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

(11) EP 3 751 354 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
16.12.2020 Bulletin 2020/51

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

(21) Application number: **20173187.4**

(22) Date of filing: **06.05.2020**

(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: **10.06.2019 JP 2019107784**
02.03.2020 JP 2020034910

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

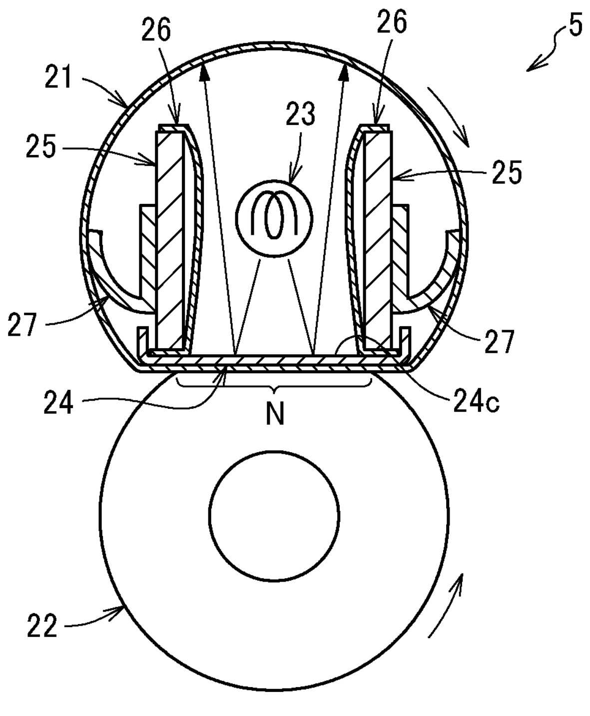
(72) Inventors:
- **SASAKI, Yoshikuni**
Tokyo, 143-8555 (JP)
- **HATTORI, Yoshio**
Tokyo, 143-8555 (JP)
- **IMADA, Takahiro**
Tokyo, 143-8555 (JP)
- **TAKAGI, Hiromasa**
Tokyo, 143-8555 (JP)
- **ISHIGAYA, Yasunori**
Tokyo, 143-8555 (JP)
- **WAIDA, Takumi**
Tokyo, 143-8555 (JP)
- **SHOJI, Keitaro**
Tokyo, 143-8555 (JP)

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

(54) **HEATING DEVICE, FIXING DEVICE, AND IMAGE FORMING APPARATUS**

(57) A heating device (5) includes a rotatable member (21), an opposite member (22) disposed opposite an outer peripheral surface of the rotatable member (21), a heater (23) disposed inside a loop of the rotatable member (21) to heat the rotatable member (21), and a nip formation member (24) disposed inside the loop of the rotatable member (21) to sandwich the rotatable member (21) between the nip formation member (24) and the opposite member (22) and form a nip between the nip formation member (24) and the opposite member (22). The nip formation member (24) is heated by the heater (23) and includes an opposite surface (24c) disposed opposite the heater (23). At least a part of the opposite surface (24c) reflects at least one of heat and light from the heater (23) with a reflectance of 50% or more.

FIG. 8



EP 3 751 354 A1

Description

BACKGROUND

Technical Field

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

Description of the Related Art

[0002] An electrophotographic image forming apparatus such as a copier or a printer includes a fixing device as a heating 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 rollers or belts opposite to each other, heat the recording medium, and fix the unfixed image on the recording medium.

[0003] As such a fixing device, for example, JP-2014-132371-A discloses a fixing device in which a heat generator heats a nip formation member to form the nip, and the nip formation member heats the sheet.

[0004] In the fixing device disclosed in JP 2014-132371-A, a plurality of recesses disposed on a surface of the nip formation member facing the heat generator to improve heat efficiency increase the surface area of the nip formation member, which enables the nip formation member to efficiently absorb radiant heat radiated by the heat generator.

[0005] However, the device in which the heat generator heats the sheet via the nip formation member and a fixing member such as a fixing belt has a larger number of parts in a path of heat transfer to the sheet than a device in which the heat generator directly heats the fixing member to heat the sheet because of the nip formation member. Therefore, in the device using the nip formation member, heat is not easily transmitted to the sheet, and the heating efficiency tends to be low.

SUMMARY

[0006] It is a general object of the present disclosure to provide an improved and useful heating 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.

[0007] Advantageously, the heating device includes a rotatable member, an opposite member disposed opposite an outer peripheral surface of the rotatable member, a heater disposed inside a loop of the rotatable member to heat the rotatable member, and a nip formation member disposed inside the loop of the rotatable member to sandwich the rotatable member between the nip formation member and the opposite member and form a nip between the nip formation member and the opposite member. The nip formation member is configured to be heated by the heater and includes an opposite surface disposed opposite the heater. At least a part of the opposite surface is configured to reflect at least one of heat and light from the heater with a reflectance of 50% or more.

[0008] The above-described present disclosure can improve the heating efficiency of the heating device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic diagram illustrating a configuration of an image forming apparatus according to an embodiment of the present disclosure;
FIG. 2 is a vertical cross-sectional view of a fixing device viewed from a lateral side of the fixing device;
FIG. 3 is a perspective view of the fixing device with the vertical cross-sectional view of the fixing device;
FIG. 4 is a vertical cross-sectional view of the fixing device viewed from a front side of the fixing device;
FIG. 5 is a perspective view of a belt holder;
FIG. 6 is a perspective view of a variation of the belt holder;
FIG. 7 is an explanatory diagram illustrating how heating energy radiated by a halogen heater reaches a fixing belt and a nip formation member;
FIG. 8 is an explanatory diagram illustrating how the heating energy is reflected by the nip formation member and reach the fixing belt;
FIG. 9 is a schematic diagram illustrating an example of the nip formation member including portions having a low reflectance in both end portions of the nip formation member;
FIG. 10 is a schematic diagram illustrating an example of the nip formation member having a high reflectance area arranged at center portion and gradually narrowed toward a downstream side in a sheet conveyance direction;
FIG. 11 is a schematic diagram illustrating an example of the nip formation member having a high reflectance area arranged at center portion and gradually widened toward a downstream side in a sheet conveyance direction;
FIG. 12 is a schematic diagram illustrating an example of a stay and a reflector having connecting wall portions (that are end shields) arranged at both ends of each of the stay and the reflector;
FIG. 13 is a cross-sectional view illustrating a part of the fixing device corresponding to an opening in which the connecting wall portions do not exist;
FIG. 14 is a cross-sectional view illustrating a part of the fixing device corresponding to the connecting

wall portions;

FIG. 15 is a schematic diagram illustrating an example of the fixing device including two halogen heaters, stays inclined so that a distance between the stays increases in a direction away from the nip formation member, and reflectors inclined so that a distance between the reflectors increases in the direction away from the nip formation member; and

FIG. 16 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.

[0010] 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

[0011] 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.

[0012] 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.

[0013] With reference to drawings attached, a description is given below of the present disclosure. In the drawings for illustrating embodiments of the present disclosure, identical reference numerals are assigned to elements such as members and parts that have an identical function or an identical shape as long as differentiation is possible, and descriptions of such elements may be omitted once the description is provided.

[0014] 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.

[0015] An image forming apparatus 1 illustrated in FIG. 1 is a monochrome electrophotographic laser printer. The image forming apparatus according to the embodiments of the present disclosure may be a printer, a copier, a facsimile machine, a multifunction peripheral (MFP) having at least two of copying, printing, scanning, facsimile, and plotter functions. The image forming apparatus is not limited to a monochrome image forming apparatus and may be a color image forming apparatus.

[0016] As illustrated in FIG. 1, the image forming apparatus 1 according to the present embodiment 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.

[0017] 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.

[0018] As the start of image forming operation is instructed, in the image forming device 2, the photoconductor 7 starts rotating, 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 a toner image on the photoconductor 7.

[0019] 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.

[0020] 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 21 and a 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. Then, a series of print operations completes.

[0021] 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.

[0022] FIG. 2 is a vertical cross-sectional view of the fixing device 5 viewed from a lateral side of the fixing device 5, FIG. 3 is a perspective view of the fixing device 5 with the vertical cross-sectional view of the fixing device 5, and FIG. 4 is a vertical cross-sectional view of the fixing device 5 viewed from a front side of the fixing device 5. In addition, FIG. 5 is a perspective view of a belt holder 30 to support the fixing belt 21, and FIG. 6 is a perspective view of a variation of the belt holder 30.

[0023] 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, stays 25, reflectors 26, guides 27, and temperature sensors 28.

[0024] The fixing belt 21 is a fixing member to fix an unfixed toner image T on the sheet P and is a rotatable member and is arranged on the side of the sheet P on which the unfixed toner 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 μm 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 of from 20 mm to 40 mm. Preferably, the loop diameter of the fixing belt 21 may not be greater than 30 mm.

[0025] The pressure roller 22 is an opposite rotatable member disposed opposite an outer peripheral 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.

[0026] A driver inside the image forming apparatus 1 drives and rotates the pressure roller 22 in a direction indicated by an arrow A in FIG. 2. The rotation of the pressure roller 22 drives the fixing belt 21 to rotate in a direction B in FIG. 2 due to frictional force therebetween. After the toner image is transferred onto the sheet P, the sheet P bearing the unfixed toner image is conveyed to a nip N between the fixing belt 21 and the pressure roller 22. The rotating fixing belt 21 and the rotating pressure roller 22 conveys the sheet P, and the sheet P passes through the nip N. When the sheet P passes through the nip N, heat and pressure applied to the sheet P fixes the unfixed image T to the sheet P.

[0027] 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.

[0028] The halogen heater 23 is a heater that radiates heat and light (for example, an infrared light) to heat the fixing belt 21 and the nip formation member 24 by radiant heat. In the present embodiment, one halogen heater 23 is disposed inside a loop of the fixing belt 21 and extends in a longitudinal direction of the fixing belt 21 that is parallel to a rotation axis direction Z of the pressure roller 22 (see FIG. 3). Alternatively, instead of the halogen heater 23, a radiant heat type heater such as a carbon heater may be employed as the heater.

[0029] The nip formation member 24 and the pressure roller 22 sandwich the fixing belt 21 to form the nip N. The nip formation member 24 according to the present embodiment is disposed inside the loop of the fixing belt 21 and extends in the longitudinal direction thereof. The nip formation member 24 has a planar nip formation portion 24a that is in contact with an inner circumferential surface of the fixing belt 21 and a pair of bent portions 24b that are bent from both end portions, that is, an upstream end portion and a downstream end portion of the nip formation portion 24a in a sheet conveyance direction (a recording medium conveyance direction) to the opposite side to the pressure roller 22. A pressing member such as a spring presses the pressure roller 22 against the nip formation member 24, which causes the pressure roller 22 to contact the fixing belt 21 and forms the nip N therebetween.

[0030] A nip formation surface 24d on which the fixing belt 21 contacts the nip formation portion 24a may be coated with an alumite treatment or a fluororesin material in order to improve abrasion resistance and slidability when the fixing belt 21 rotates. Additionally, a lubricant such as a fluorine-based grease may be applied to the nip formation surface 24d to ensure slidability over time. In the present embodiment, the nip formation surface 24d is planar. Alternatively, the nip formation surface 24d may define a recess or other shape. For example, the nip formation surface 24d having a concave shape recessed to the side opposite to the pressure roller 22 leads the outlet of the sheet in the fixing nip N to be closer to the pressure roller 22, which improves separation of the sheet from the fixing belt 21.

[0031] 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 but not larger than 5 mm can improve a heat storage capacity of the nip formation member 24.

[0032] The stay 25 is a support member to support the nip formation member 24 against the pressing force from the pressure roller 22. Note that "supporting" the nip formation member 24 means that the support member (in the present embodiment, the stay 25) is in contact with the nip formation member 24 on the side opposite to the side facing the pressure roller 22 to restrain the nip formation member 24 from being bent by the pressure from the pressure roller 22, particularly, restrain the nip formation member 24 from being bent in the longitudinal direction.

[0033] In the present embodiment, the stays 25 are a pair of flat plates disposed inside the loop of the fixing belt 21 and arranged at the upstream side and the downstream side in the sheet conveyance direction in parallel with each other with the halogen heater 23 interposed between the pair of flat plates. The stays 25 extend in the longitudinal direction of the fixing belt 21 and contact an upstream portion of the nip formation member 24 and a downstream portion of the nip formation member 24 in the sheet conveyance direction via the reflectors 26, respectively. As described above, the stays 25 are in contact with the nip formation member 24 via the reflectors 26 and support the nip formation member 24 to reduce a bend of the nip formation member 24 in a direction in which the pressure roller 22 presses against the nip formation member 24. Such a configuration results in a uniform width of the nip N in the longitudinal direction. The stays 25 are 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.

[0034] The reflectors 26 reflect the heat and light (for example, the infrared light) radiated by the halogen heater 23. In the present embodiment, a pair of reflectors 26 are disposed inside the loop of the fixing belt 21 and arranged at the upstream side and the downstream side in the sheet conveyance direction with the halogen heater 23 interposed between the pair of reflectors. Each reflector 26 includes a reflector portion 26a facing the halogen heater 23 and a pair of bent portions 26b disposed at both ends of the reflector portion 26a. Each bent portion 26b of the reflector 26 is engaged with one end face of the stay 25 facing the nip N (that is, a lower end face in FIG. 2) and the other end face of the stay 25 (that is, an upper end face in FIG. 2). Thus, the reflector 26 is supported by the stay 25.

[0035] A reflection face of the reflector 26 facing the halogen heater 23 is treated with mirror finish or the like to increase reflectance. Preferably, the reflectance of the reflection face is 70% or more when it 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.

[0036] Alternatively, the stay 25 may have the function of the reflector 26. For example, the surface of the stay 25 facing the halogen heater 23 may be mirror-finished so that the stay 25 also functions as the reflector 26. Such a configuration can obviate the reflector 26 that is a separate component from the stay 25.

[0037] The guides 27 contact the inner peripheral surface of the fixing belt 21 to guide the rotating fixing belt 21. In the present embodiment, a pair of the guides 27 are disposed on both the upstream side and the downstream side of the nip N in the sheet conveyance direction. Each guide 27 includes an attachment portion 27a fixed to the stay 25 and a curved guide portion 27b in contact with the inner peripheral surface of the fixing belt

21. As illustrated in FIG. 3, the guide portion 27b includes a plurality of ribs 27c that are projections provided at equal intervals in the belt width direction on a guide surface of the guide portion 27b that is the surface of the guide portion 27b on 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.

[0038] The temperature sensors 28 face the outer surface of the fixing belt 21 to detect temperatures 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.

[0039] As illustrated in FIG. 4, each belt holder 30 as a fixing rotator support to support a lateral end of the fixing belt 21 is inserted in each of 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.

[0040] As illustrated in FIGS. 3 to 5, the belt holder 30 includes a C-shaped supporter 30a inserted into the inner periphery of the fixing belt 21 to support the fixing belt 21 and a flange 30b that contacts an end surface 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. 6, the supporter 30a may have a cylindrical shape which is continuous over its entire circumference. As illustrated in FIG. 4, the belt holders 30 are fixed on a pair of side plates 31 that are frames of the fixing device 5. Each belt holder 30 has an opening 30c as illustrated in FIG. 5, and both ends of the halogen heater 23 and the stays 25 are supported by the side plates 31 through the openings 30c of the belt holders 30. Further, the halogen heater 23 and the stay 25 may be supported by the belt holder 30.

[0041] As illustrated in FIG. 7, in the present embodiment, the halogen heater 23 radiates heat and light (hereinafter "heating energy" is used as a concept including heat and light). A part of the heating energy radiated upward directly reaches the inner circumferential surface of the fixing belt 21, and another part of heating energy radiated upward is reflected by the reflectors 26 and reaches the inner circumferential surface of the fixing belt 21. On the other hand, a part of the heating energy radiated downward by the halogen heater 23 directly reaches the nip formation member 24, and another part of heating energy radiated downward by the halogen heater 23 is reflected by the reflectors 26 and reaches the nip formation member 24. As described above, the heating energy radiated by the halogen heater 23 directly reaches the fixing belt 21 and the nip formation member 24 or are reflected by the reflectors 26 and indirectly reach the fixing belt 21 and the nip formation member 24 to heat both of the fixing belt 21 and the nip formation member 24.

[0042] The heating energy that reaches the fixing belt 21 give heat to the fixing belt 21, and the heat transfers from the fixing belt 21 to the sheet at the nip N. On the other hand, the heating energy that reaches the nip formation member 24 give heat to the nip formation member 24, and the heat transfers from the nip formation member 24 to the fixing belt 21 and further transfers from the fixing belt 21 to the sheet. As described above, transferring the sheet the heat given by the heating energy that reaches the nip formation member 24 is more difficult than transferring the sheet the heat given by the heating energy that reaches the fixing belt 21 and tends to have low heating efficiency for heating the sheet because the heat given by the heating energy that reaches the nip formation member 24 transfers from the nip formation member 24 to the fixing belt 21. Therefore, in order to improve the heating efficiency, it is preferable to increase a proportion of the heating energy radiated from the halogen heater 23 to the fixing belt 21.

[0043] Therefore, in the present embodiment, in order to improve the heating efficiency, as illustrated in FIG. 8, an opposite surface 24c of the nip formation member 24 facing the halogen heater 23 is mirror-finished so that the opposite surface 24c reflects the heating energy to the fixing belt 21. FIG. 8 illustrates paths in which the heating energy is radiated by the halogen heater 23 to the nip formation member 24 and reflected by the opposite surface 24c to the fixing belt 21, but the paths of the heating energy from the halogen heater 23 to the fixing belt 21 via the opposite surface 24c includes the paths including reflections by the reflector 26.

[0044] As described above, in the present embodiment, the opposite surface 24c of the nip formation member 24 reflects the heating energy to the fixing belt 21, and the nip formation member 24 functions as a second reflector different from the reflector 26. Therefore, the heating energy that reaches the fixing belt 21 increase, which improves the heating efficiency. The improvement of the heating efficiency reduces consumption of unnecessary heat energy and improves energy saving.

[0045] A reflectance of the light on the opposite surface 24c is 50% or more. The opposite surface 24c having the reflectance of the light less than 50% reduces the light reflected from the nip formation member 24 to the fixing belt 21 and does not significantly improve the heating efficiency. The reflectance of the light on the opposite surface 24c is measured by the same method as the reflectance of the reflector 26 described above. Measurement results of the reflectance of the light measured by the above-described method are used as substitutes for reflectance of the heat on the opposite surface 24c. That is, the reflectance of the heat equals to the reflectance of the light. Hereinafter, reflectance on the opposite surface 24c is described as the reflectance of the light.

[0046] In the present embodiment, setting the reflectance of the opposite surface 24c of the nip formation member 24 to 50% or more as described above enables the nip formation member 24 to effectively reflect the light emitted by the halogen heater 23 to the fixing belt 21 and improve the heating efficiency. The opposite surface 24c of the nip formation member 24 does not necessarily have to have the reflectance of 50% or more over the entire surface. That is, setting the reflectance of at least a part of the opposite surface 24c to 50% or more can increase an amount of the heating energy reflected to the fixing belt 21 and improve the heating efficiency. In addition, setting the reflectance of the opposite surface 24c to 50% or more enables using the nip formation member 24 as a reflector and reducing the number of components.

[0047] Reducing the surface roughness of the opposite surface 24c by grinding or the like can increase the reflectance on the opposite surface 24c. For example, setting the surface roughness Ra of the opposite surface 24c to be 0.02 μm or less as the arithmetic average roughness defined in JIS B0601 2001 can make the reflectance 85% or more.

[0048] The reflectance on the opposite surface 24c may not be the same over the entire nip formation member 24 in the longitudinal direction thereof. For example, as illustrated in FIG. 9, a reflectance of portions U in both end portions E1 and E2 of the nip formation member 24 in the longitudinal direction of the nip formation member 24 that is the rotation axis direction Z of the pressure roller 22 may be set lower than a reflectance of the center portion C that is a portion between the portions U in both end portions E1 and E2 when temperatures at both end portions of the fixing belt 21 in the longitudinal direction of the fixing belt 21 may increase too much because the both end portions of the fixing belt 21 correspond to non-conveyance spans in which the sheet is not conveyed and does not consume heat. Setting the reflectance in the both end portions E1 and E2 of the opposite surface 24c smaller than the reflectance in the center portion C as described above causes an amount of heating energy reflected by both end portions E1 and E2 of the opposite surface 24c to be smaller than an amount of the heating energy reflected by the center portion C, reduces heat amounts supplied to the both end portions of the fixing belt 21, and, therefore, prevents the temperatures at both end portions of the fixing belt 21 corresponding to the non-conveyance span from increasing too much.

[0049] In the above-described case, reducing the amount of the heating energy reflected by the both end portions E1 and E2 of the opposite surface 24c results in increasing an amount of the heating energy absorbed by the nip formation member 24, but the nip formation member 24 having a thicker thickness and a larger thermal capacity than the fixing belt 21 does not easily raise the temperature of the nip formation member 24 and cause deterioration and deformation due to heat. Heat given to the both end portions E1 and E2 of the nip formation member 24 is transferred from the both end portions E1 and E2 to the center portion C along the nip formation member 24 so that the heat is evenly distributed and can be effectively used as heat for a fixing process, which improves the heating efficiency.

[0050] A method to decrease the reflectance at both end portions E1 and E2 is, for example, setting the surface roughness in both end portions E1 and E2 of the opposite surface 24c to be larger than the surface roughness in the center portion C. Alternatively, a low-reflection material such as black paint having a lower reflectance than the center portion C of the opposite surface 24c may be attached to both end portions E1 and E2 of the opposite surface 24c. To greatly reduce the reflectance at both end portions E1 and E2, for example, to 10% or less, the method of attaching a low-reflection material is more preferable than the method of roughening the surface roughness. On the other hand, the method of roughening the surface roughness has an advantage that roughening the surface roughness does not need an additional process of attaching the low-reflection material and simplify a manufacturing process of the heater because roughening the surface roughness requires only changing grinding conditions for grinding the opposite surface 24c between the center portion C and both end portions E1 and E2.

[0051] Widening the portions U in the both end portions E1 and E2 having low reflectances can effectively prevent the temperatures at both end portions of the fixing belt 21 from increasing too much. However, since widening the portions U reduces the amount of heating energy reflected to both end portions of the fixing belt 21, heat radiation from belt holders 30 that support both end portions of the fixing belt 21 and heat radiation from the surface of the fixing belt 21 that is caused by airflows occurring in the image forming apparatus may affect to be the temperatures at both end portions of the fixing belt 21 lower than a necessary temperature. Therefore, positions of the boundary lines X between the center portion C having a high reflectance and the portions U in the both end portions E1 and E2 having the low reflectance are appropriately set according to the configuration of the fixing device, the influence of heat radiation, and the like.

[0052] In the example illustrated in FIG. 9, the boundary lines X between the portion having the high reflectance and the portions having the low reflectance are parallel to the sheet conveyance direction F, but the boundary lines X may not be parallel to the sheet conveyance direction F. For example, as in the examples illustrated in FIGS. 10 and FIG. 11, the boundary lines X may be inclined with respect to the sheet conveyance direction F.

[0053] In the example illustrated in FIG. 10, the two boundary lines X inclined so as to approach each other toward the downstream side in the sheet conveyance direction that is downward in FIG. 10 form the portions U that have the low reflectance and gradually spread in the longitudinal direction toward the downstream side in the sheet conveyance direction F. In contrast, the center portion C having the high reflectance gradually narrows in the longitudinal direction toward the downstream side in the sheet conveyance direction F. In the above-described case, the center portion C having high reflectance and being wider upstream than downstream in the sheet conveyance direction F can improve the heating efficiency of the fixing belt 21, in particular, at an upstream portion of the nip N in the sheet conveyance direction F. Since an amount of heat supplied from the fixing belt 21 to the sheet in the upstream portion of the nip N in the sheet conveyance direction F is generally larger than an amount of heat supplied from the fixing belt 21 to the sheet in a downstream portion of the nip N in the sheet conveyance direction F, adopting a configuration illustrated in FIG. 10 enables supplying enough amount of heat to the sheet in the upstream portion and prevents a fall in the temperature of the fixing belt 21 that is caused by supplying the amount of heat to the sheet. On the other hand, since the portions U having the low reflectance and becoming wider in the downstream portion of the nip N in the sheet conveyance direction F increases a proportion of heat absorbed by the nip formation member and can supply much heat via the nip formation member, the sheet bearing toner that is in high temperature can be separated from the fixing belt 21, which can easily give a glossy image.

[0054] On the other hand, in the example illustrated in FIG. 11, since the portions U having the low reflectance is formed so as to gradually narrow in the longitudinal direction of the nip formation member 24 toward the downstream side in the sheet conveyance direction F that is downward in FIG. 11, contrary to the example illustrated in FIG. 10, the center portion C having the high reflectance is wider downstream than upstream. In the above-described case, the nip formation member 24 can store a large amount of heat in both end portions in the longitudinal direction on the upstream side of the nip formation member 24 in the sheet conveyance direction F. In general fixing devices, since heat tends to dissipate from both ends in the longitudinal direction of the fixing belt, temperatures at both ends of the nip may decrease, which is called temperature decrease at the end portion. The temperature decrease at the end portion hinders obtaining good fixing property on an end portion of the sheet in a width direction of the sheet and may cause a fixing failure. In particular, in the upstream portion of the nip in the sheet conveyance direction, the unheated sheet enters the nip and absorbs a large amount of heat, and the influence of the temperature decrease at the end portion tends to be significant. As in the example illustrated in FIG. 11, widening the portions U having the low reflectance on the upstream side in the sheet conveyance direction F increases the heat stored at both end portions of the nip formation member 24 in the longitudinal direction on the upstream side in the sheet conveyance direction F. Increasing the heat stored at both end portions of the nip formation member 24 prevents the temperature decrease at both end portions of the nip when the sheet enters the nip and the fixing failure caused by the temperature decrease described above at both end portions.

[0055] In the above-described embodiment, as illustrated in FIGS. 2 and 3, the stays 25 and the reflectors 26 are a pair of parts that are separate members disposed on both sides to interpose the halogen heater 23, but, as in the example illustrated in FIG. 12, these paired members may be connected to each other at both end portions in the longitudinal direction that is the rotation axis direction Z of the pressure roller 22 and form on unit.

[0056] In the example illustrated in FIG. 12, the stay 25 and the reflector 26 include upstream wall portions 25c and 26c disposed upstream from the halogen heater 23 in the sheet conveyance direction F, downstream wall portions 25d and 26d disposed downstream from the halogen heater 23 in the sheet conveyance direction F, and a pair of connecting wall portions 25e and 26e connecting both end portions of the upstream wall portions 25c and 26c in the longitudinal direction and both end portions of the downstream wall portions 25d and 26d in the longitudinal direction. The stay 25 and the reflector 26 have openings 25f and 26f, which are regions not including the connecting wall portions 25e and 26e, opposite the pressure roller 22 with the halogen heater 23 interposed between the openings 25f and 26f and the pressure roller 22.

[0057] As illustrated in FIG. 13, in the openings 25f and 26f, the heating energy radiated from the halogen heater 23 and reflected by the opposite surface 24c of the nip formation member 24 and the reflector 26 passes through the openings 25f and 26f and reach the inner peripheral surface of the fixing belt 21.

[0058] On the other hand, as illustrated in FIG. 14, the connecting wall portions 25e of the stay 25 and the connecting portions 26e of the reflector 26 that are disposed opposite the nip formation member 24 with respect to the halogen heater 23 block the heating energy radiated from the halogen heater 23 and reflected by the opposite surface 24c of the nip formation member 24 and the reflector 26. That is, the connecting wall portions 25e and 26e function as end shields that block the heating energy radiated to the end portions of the fixing belt 21 in the longitudinal direction of the fixing belt 21. Note that "block the heating energy" described above means "block the heating energy (at least one of heat and light), and for example, a concept including reflecting the heating energy and absorbing the heating energy. The end shield is disposed opposite the nip formation member with respect to the heater 23 on an end side in the rotation axis direction of the pressure roller 22 as the opposite member and may be a single component. The block of the heating energy to the fixing belt 21 due to the connecting wall portions 25e and 26e efficiently prevents the temperatures at both end portions of the fixing belt 21 corresponding to the non-conveyance span from increasing too much.

[0059] In the fixing device according to the present disclosure, a number of the halogen heater 23 and the shapes of the stay 25 and the reflector 26 are not limited to the above-described embodiments and may be appropriately changed.

[0060] For example, as in the example illustrated in FIG. 15, the fixing device 5 may include two halogen heaters 23, a pair of stays 25 that are not parallel to each other and inclined to expand a distance between the stays 25 toward an upper side of the halogen heater 23 that is a side opposite to the nip N, and a pair of reflectors 26 that are not parallel to each other and inclined to expand a distance between the reflectors 26 toward the upper side of the halogen heater 23 that is the side opposite to the nip N.

[0061] 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 sheet conveyance direction in the fixing device 5 is not limited to the above-described embodiment, and the fixing device may convey the sheet in the vertical direction as illustrated in FIG. 16.

[0062] In the above-described embodiments, the present disclosure is applied to the fixing device that is an example of the heating device. However, the present disclosure may be applied to other heating devices. For example, in an inkjet type image forming apparatus, the heating device of the present disclosure may be applied to a drying device that heats the sheet to dry an ink (that is liquid) on the surface of the sheet.

[0063] 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 heating device (5) comprising:

   a rotatable member (21);
   an opposite member (22) disposed opposite an outer peripheral surface of the rotatable member (21);
   a heater (23) disposed inside a loop of the rotatable member (21) to heat the rotatable member (21); and
   a nip formation member (24) disposed inside the loop of the rotatable member (21) to sandwich the rotatable member (21) between the nip formation member (24) and the opposite member (22) and form a nip between the nip formation member (24) and the opposite member (22),
   the nip formation member (24) configured to be heated by the heater (23) and
   including an opposite surface (24c) disposed opposite the heater (23),
   at least a part of the opposite surface (24c) configured to reflect at least one of heat and light from the heater (23) with a reflectance of 50% or more.

2. The heating device (5) according to claim 1, wherein, in a rotation axis direction of the opposite member (22), the reflectance in an end portion of the opposite surface (24c) is lower than the reflectance in a center portion of the opposite surface (24c).

3. The heating device (5) according to claim 2, wherein a surface roughness of the end portion is larger than the surface roughness of the center portion.

4. The heating device (5) according to claim 2, wherein a low-reflection material having a lower reflectance than the center portion is attached to the end portion.

5. The heating device (5) according to any one of claims 2 to 4,
   wherein the center portion having a higher reflectance than the end portion is wider upstream than downstream in a recording medium conveyance direction.

6. The heating device (5) according to any one of claims 2 to 4,
   wherein the center portion having a higher reflectance than the end portion is wider downstream than upstream in a recording medium conveyance direction.

7. The heating device (5) according to any one of claims 1 to 6, further comprising an end shield (25e, 26e) disposed opposite the nip formation member (24) with respect to the heater (23) on an end side in a rotation axis direction of the opposite member (22) to shield the rotatable member (21) from at least one of the heat and light.

8. A fixing device (5) comprising the heating device according to any one of claims 1 to 7.

9. An image forming apparatus (1) comprising the heat-

ing device according to any one of claims 1 to 7.

FIG. 1

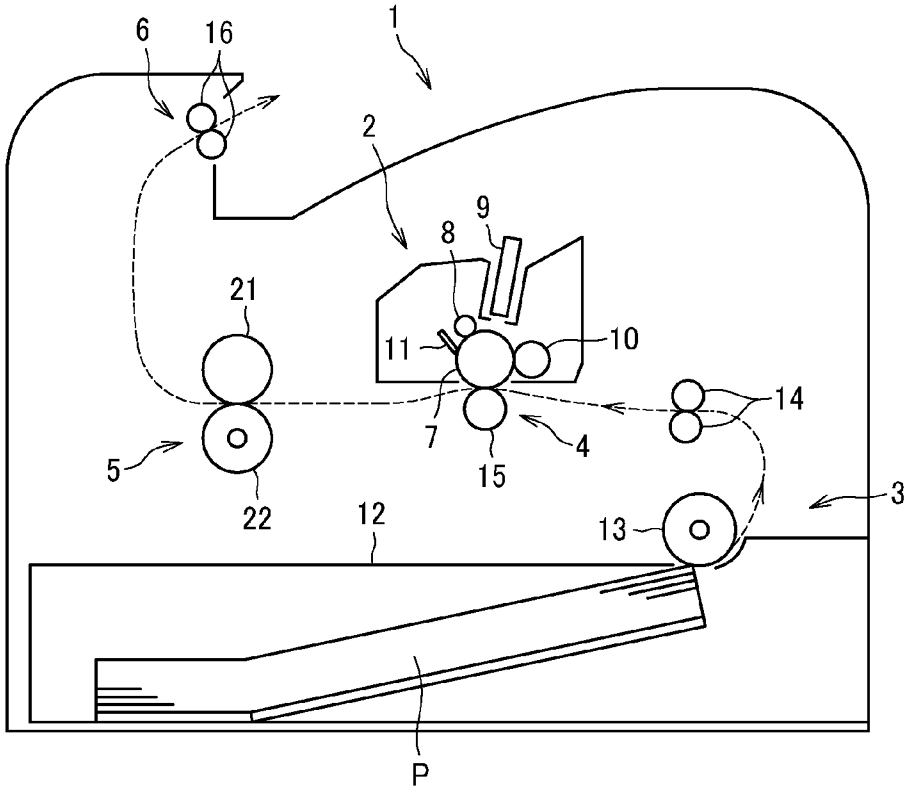

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
21
22
P

FIG. 2

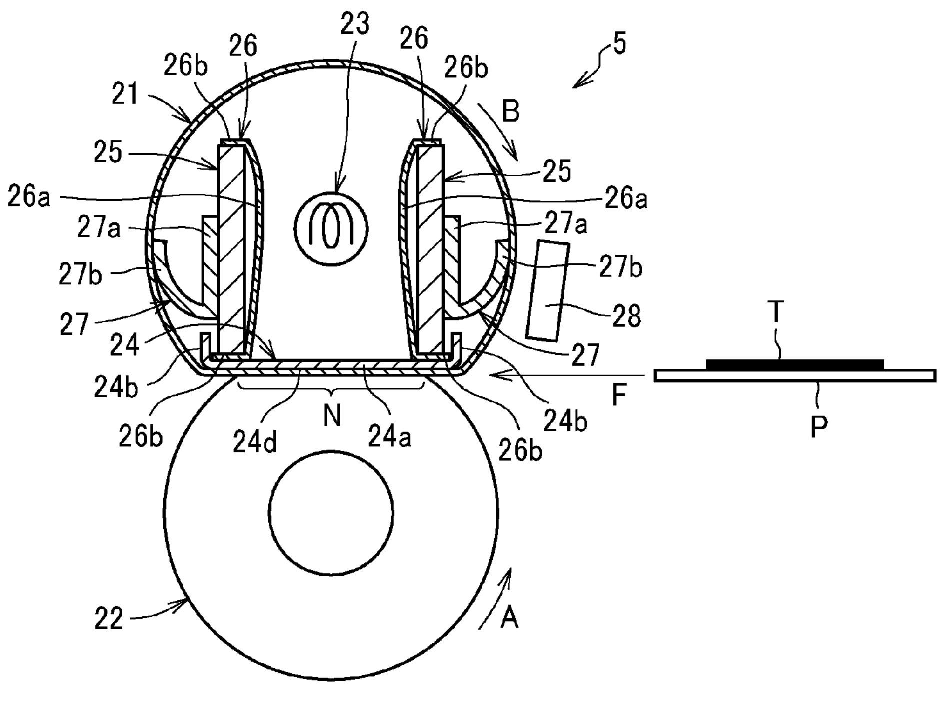

5
21
22
23
24
24a
24b
24d
25
26
26a
26b
27
27a
27b
28
A
B
F
N
T
P

FIG. 3

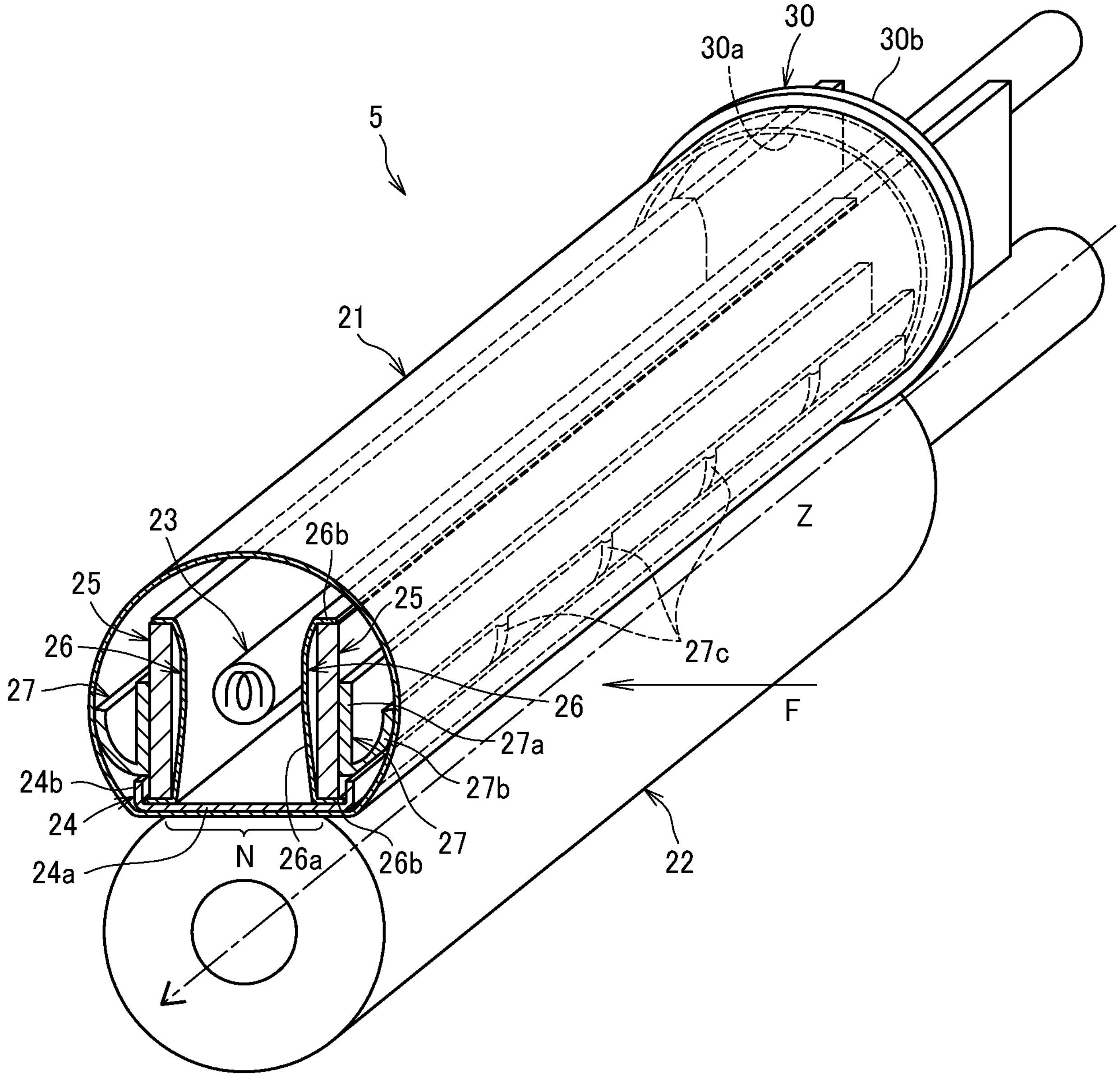


FIG. 4

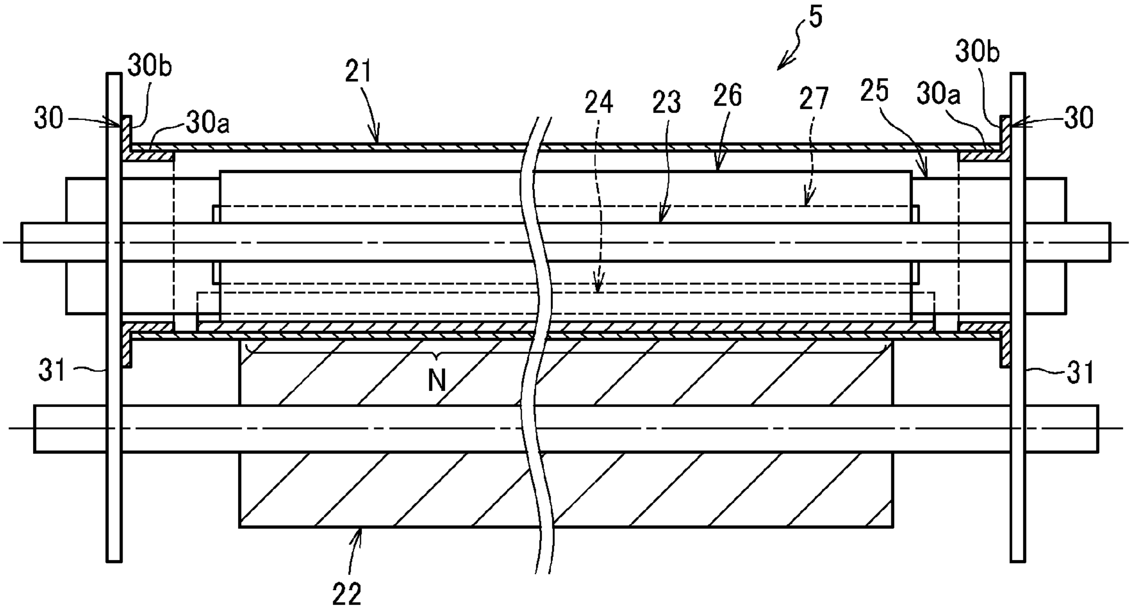


FIG. 5

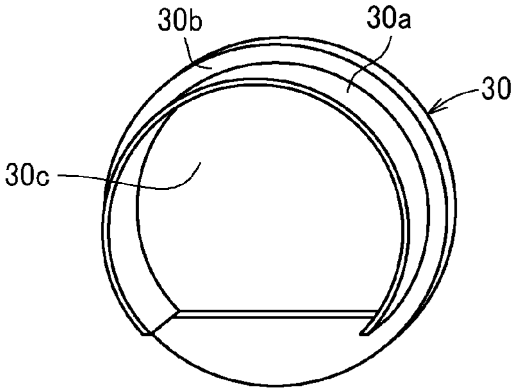


FIG. 6

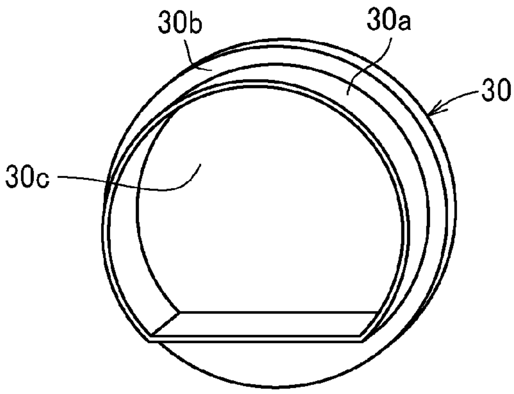


FIG. 7

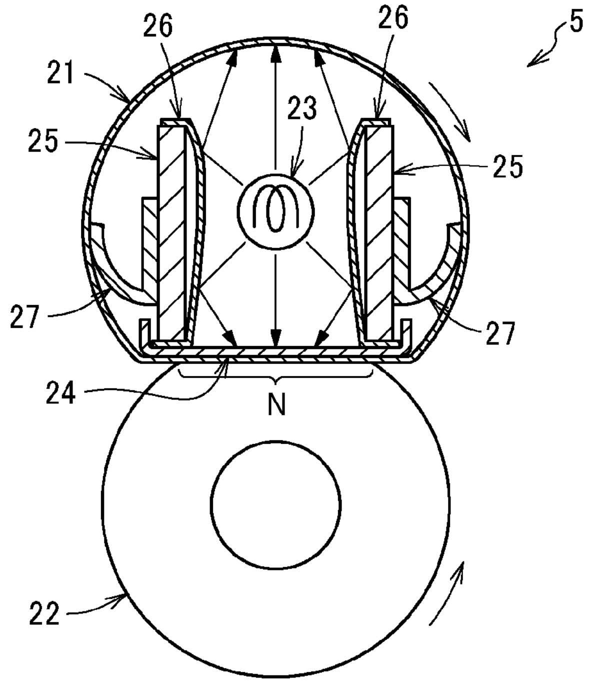


FIG. 8

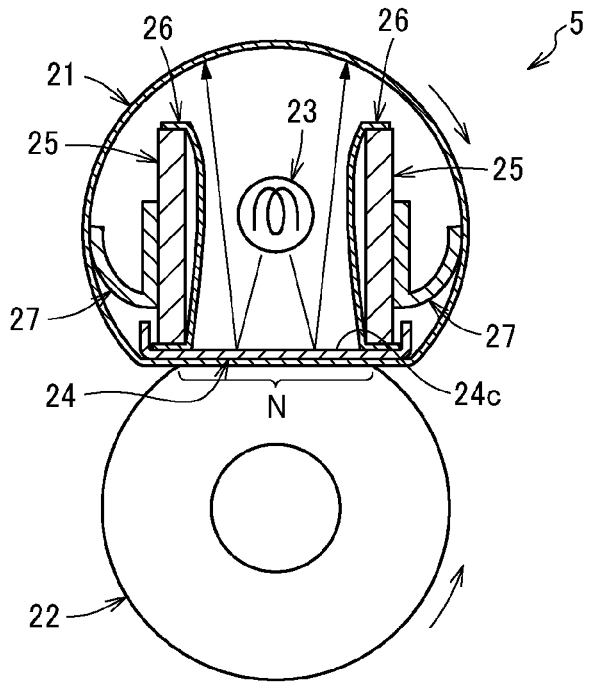


FIG. 9

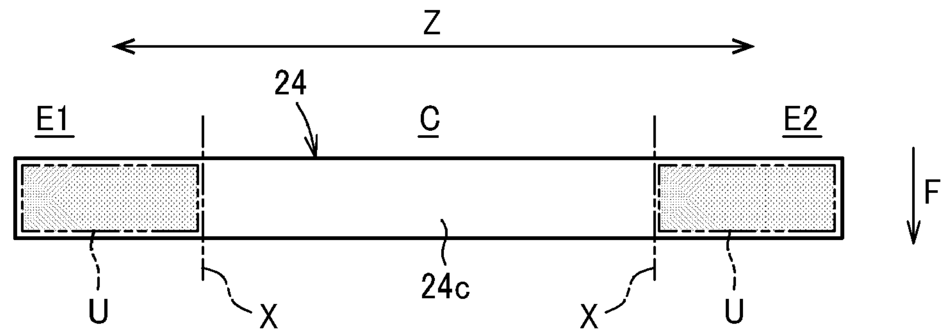


FIG. 10

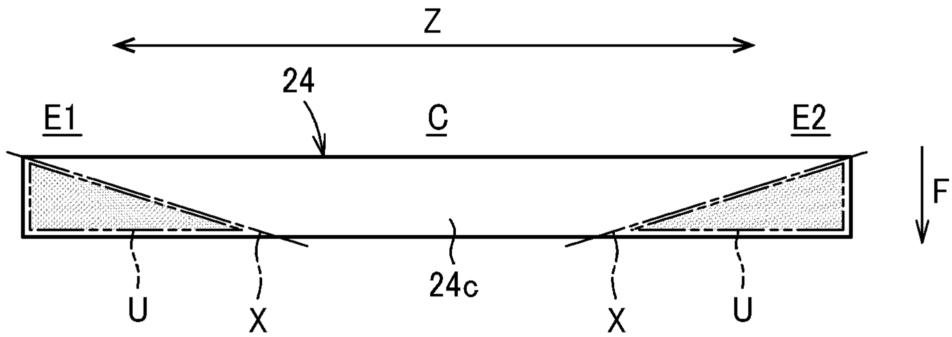


FIG. 11

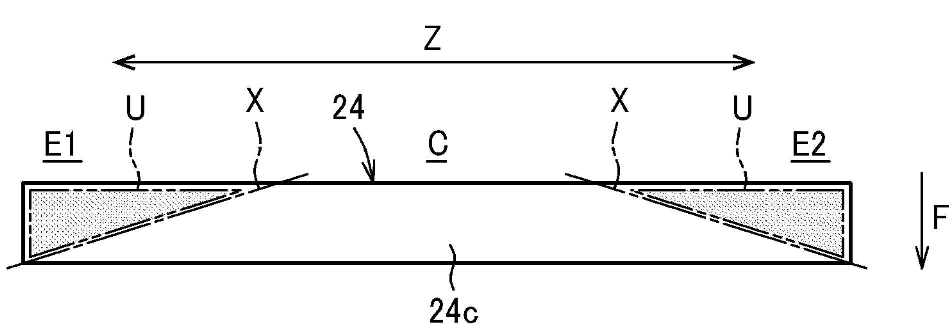


FIG. 12

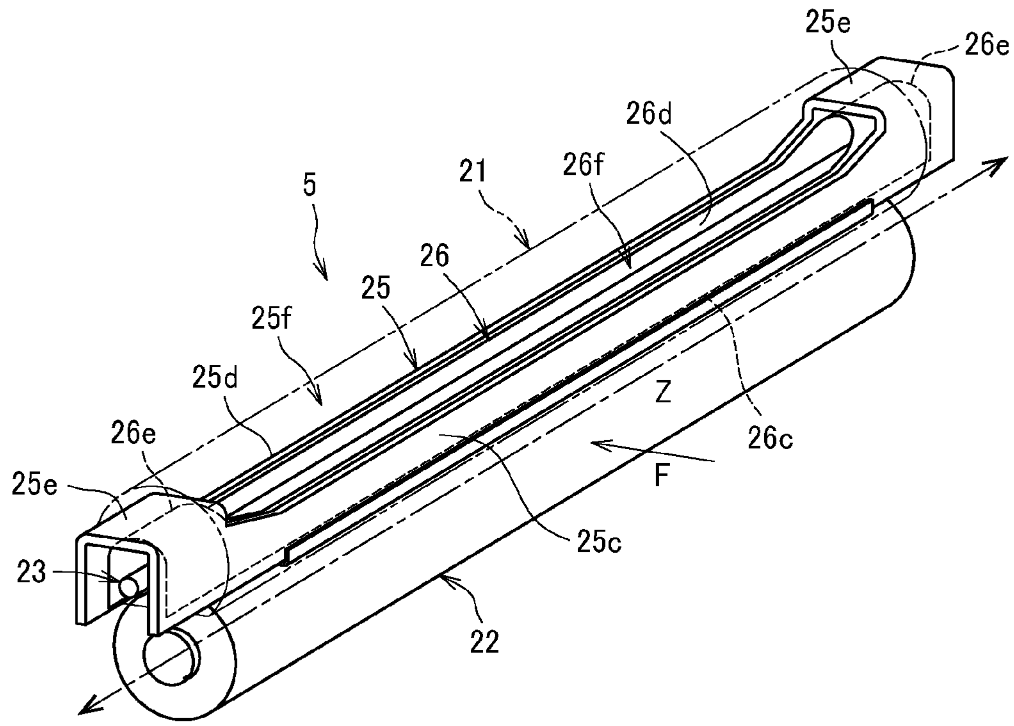

25e
26e
26d
21
26f
5
26
25
25f
25d
Z
26e
26c
25e
F
25c
23
22

FIG. 13

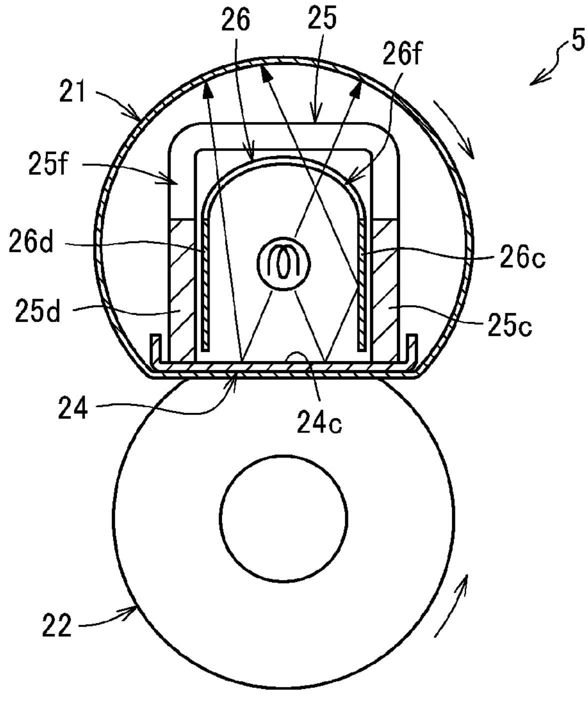

26
25
5
26f
21
25f
26d
26c
25d
25c
24
24c
22

FIG. 14

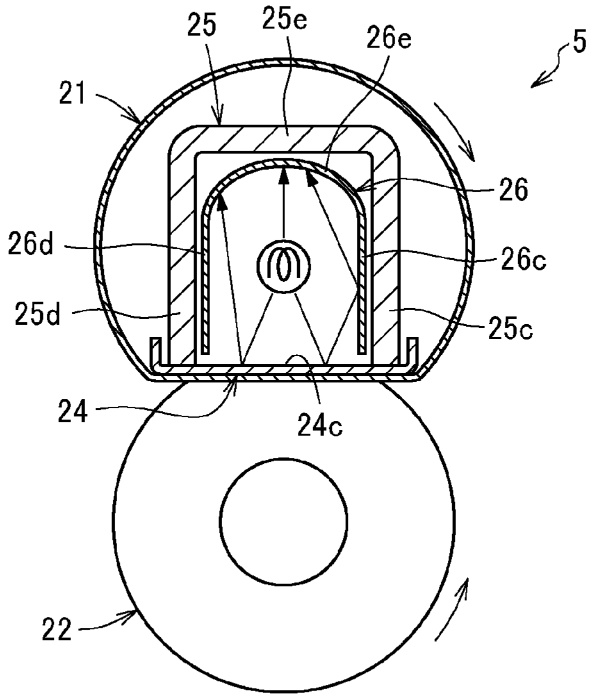

25
25e
26e
5
21
26
26d
26c
25d
25c
24
24c
22

FIG. 15

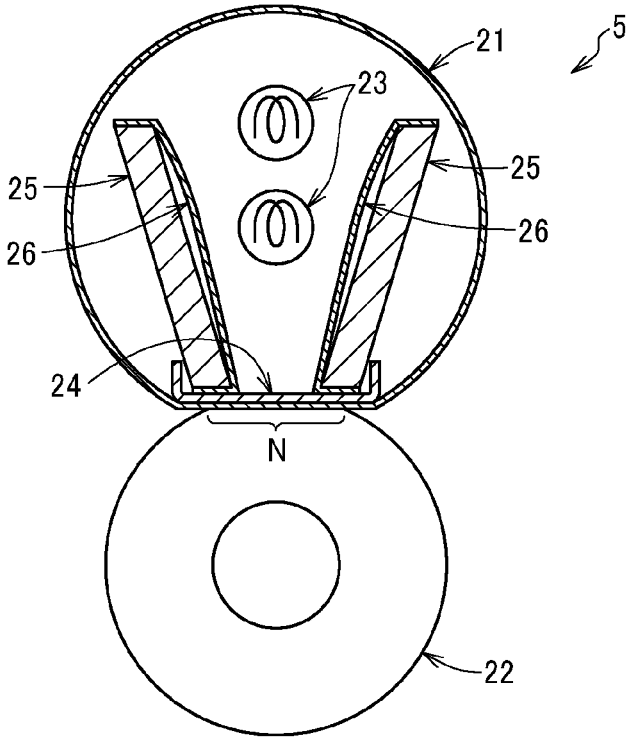
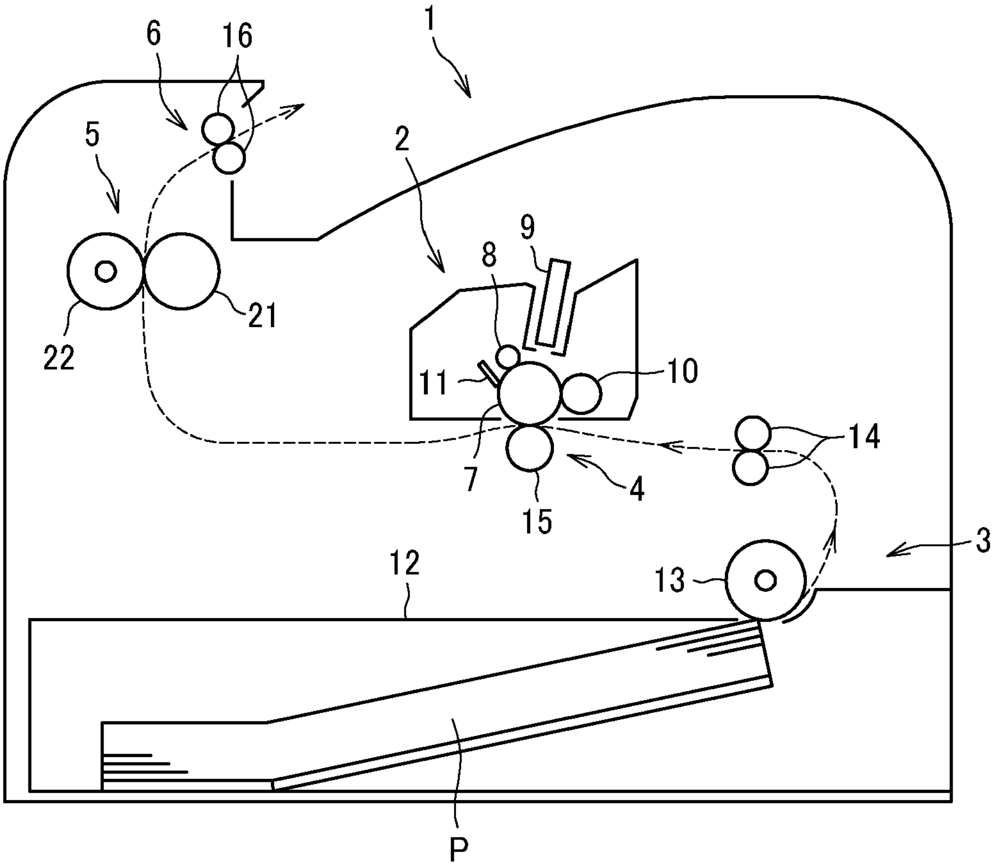

5
21
23
25
25
26
26
24
N
22

FIG. 16



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 17 3187

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 2005 283927 A (CASIO ELECTRONICS CO LTD; CASIO COMPUTER CO LTD) 13 October 2005 (2005-10-13) * paragraph [0010] - paragraph [0052]; figures 1-5 * -----	1,7-9 2-4 5,6	INV. G03G15/20
X Y	US 2015/063883 A1 (NAKANO KUNIAKI [JP]) 5 March 2015 (2015-03-05) * paragraph [0012] - paragraph [0055]; figures 1, 2 * -----	1,8,9 2-4	
Y A	JP 2013 164453 A (RICOH CO LTD) 22 August 2013 (2013-08-22) * paragraphs [0036], [0037], [0043] - [0045], [0050]; figures 1-5 * -----	2-4 1	
Y	US 2017/176898 A1 (IZAWA TATSUNORI [JP]) 22 June 2017 (2017-06-22) * paragraphs [0083] - [0088]; figures 2, 4 * -----	2-4	
			TECHNICAL FIELDS SEARCHED (IPC)
			G03G

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	23 September 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 17 3187

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.

23-09-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2005283927 A	13-10-2005	NONE	
US 2015063883 A1	05-03-2015	CN 104423224 A	18-03-2015
		JP 5993820 B2	14-09-2016
		JP 2015045713 A	12-03-2015
		US 2015063883 A1	05-03-2015
JP 2013164453 A	22-08-2013	JP 5948925 B2	06-07-2016
		JP 2013164453 A	22-08-2013
US 2017176898 A1	22-06-2017	US 2017176898 A1	22-06-2017
		WO 2017104944 A1	22-06-2017

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 2014132371 A **[0003] [0004]**