is disposed between the heaters 31a and 31b and can block the heat transfer between the two heaters 31a and 31b. The stay 33b is in contact with the nip formation member 32 at one end of the stay 33b and can transfer the heat received from both the heaters 31a and 31b to the nip formation member 32.

[0061] In the above configuration, preferably, a contact area of the stay 33b with the nip formation member 32 is larger than a contact area of the stay 33a with the nip formation member 32. To support the back of the nip formation member 32, the stays 33a and 33b are designed thicker than the heat shield 34 illustrated in FIG. 2 and designed to have a larger thermal capacity than the heat shield 34. Additionally, since the stay 33b has the bent portion 33b2 that receives a lot of heat amount from both heaters 31a and 31b, the stay 33a receives relatively smaller heat amount from both heaters 31a and 31b than the stay 33b and is less likely to reach a high temperature. Therefore, preferably, the stay 33a has the contact area to support the nip formation member 32, and the stay 33b has the large contact area with the nip formation member 32 to facilitate heat transfer from the stay 33b to the nip formation member 32 when the heaters 31a and 31b generate heat and raise temperature largely. A method employed to design relatively large contact area of the stay 33b with the nip formation member 32 is, for example, as illustrated in FIG. 12A, designing a thickness of a part of one end portion of the stay 33b that contacts the nip formation member 32 larger than a part of the stay 33a that contacts the nip formation member 32, or, as illustrated in FIG. 12B, designing the stay 33a that is intermittently brought into contact with the nip formation member 32 in the longitudinal direction (the lateral direction in FIG. 12B) to reduce the contact area.

[0062] The stay 33b that also functions as the heat shield as described above can reduce the number of parts and the cost of the fixing device 5. Since the above-described configuration can design the stay 33b thicker and design the stay 33b to have a larger thermal capacity than a configuration having the heat shield and the stay separately, the temperature rise of the stay 33b is moderately even when the heaters 31a and 31b heat the stay 33b for a long time. In contrast, since the configuration described in the above embodiments having the heat shield and the stay separately can design the stay 33b thinner and design the stay 33b to have a smaller thermal capacity than the configuration in which the stay 33b functions as the heat shield, the configuration having the heat shield and the stay separately has an advantage that the stay 33b can efficiently transfer the heat to the nip formation member 32.

[0063] The surface of the stays 33a and 33b as illustrated in FIG. 11 may be also coated with the black coating agent having the higher absorption coefficient of heat or light, which is the infrared light in the present embodiment, than the surface of the stays 33a and 33b to increase the absorption coefficient of the radiant heat from the heaters 31a and 31b, In contrast, the surface of the stay 33a and 33b may be coated with the coating agent having the higher reflectance for heat or light, which is the infrared light in the present embodiment, than the surface of the stays 33a and 33b. In addition, these coating agents may be combined and applied to the stays 33a and 33b. The coating agent described above may be applied to a part of the stay in the longitudinal direction.

[0064] Next, the fixing device 5 according to the embodiment illustrated in FIG. 13 includes the heat shield 42 facing the heater 31a, the heat shield 43 facing the heater 31b, and the stay 33 having the shield portion 332.

[0065] Specifically, the stay 33 has upright portions (contact portions) 331 that extend in the direction perpendicular to the sheet conveyance direction and the shield portion 332 that bridges both upright portions 331 on the opposite side of the nip formation member 32. The upright portions 331 are in contact with the backside surface of the nip formation portion 32a at both end portions in the sheet conveyance direction, that is, a left end portion and a right end portion in FIG. 13, to reduce a bend of the nip formation portion 32a at both end portions in the sheet conveyance direction. The shield portion 332 is disposed between the heaters 31a and 31b in the cross-section perpendicular to the width direction of the fixing belt 22 to block the heat transfer between the heaters 31a and 31b. As described above, in the present embodiment, the stay 33 functions as the heat shield.

[0066] The heat shield 42 has a substantially L-shaped cross section having a first portion extending in the sheet conveyance direction and disposed between the heaters 31a and 31b in the cross-section perpendicular to the width direction of the fixing belt 22 and a second portion extending from one end of the first portion in the direction perpendicular to the sheet conveyance direction. In the heat shield 42, the first portion blocks heat transfer between the heaters 31a and 31b, and the second portion blocks a part of heat radiated from the heater 31a to the upstream side in the sheet conveyance direction.

[0067] The heat shield 43 has upright portions that are both end portions in the sheet conveyance direction and extend in the direction perpendicular to the sheet conveyance direction and a shield portion that connects the upright portions and is disposed between the heaters 31a and 31b in the cross-section perpendicular to the width direction of the fixing belt 22 to block the heat transfer between the heaters 31a and 31b. The heat shield 43 covers the heater 31b but does not cover a portion facing the nip formation member 32. The upright portions of the heat shield 43 are in contact with the nip formation member 32 and transfer heat received from the heater 31b to the nip formation member 32.

[0068] In the present embodiment, the heat shields 42 and 43 function as reflectors that reflect heat or light, which is the infrared light in the present embodiment. That is, the heat shields 42 and 43 are configured by members having high reflectance of the heat or light and can reflect the radiant heat that reaches the heat shields 42 and 43 from the heaters 31a and 31b. The above-described structure can prevent the heat shields 42 and 43 from overheating and improve heat efficiency of heating the fixing belt 22. Similar to the above described embodiments, the surface of the heat shield 42 facing the heater 31a and the surface of the heat shield 43 facing the heater 31b may be coated with the coating agent having a higher reflectance for heat or light than the surfaces of the heat shields 42 and 43.

[0069] In the present embodiment, arranging the heat shield 42, the shield portion 332 of the stay 33, the air layer, and the heat shield 43 between the heaters 31a and 31b can efficiently prevent the heaters 31a and 31b from overheating each other. In particular, the heater 31b is covered with the heat shield 43 except for the portion facing the fixing nip N and can efficiently heat the portion facing the fixing nip N.

[0070] Next, in the embodiment as illustrated in FIG. 15, the heat shield 34 has the bent portion 34b as the shield portion that extends in a direction inclined with respect to the nip formation member 32 and not parallel to the nip formation member 32. Specifically, the bent portion 34b is inclined so that, with respect to one end of the bent portion 34b continuously connected to the upright portion 34a, the other end of the bent portion 34b is located at upper side in FIG. 15, that is, the side closer to the heater 31a. Accordingly, the inclined bent portion 34b can be closer to the heater 31a than the bent portion parallel to the nip formation member 32 and efficiently reflect the radiant heat from the heater 31a to the fixing belt 22. Therefore, the heater 31a can efficiently heat the central portion of the fixing belt 22 in the width direction.

[0071] The surface of the bent portion 34b facing the heater 31a has the coated surface 40a coated with the coating agent having higher reflectance for the infrared light than the surface of the bent portion 34b, and the surface of the stay 33 facing the heater 31a has the coated surface 41 coated with the coating agent having higher reflectance for the infrared light than the surface of the stay 33. The above-described structure can efficiently reflect the radiant heat from the heater 31a to the fixing belt 22. In addition, the surface of the bent portion 34b facing the heater 31b has the coated surface 40b coated with the coating agent having the higher absorption coefficient for the infrared light than the surface of the bent portion 34b to increase the heat amount transferred from the heat shield 34 to the nip formation member 32.

[0072] Additionally, as illustrated in FIG. 16, the heat shield 34 may have a second bent portion 34d bent from the tip end of the bent portion 34b toward the stay 33a. According to the above, an outer circumferential surface of the heater 31b can be surrounded by the heat shield 34, the stay 33, and the nip formation member 32, which can efficiently transfer the radiant heat from the heater 31b to the nip formation member 32.

[0073] The above-described bent portion 34b may be partially inclined in the longitudinal direction of the heat shield 34. For example, in the longitudinal direction of the heat shield 34, the heat shield 34 may have an inclined portion in which the bent portion 34b is partially inclined corresponding to the heat generation area of the heater 31a and the other portion parallel to the nip formation member 32. Additionally, the coated surface described above may be disposed on a part of the stay 33 in the longitudinal direction.

[0074] The present disclosure is not limited to the de-

tails of the embodiments described above and various modifications and improvements are possible.

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

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

[0077] In the present disclosure, blocking the heat transfer between the two heating members by the heat shield does not necessarily mean perfect block of the heat transfer. The meaning of blocking the heat transfer naturally includes a case in which a part of the heat transfer is blocked. For example, in FIG. 2, heat transfer between the heaters 31a and 31b may occur through a gap between the right end of the bent portion 34b of the heat shield 34 and the stay 33. Even in this case, the heat shield 34 blocks a part of the heat transfer between the heaters 31a and 31b.

[0078] Numerous additional modifications and variations are possible in light of the above teachings. It is therefore to be understood that, within the scope of the above teachings, the present disclosure may be practiced otherwise than as specifically described herein. With some embodiments having thus been described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the scope of the present disclosure and appended claims, and all such modifications are intended to be included within the scope of the present disclosure and appended claims.

Claims

1. A fixing device (5) comprising:

a fixing member (22) in a cylindrical form;
a pressing member (23) configured to press an outer surface of the fixing member (22);
a nip formation member (32) disposed inside a loop of the fixing member (22), the nip formation member (32) configured to be pressed by the pressing member (23) via the fixing member (22) to form a fixing nip;
a plurality of heat generators (31a, 31b) disposed inside the loop of the fixing member (22) and configured to heat the fixing member (22), the plurality of heat generators (31a, 31b) including one heat generator (31b) disposed close to the nip formation member (32) and the other heat generator (31a) disposed farther from the nip formation member (32) than the one heat generator (31b) in a direction that is perpendicular to a recording medium conveyance direction and is not a width direction of the fixing member (22); and
a shield (34) disposed inside the loop of the fixing member (22) and configured to block heat from the plurality of heat generators (31a, 31b), the shield (34) having a part disposed between the one heat generator (31b) and the other heat generator (31a) in a cross section that intersects the width direction of the fixing member (22).

2. The fixing device (5) according to claim 1,
wherein the shield (34) contacts the nip formation member (32).

3. The fixing device (5) according to claim 2,
wherein the shield (34) contacts a surface of the nip formation member (32) on a side opposite to a side facing the pressing member (23).

4. The fixing device (5) according to claim 3, further comprising a contact member (33a) that is different from the shield (33b) and is configured to contact the surface of the nip formation member (32) on the side opposite to the side facing the pressing member (23),
wherein a contact area between the contact member (33a) and the nip formation member (32) is smaller than a contact area between the shield (33b) and the nip formation member (32).

5. The fixing device (5) according to claim 2, further comprising a contact member (33) disposed inside the loop of the fixing member (22),
wherein the contact member (33) is different from the shield (34) and is configured to contact a surface of the nip formation member (32) on a side opposite to a side facing the pressing member (23).

6. The fixing device (5) according to claim 5,
wherein the contact member (33) has:

a contact portion (33a1, 33b1) contacting the nip formation member (32) and extending in a direction that intersects the recording medium conveyance direction and is not the width direction of the fixing member (22); and
a curved portion (33a3, 33b3) extending from the contact portion (33a1, 33b1) in a direction that is away from the other heat generator (31a) and different from the direction in which the contact portion (33a1, 33b1) extends.

7. The fixing device (5) according to any one of claims 2 to 6,
wherein at least one of the contact member (33) and the shield (34) includes a coated surface disposed

opposite one of the plurality of heat generators (31a, 31b) and coated with a coating agent having a higher reflectance than an uncoated surface of the at least one of the contact member (33) and the shield (34).

8. The fixing device (5) according to any one of claims 1 to 7, further comprising a plurality of shields (34) including the shield (34).

9. The fixing device (5) according to any one of claims 1 to 8,
wherein the shield (34) includes a coated surface disposed opposite one of the plurality of heat generators (31a, 31b) and coated with a coating agent having a higher absorption coefficient than a surface of the shield (34).

10. The fixing device (5) according to any one of claims 1 to 8,
wherein the shield (34) includes a coated surface disposed opposite one of the plurality of heat generators (31a, 31b) and coated with a coating agent having a higher reflectance than a surface of the shield (34).

11. The fixing device (5) according to claim 9 or 10,
wherein the shield (34) includes:

a coated surface disposed opposite the one heat generator (31b) and coated with the coating agent having a higher absorption coefficient than a surface of the shield (34); and
a coated surface disposed opposite the other heat generator (31a) and coated with the coating agent having a higher reflectance than a surface of the shield (34).

12. The fixing device (5) according to any one of claims 9 to 11,
wherein an area of the coated surface corresponds to a heat generation area of one of the plurality of heat generators (31a, 31b) facing the coated surface in the width direction of the fixing member (22).

13. The fixing device (5) according to any one of claims 1 to 12,
wherein the shield (34) has:

an upright portion (34a) extending in a direction that intersects the recording medium conveyance direction and is not the width direction of the fixing member (22); and
a shield portion (34b) coupled to the upright portion (34a) and disposed between the one heat generator (31b) and the other heat generator (31a) in the cross section that intersects the width direction of the fixing member (22), at least part of the shield portion (34b) extending in an inclined direction with respect to the nip formation member (32) in the cross section that intersects the width direction of the fixing member (22), and
wherein the inclined direction is a direction from one end of the shield portion (34b) coupled to the upright portion (34a) to another end of the shield portion (34b) closer to the other heat generator (31a) than a point at which said another end of the shield portion (34b) exists if the shield portion (34b) is parallel to the nip formation member (32).

14. The fixing device (5) according to claim 13,
wherein an inclined part of the shield portion (34b) corresponds to a heat generation area of the other heat generator (31a) in the width direction of the fixing member (22).

15. An image forming apparatus (1) comprising the fixing device (5) according to any one of claims 1 to 14.

FIG. 1

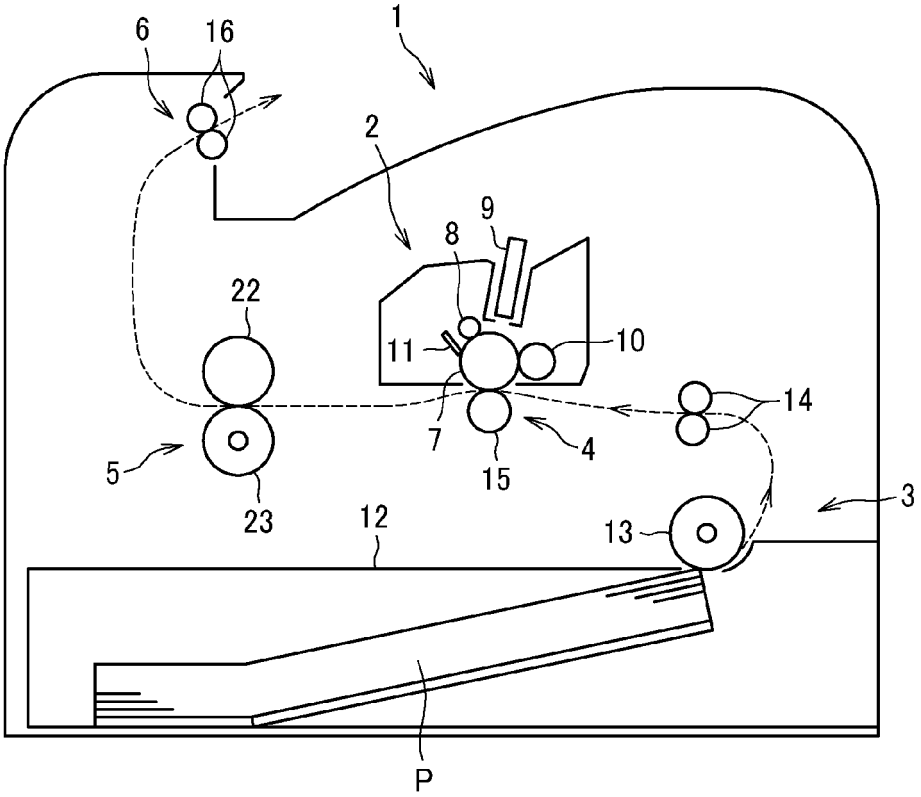

6
16
1
2
9
8
22
11
10
14
7
4
15
5
23
12
13
3
P

FIG. 2

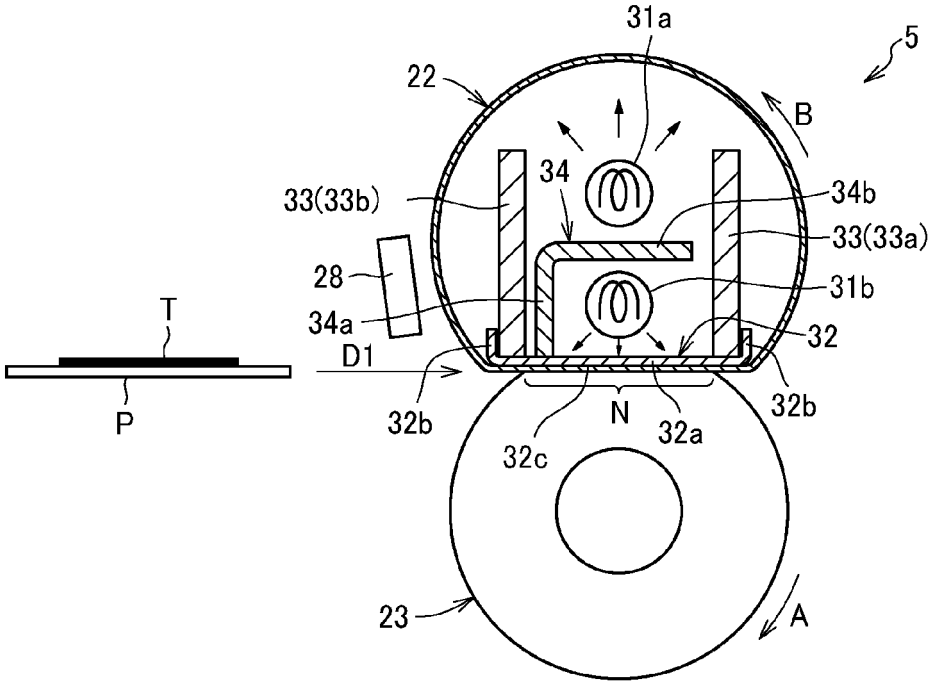

31a
5
22
B
34
33(33b)
34b
33(33a)
28
31b
T
34a
32
D1
32b
N
32a
32b
32c
23
A
P

FIG. 3

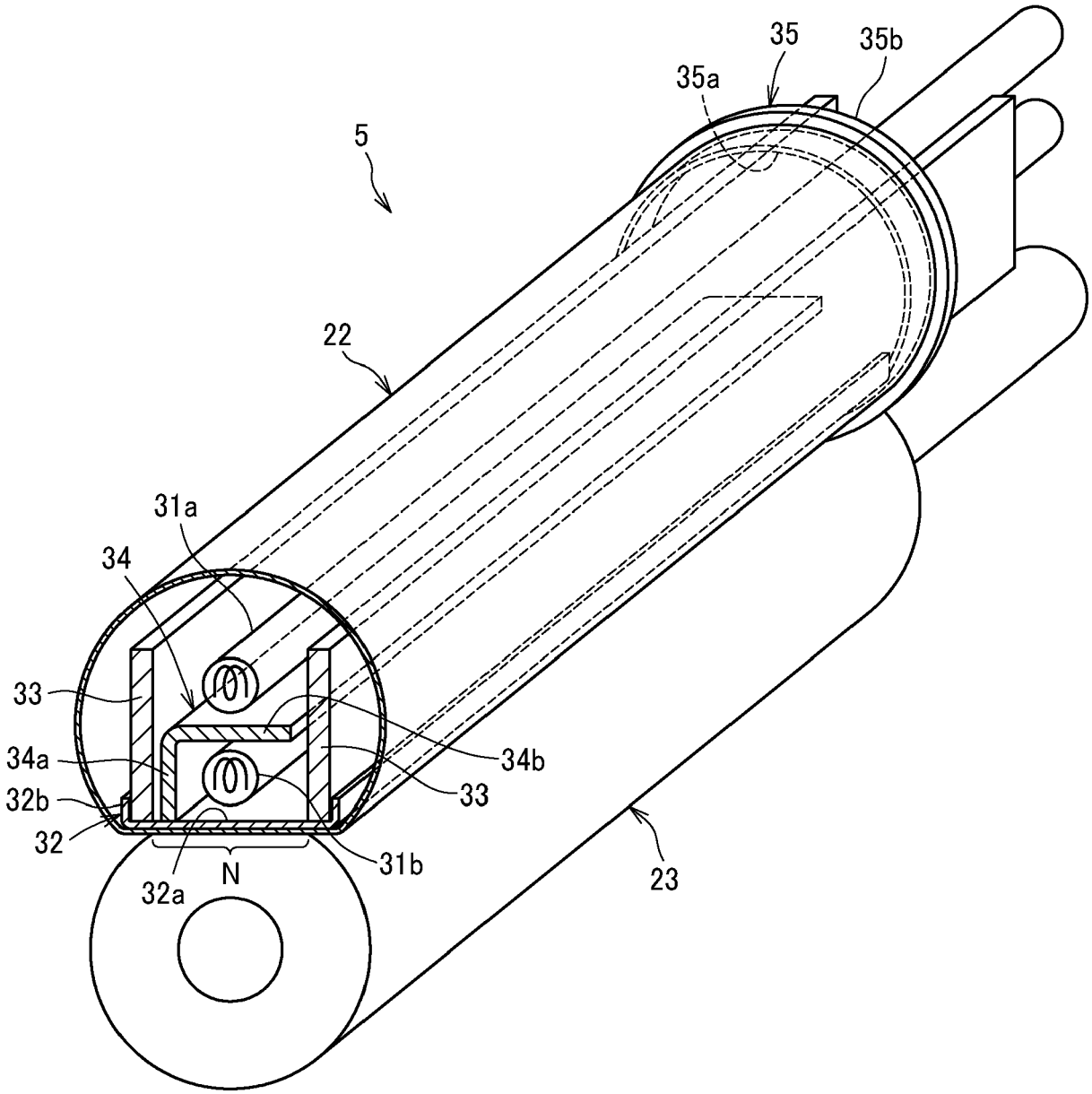


FIG. 4

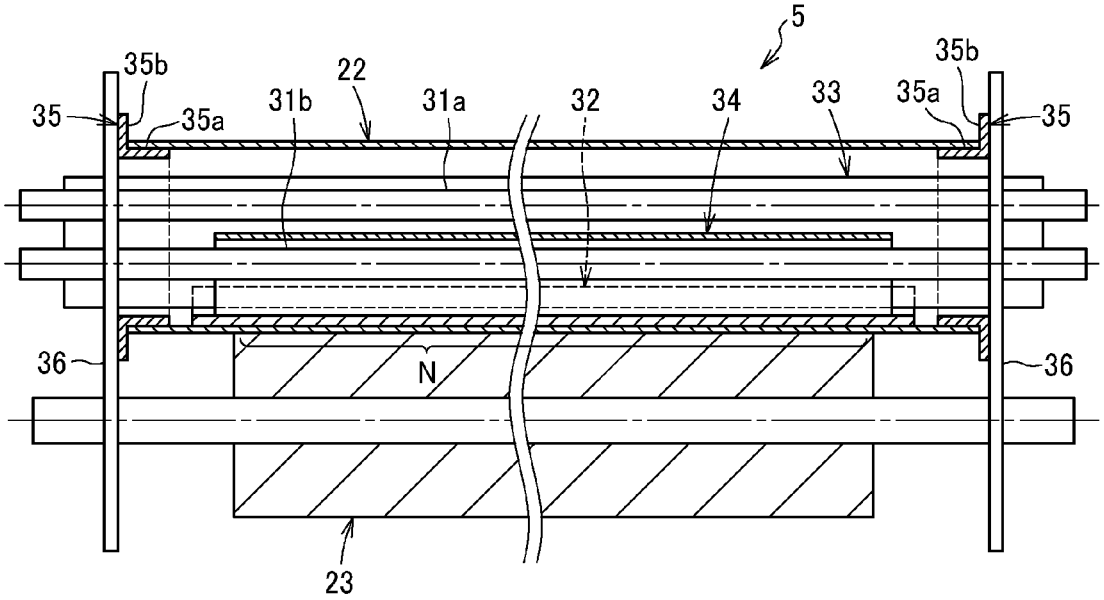


FIG. 5

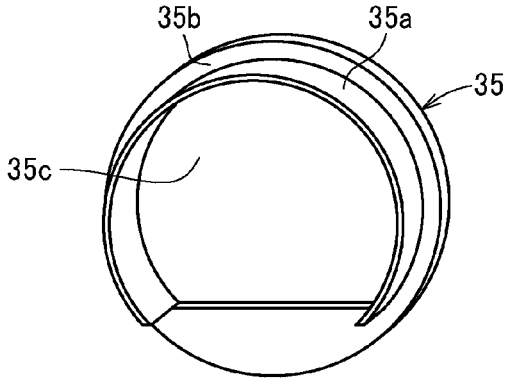


FIG. 6

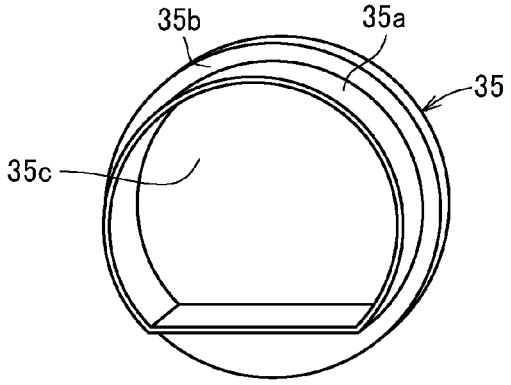


FIG. 7

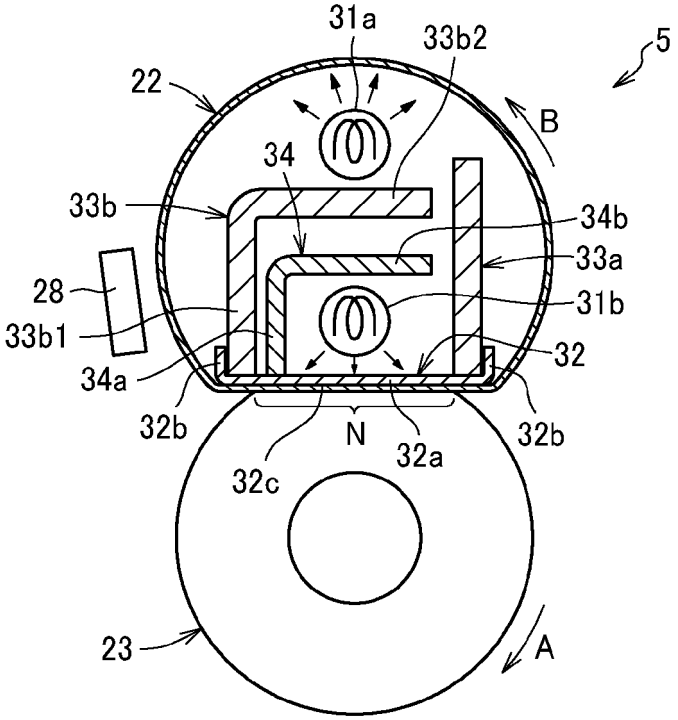

31a
33b2
5
22
B
34
33b
34b
33a
28
31b
33b1
32
34a
32b
N
32a
32b
32c
23
A

FIG. 8

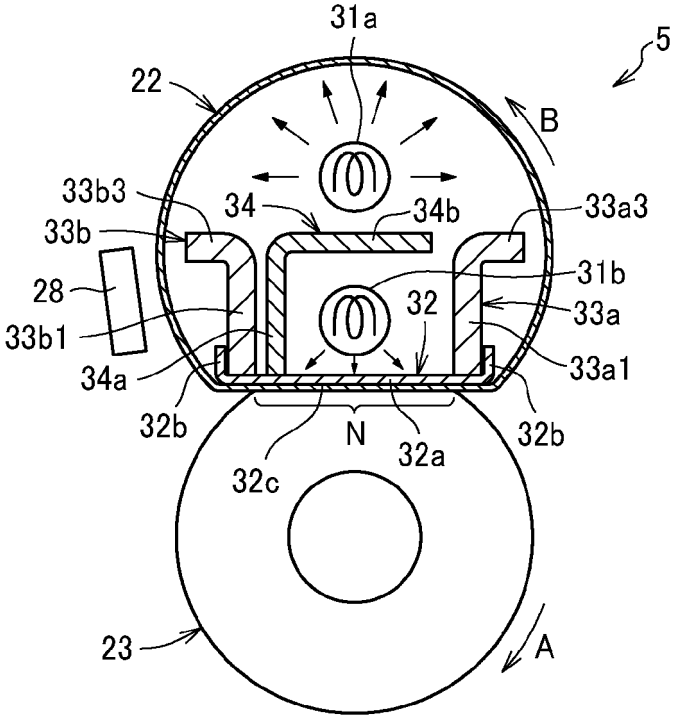

31a
5
22
B
33b3
34
34b
33a3
33b
31b
28
32
33a
33b1
33a1
34a
32b
N
32a
32b
32c
23
A

FIG. 9

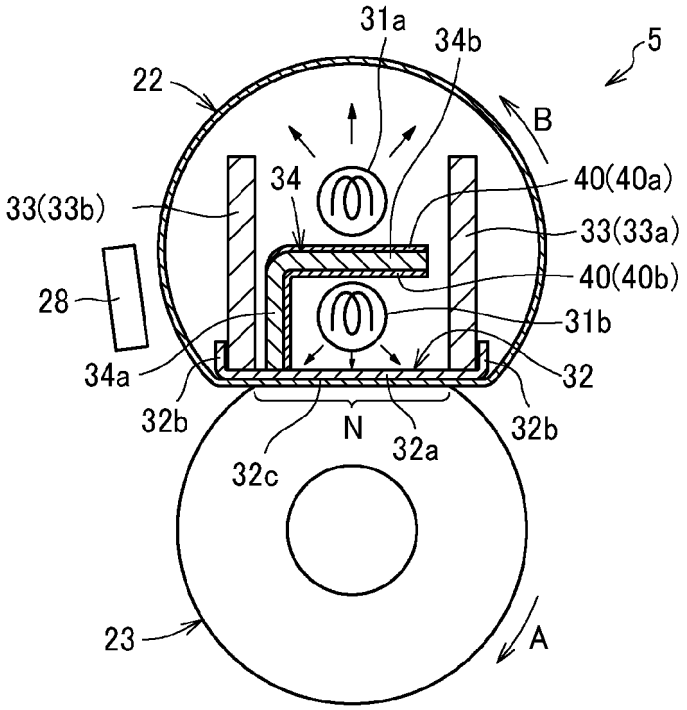

31a
34b
5
22
B
34
40(40a)
33(33b)
33(33a)
28
40(40b)
31b
34a
32
32b
N
32a
32b
32c
23
A

FIG. 10

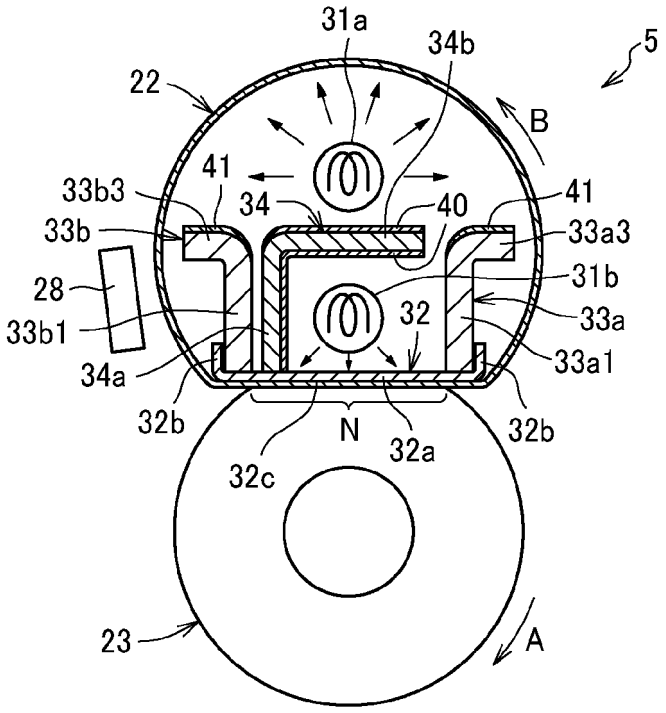

31a
34b
5
22
B
41
33b3
34
40
41
33b
33a3
28
31b
32
33b1
33a
34a
33a1
32b
N
32a
32b
32c
23
A

FIG. 11

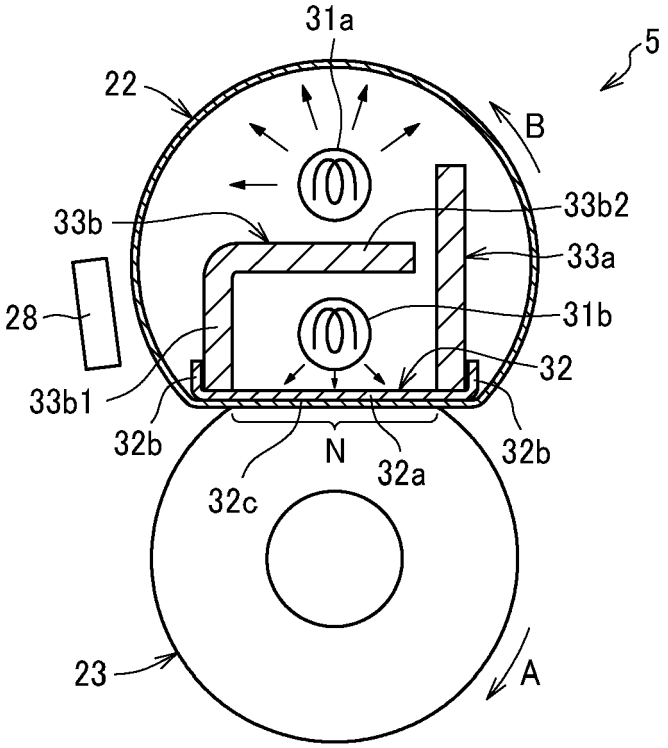


FIG. 12A

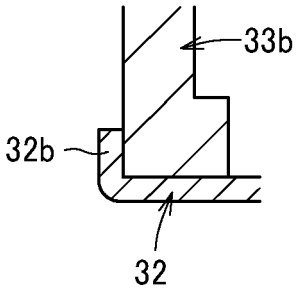


FIG. 12B

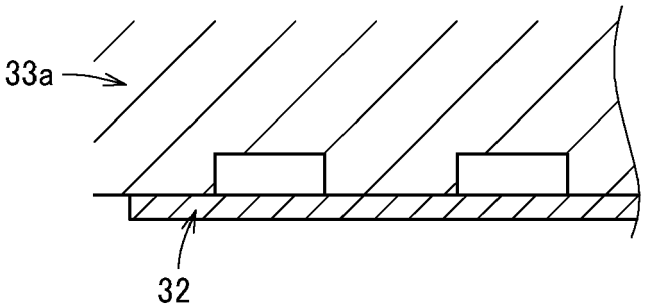


FIG. 13

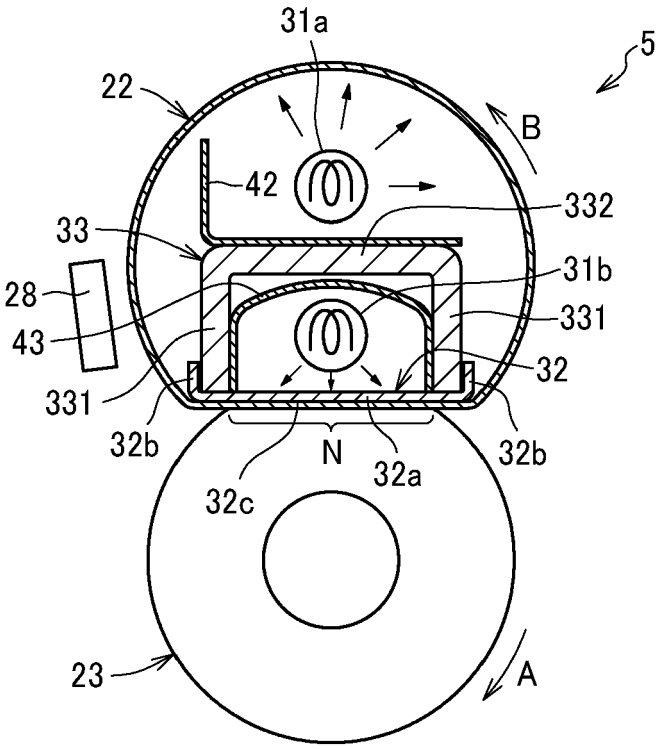


FIG. 14A

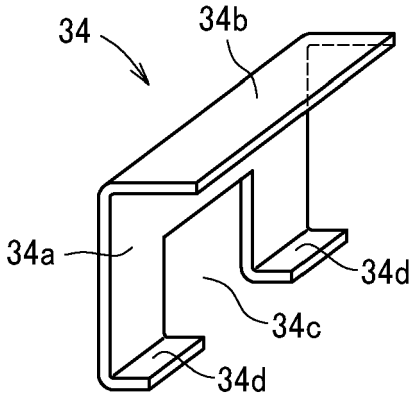


FIG. 14B

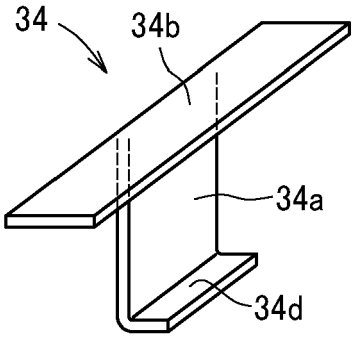


FIG. 15

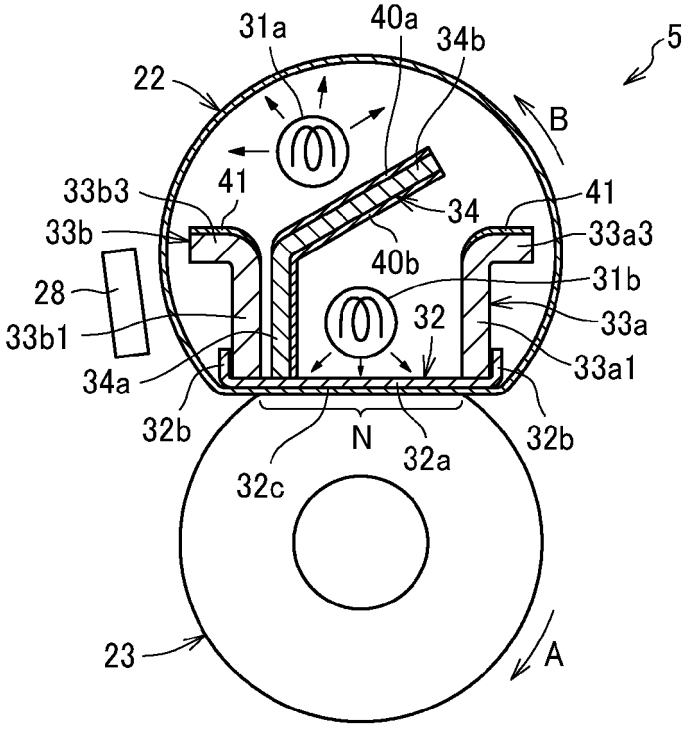
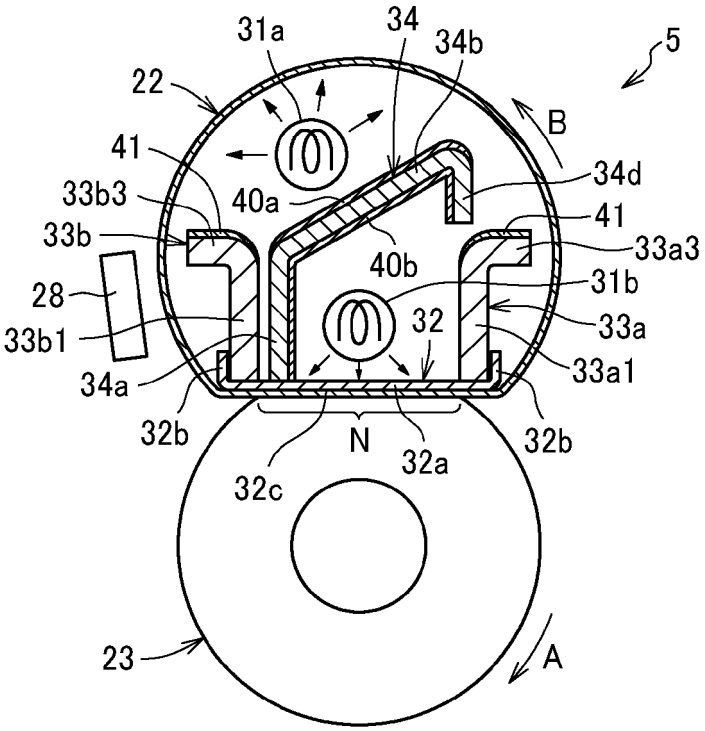

31a
40a
34b
5
22
B
41
33b3
34
41
33b
33a3
40b
28
31b
33b1
32
33a
34a
33a1
32b
N
32a
32b
32c
23
A

FIG. 16


31a
34
34b
5
22
B
41
34d
33b3
40a
41
33b
33a3
40b
28
31b
33b1
32
33a
34a
33a1
32b
N
32a
32b
32c
23
A

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 15 4150

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y A	JP 2016 212278 A (RICOH CO LTD) 15 December 2016 (2016-12-15) * paragraph [0032] - paragraph [0062]; figures 1-15 *	1-3,5,6, 8,15 7,9-12 4	INV. G03G15/20
X Y	JP 2014 041172 A (CANON KK) 6 March 2014 (2014-03-06) * paragraph [0014] - paragraph [0050]; figures 1, 2 *	1,8, 13-15 9-12	
X Y	US 2016/246228 A1 (FUJIMOTO IPPEI [JP] ET AL) 25 August 2016 (2016-08-25) * paragraphs [0022] - [0043], [0052] - [0058]; figures 1, 2, 4 *	1,13-15 9-12	
X Y	US 2014/169820 A1 (KUSUMOTO HIROSHI [JP]) 19 June 2014 (2014-06-19) * paragraph [0012] - paragraph [0061]; figures 1, 2 *	1,13-15 9-12	
Y	JP 2014 238428 A (RICOH CO LTD) 18 December 2014 (2014-12-18) * paragraphs [0001], [0074]; figures 2, 3 *	7,9-12	TECHNICAL FIELDS SEARCHED (IPC) G03G
Y	JP 2015 118238 A (KONICA MINOLTA INC) 25 June 2015 (2015-06-25) * paragraphs [0045] - [0048], [0065], [0078], [0079], [0082], [0083], [0090], [0091]; figures 9, 10, 17, 22-24, 28, 29 *	7,9-12	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 July 2020	Billmann, Frank

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 15 4150

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

03-07-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2016212278 A	15-12-2016	JP 6492945 B2	03-04-2019
		JP 2016212278 A	15-12-2016
JP 2014041172 A	06-03-2014	JP 6053391 B2	27-12-2016
		JP 2014041172 A	06-03-2014
US 2016246228 A1	25-08-2016	JP 2016156858 A	01-09-2016
		US 2016246228 A1	25-08-2016
US 2014169820 A1	19-06-2014	JP 5764548 B2	19-08-2015
		JP 2014119532 A	30-06-2014
		US 2014169820 A1	19-06-2014
JP 2014238428 A	18-12-2014	JP 6213890 B2	18-10-2017
		JP 2014238428 A	18-12-2014
JP 2015118238 A	25-06-2015	CN 104730888 A	24-06-2015
		JP 5967068 B2	10-08-2016
		JP 2015118238 A	25-06-2015

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2016035601 A **[0004] [0005]**