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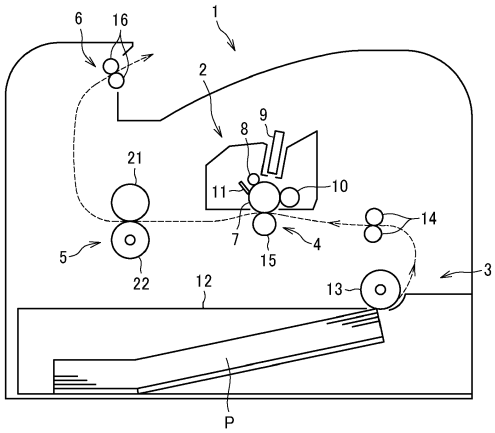
(54) HEATING DEVICE, FIXING DEVICE, AND IMAGE FORMING APPARATUS

(57) A heating device (5) includes a rotating member (21), an opposite member (22), a nip formation member (24), a heater (23), and a structure (25, 26) upstream and downstream from the heater (23) in a recording medium conveyance direction. The structure (25, 26) blocks light from the heater (23) and forms a light irradiated area (R) on a surface of the rotating member (21). On a cross section intersecting a rotation axis direction of the opposite member (22), the light irradiated area (R) is formed between a point with a first distance (K1) from an upstream end of the nip (N) along the rotating member (21) in a direction opposite to a rotation direction of the rotating member (21) and a point with a second distance (K2) longer than the first distance (K1) from a downstream end of the nip (N) along the rotating member (21) in the rotation direction.

FIG. 1



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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 and a printer includes a fixing device to convey a recording medium such as a sheet on which an unfixed image is formed to a nip formed between members such as a roller and a belt facing each other, heat the recording medium, and fix the unfixed image on the recording medium.

[0003] As this type of fixing device, for example, JP-2009-093141-A discloses a fixing device that includes a heating unit to heat both a belt unit and a nip forming unit that forms a nip.

SUMMARY

[0004] In a fixing device using a radiant heat heater such as a halogen heater or a carbon heater as a heating member, using all radiant heat radiated from the heater as a fixing energy is difficult. A part of the radiant heat is not used. Further improvement of heating efficiency is desired. In order to achieve this object, there is provided a heating device according to claim 1. Advantageous embodiments are defined by the dependent claims.

[0005] Advantageously, the heating device includes a rotating member, a rotatable opposite member disposed opposite an outer peripheral surface of the rotating member, a nip formation member disposed inside a loop of the rotating member to form a nip by sandwiching the rotating member with the opposite member, a heater disposed inside the loop of the rotating member and configured to heat the rotating member and the nip formation member; and a structure disposed inside the loop of the rotating member and arranged at upstream from the heater and downstream from the heater in a recording medium conveyance direction. The structure is configured to block light radially irradiated from the heater and form a light irradiated area on an inner circumferential surface of the rotating member to which the light is irradiated. The light irradiated area is formed in a cross section intersecting a rotation axis direction of the opposite member between a point with a first distance K1 from an upstream end of the nip in the recording medium conveyance direction along the rotating member in a direction opposite to a rotation direction of the rotating member when the recording medium is conveyed and a point with a second distance K2 from a downstream end of the nip in the recording medium conveyance direction along the rotating member in the rotation direction of the rotating member when the recording medium is conveyed, and the second distance K2 is longer than the first distance K1.

[0006] The above-described present disclosure can improve the heating efficiency of the heating device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic view 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 according to the first embodiment with the vertical cross-sectional view of the fixing device;
FIG. 4 is a vertical cross-sectional view of the fixing device according to the first embodiment 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 perspective view of the fixing device according to the first embodiment;
FIG. 8 is a cross-sectional view of the fixing device taken along line C-C in FIG. 7;
FIG. 9 is a cross-sectional view of the fixing device taken along line D-D and line E-E in FIG. 7;
FIG. 10 is a vertical cross-sectional view of the fixing device according to a second embodiment of the present disclosure viewed from a lateral side of the fixing device; and
FIG. 11 is a schematic view illustrating an example of a configuration of the image forming apparatus including a fixing device which conveys a sheet in a vertical direction.

[0008] The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

DETAILED DESCRIPTION

[0009] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that have a similar function, operate in a similar manner, and achieve a similar result.

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

[0011] The following is a description of the present disclosure with reference to attached drawings. In the drawings for explaining 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 a description of those elements is omitted once the description is provided.

[0012] FIG. 1 is a schematic view illustrating a configuration of an image forming apparatus according to an embodiment of the present disclosure. Referring to FIG. 1, the configuration and operation of the image forming apparatus are described below.

[0013] The image forming apparatus 1 illustrated in FIG. 1 is a monochrome electrophotographic laser printer. The image forming apparatus according to the present disclosure may be a printer, a copier, a facsimile machine, a multifunction peripheral 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.

[0014] As illustrated in FIG. 1, the image forming apparatus 1 includes an image forming device 2 to form an image, a recording medium feeding device 3 to feed a sheet P as a recording medium, a transfer device 4 to transfer the image onto the fed sheet P, a fixing device 5 to fix the image transferred onto the sheet P, and a sheet ejection device 6 to eject the sheet P with the fixed image to an outside of the image forming apparatus 1.

[0015] The image forming device 2 includes a drum-shaped photoconductor 7, a charging roller 8 as a charging device to charge a surface of the photoconductor 7, an exposure device 9 as a latent image forming device that exposes the surface of the photoconductor 7 to form an electrostatic latent image on the photoconductor 7, a developing roller 10 as a developing device that supplies toner as a developer to the surface of the photoconductor 7 to visualize the electrostatic latent image, and a cleaning blade 11 as a cleaner to clean the surface of the photoconductor 7.

[0016] As 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 a document read by a scanner or print data transmitted by a terminal device, the exposure device 9 exposes the surface of the photoconductor 7. Then, the 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.

[0017] The toner image formed on the photoconductor 7 is transferred onto the sheet P in a transfer nip between the photoconductor 7 and a transfer roller 15 disposed in the transfer device 4. The sheet P is fed from the recording medium feeding device 3. In the recording medium feeding device 3, a sheet feeding roller 13 feeds the sheet P from a sheet tray 12 to a feeding path one by one. A timing roller pair 14 sends out the sheet P fed from the sheet tray 12 to the transfer nip, timed to coincide with the toner image on the photoconductor 7. The toner image on the photoconductor 7 is transferred onto the sheet P at the transfer nip. After the toner image is transferred from the photoconductors 7 onto the sheet P, the cleaning blade 11 removes residual toner on the photoconductor 7.

[0018] The sheet P bearing the toner image is conveyed to the fixing device 5. In the fixing device 5, heat and pressure when the sheet P passes through between 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, and a series of print operations are completed.

[0019] With reference to FIGS. 2 to 6, a detailed description is provided of a configuration of the fixing device 5 according to a first embodiment of the present disclosure.

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

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

[0022] The fixing belt 21 is a fixing member to fix an unfixed toner image T on the sheet P. The fixing belt 21 is a rotatable rotating member arranged on an image bearing 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 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, polytetrafluoroethylene, or the like.

[0023] 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.

[0024] 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.

[0025] 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 to 40 mm. Preferably, the loop diameter of the fixing belt 21 may not be greater than 30 mm.

[0026] The pressure roller 22 is a rotatable opposite member disposed opposite an outer peripheral surface of the fixing belt 21. In the present embodiment, 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.

[0027] A driver disposed inside the image forming apparatus 1 drives and rotates the pressure roller 22 in a direction indicated by arrow A in FIG. 2. The rotation of the pressure roller 22 drives the fixing belt 21 to rotate in a direction 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 T 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 are applied to the sheet P to fix the unfixed toner image T onto the sheet P.

[0028] The pressure roller 22 and the fixing belt 21 are configured to be able to approach and move away from 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 fixed and the other may 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 moved so that the pressure roller 22 and the fixing belt 21 contact and separate each other.

[0029] The halogen heater 23 is a heater that radiates heat and light to heat the fixing belt 21 and the nip formation member 24 by radiant heat. Alternatively, instead of the halogen heater 23, a radiant heat type heater such as a carbon heater may be employed as the heater. In the present embodiment, only one halogen heater 23 is disposed in the loop of the fixing belt 21, but a plurality of halogen heaters 23 having different heat generation areas according to the widths of the sheets may be disposed.

[0030] The nip formation member 24 and the pressure roller 22 sandwich the fixing belt 21 to form the nip N. Specifically, the nip formation member 24 extends inside the loop of the fixing belt 21 in a longitudinal direction of the fixing belt 21 that is also a rotation axis direction X of the pressure roller 22 and 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 of the nip formation portion 24a in a sheet conveyance direction F 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.

[0031] A belt contact surface of the nip formation member 24 on which the nip formation member 24 contacts the fixing belt 21 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 belt contact surface to ensure the slidability over time. In the present embodiment, the belt contact surface is planar. Alternatively, the belt contact surface may define a recess or other shape. For example, the belt contact surface 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.

[0032] 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 or aluminum. 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.

[0033] 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 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. Similar to the nip formation member 24, the stay 25 extends in the longitudinal direction of the fixing belt 21 and is disposed inside the loop of the fixing belt 21.

[0034] The stay 25 includes an upstream wall portion 25a disposed upstream from the halogen heater 23 in the sheet conveyance direction F, a downstream wall portion 25b disposed downstream from the halogen heater 23 in the sheet conveyance direction F, and a pair of connecting wall portions 25c connecting both end portions of the upstream wall portion 25a and the downstream wall portion 25b in the longitudinal direction. An opening 25d is formed in a portion between the upstream wall portion 25a and the downstream wall portion 25b in which the connecting wall portion 25c does not exist.

[0035] The upstream wall portion 25a and the downstream wall portion 25b extend in a pressing direction of the pressure roller 22. The upstream wall portion 25a is in contact with an upstream portion of the nip formation member 24 in the sheet conveyance direction F, and the downstream wall portion 25b is in contact with a downstream portion of the nip formation member 24 in the sheet conveyance direction F. Since the stays 25 supports the upstream portion of the nip formation member 24 and the downstream portion of the nip formation member 24 in the sheet conveyance direction F, the bending of the nip formation member 24 in the pressing direction is restrained. The stay 25 is preferably made of an iron-based metal such as stainless steel or steel electrolytic cold commercial that is electrogalvanized sheet steel to ensure rigidity.

[0036] The reflector 26 reflects at least one of the heat and light (for example, the infrared light) radiated by the halogen heater 23 to at least one of the fixing belt 21 and the nip formation member 24. The reflector 26 may reflect at least one of the heat and light radiated by the halogen heater 23 to either the fixing belt 21 or the nip formation member 24. The reflector 26 exists between the stay 25 and the halogen heater 23. Similar to the nip formation member 24 and the stay 25, the reflector 26 extends in the longitudinal direction of the fixing belt 21. In addition, similar to the stay 25, the reflector 26 includes an upstream wall portion 26a disposed upstream from the halogen heater 23 in the sheet conveyance direction F, a downstream wall portion 26b disposed downstream from the halogen heater 23 in the sheet conveyance direction F, and a pair of connecting wall portions 26c connecting both end portions of the upstream wall portion 26a in the longitudinal direction and both end portions of the downstream wall portion 26b in the longitudinal direction. An opening 26d is formed in a portion between the upstream wall portion 26a and the downstream wall portion 26b in which the connecting wall portion 26c does not exist.

[0037] The surface 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 surface of the reflector 26 facing the halogen heater 23 is 70% or more when it is measured using, for example, the spectrophotometer that is the ultraviolet visible infrared spectrophotometer UH4150 manufactured by Hitachi High-Tech Science 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.

[0038] Alternatively, the stay 25 may have the function of the reflector 26. For example, the inner surface of the stay 25 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.

[0039] 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 longitudinal direction of the fixing belt 21, and one end position of the fixing belt 21 in the longitudinal 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 sensor.

[0040] As illustrated in FIG. 4, each belt holder 30 as a fixing member 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.

[0041] 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. Both ends of the halogen heater 23, the stay 25, and the reflector 26 are inserted into the openings 30c and supported by the pair of side plates 31. Further, the halogen heater 23, the stay 25, and the reflector 26 may be supported by the belt holder 30.

[0042] As illustrated in FIG. 2, in the present embodiment, the halogen heater 23 radiates heat and light. A part of the heating energy such as the heat and light 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 the 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 is reflected by the reflector 26 and indirectly reaches the fixing belt 21 and the nip formation member 24 to heat both of the fixing belt 21 and the nip formation member 24.

[0043] The present inventors noticed the following to improve a heating efficiency of a heating device such as the fixing device. An efficiency of heat transfer when the heat is applied to a downstream portion of the fixing belt 21 from the nip in the sheet conveyance direction and transferred to the nip and the sheet tends to be lower than an efficiency of heat transfer when the heat is applied to an upstream portion of the fixing belt 21 from the nip in the sheet conveyance direction and transferred to the nip and the sheet. A time while the heat is applied to the downstream portion and transferred to the nip is longer than a time while the heat is applied to the upstream portion and transferred to the nip. Heat loss while the heat is applied to the downstream portion and transferred to the nip reduces heat stored in the fixing belt 21. As a result, heat transferred to the nip and the sheet is reduced. Therefore, preferably, more heating energy is applied to the upstream portion than the downstream portion of the fixing belt 21 from the nip in the sheet conveyance direction, improving the heating efficiency. Focusing on the above, the fixing device according to the present embodiment is configured as follows to improve the heating efficiency.

[0044] FIG. 7 is a perspective view of the fixing device 5 according to the first embodiment, FIG. 8 is a cross-sectional view of the fixing device 5 taken along line C-C in FIG. 7, and FIG. 9 is a cross-sectional view of the fixing device 5 taken along line D-D and line E-E in FIG. 7.

[0045] As illustrated in FIG. 7, in the present embodiment, upstream portions in the sheet conveyance direction F of the openings 25d and 26d formed in the stay 25 and the reflector 26, respectively are configured to be larger than downstream portions in the sheet conveyance direction F of the openings 25d and 26d. To form the openings 25d and 26d as described above, heights of the upstream wall portions 25a and 26a of the stay 25 and the reflector 26 in a direction of arrow Z in FIG. 7 are formed to be lower than heights of the downstream wall portions 25b and 26b of the stay 25 and the reflector 26 in the direction of arrow Z.

[0046] The above-described direction of arrow Z is referred to as "a direction orthogonal to the nip" because the direction of arrow Z is orthogonal to a nip surface of the nip N. As illustrated in FIG. 8, a dimension H1 of the upstream wall portion 25a of the stay 25 in the direction orthogonal to the nip is formed to be shorter than a dimension H2 of the downstream wall portion 25b of the stay 25 in the direction orthogonal to the nip. Similarly, a dimension H3 of the upstream wall portion 26a of the reflector 26 in the direction orthogonal to the nip is formed to be shorter than a dimension H4 of the downstream wall portion 26b of the reflector 26 in the direction orthogonal to the nip. The above dimensional conditions of the stay 25 and the reflector 26 are satisfied continuously from the central portions of the stay 25 and the reflector 26 to both end portions of the stay 25 and the reflector 26 in their longitudinal direction.

[0047] In the present embodiment, the above direction of arrow Z is defined as the direction orthogonal to the nip N having a flat nip surface. When the definition of the direction orthogonal to the nip is difficult, for example, when the nip does not have a flat surface, the direction of arrow Z may be defined as a direction of a center line M passing through the rotation center O of the fixing belt 21 and the rotation center Q of the pressure roller 22 as illustrated in FIG. 8.

[0048] As illustrated in FIG. 8, in the fixing device 5 according to the present embodiment, the light radially irradiated from the halogen heater 23 passes through the opening 26d of the reflector 26 and the opening 25d of the stay 25 and reaches the inner circumferential surface of the fixing belt 21. As a result, a light irradiated area R that is directly irradiated with the light from the halogen heater 23 is formed on the inner circumferential surface of the fixing belt 21. On the other hand, a part of the light is blocked by the stay 25 and the reflector 26.

[0049] As described above, in the present embodiment, the dimensions H1 and H3 of the upstream wall portions 25a and 26a of the stay 25 and the reflector 26 in the direction orthogonal to the nip are formed to be shorter than the dimensions H2 and H4 of the downstream wall portions 25b and 26b of the stay 25 and the reflector 26 in the direction orthogonal to the nip, respectively. These dimensions in the direction orthogonal to the nip determine sizes of areas in which the light is blocked by the upstream wall portions 25a and 26a or the downstream wall portions 25b and 26b. The area in which the light is blocked by the upstream wall portions 25a and 26a having a small dimension in the direction orthogonal to the nip is smaller than the area in which the light is blocked by the downstream wall portions 25b, 26b having a large dimension in the direction orthogonal to the nip.

[0050] The area in which the upstream wall portions block the light is smaller than the area in which the downstream wall portions block the light. Therefore, as illustrated in FIG. 8 that is a figure on a cross section intersecting the longitudinal direction of the fixing belt 21 that is the rotation axis direction X of the pressure roller 22, a distance K1 from the upstream end n1 of the nip N in the sheet conveyance direction F to the light irradiated area R is shorter than a distance K2 from the downstream end n2 of the nip N in the sheet conveyance direction F to the light irradiated area R. The above-described "distance K1 from the upstream end n1 of the nip N in the sheet conveyance direction F to the light irradiated area R" means a distance from the upstream end n1 of the nip N to the light irradiated area R in the direction opposite to the rotation direction B of the fixing belt 21 when the sheet is conveyed. In addition, the "distance K2 from the downstream end n2 of the nip N in the sheet conveyance direction F to the light irradiated area R" means a distance from the downstream end n2 of the nip N to the light irradiated area R in the rotation direction B of the fixing belt 21 when the sheet is conveyed.

[0051] Since the dimensions H1 and H3 of the upstream wall portions 25a and 26a of the stay 25 and the reflector 26 in the direction orthogonal to the nip are formed to be shorter than the dimensions H2 and H4 of the downstream wall portions 25b and 26b of the stay 25 and the reflector 26 in the direction orthogonal to the nip, respectively in the present embodiment, upstream portions of the openings 25d and 26d are larger than downstream portions of the openings 25d and 26d in the sheet conveyance direction F. As a result, as illustrated in FIG. 8 that is the figure on the cross section intersecting the longitudinal direction of the fixing belt 21 that is the rotation axis direction X of the pressure roller 22, when the halogen heater 23 radially radiates the light, a light irradiated upstream area G1 that is an upstream portion irradiated with the light on the fixing belt 21 in the sheet conveyance direction F is larger than a light irradiated downstream area G2 that is a downstream portion irradiated with the light on the fixing belt 21 in the sheet conveyance direction F. The above-described the "light irradiated upstream area G1" and the "light irradiated downstream area G2" are set as areas irradiated with the light and given by dividing the fixing belt 21 into two parts, that is, the upstream area and the downstream area in the sheet conveyance direction F, with reference to, for example, the center line M passing through the rotation center O of the fixing belt 21 and the rotation center Q of the pressure roller 22.

[0052] As described above, in the fixing device 5 according to the present embodiment, the distance K1 from the upstream end n1 of the nip N in the sheet conveyance direction F to the light irradiated area R is shorter than the distance K2 from the downstream end n2 of the nip N in the sheet conveyance direction F to the light irradiated area R. In addition, on the fixing belt 21 irradiated with the light, the light irradiated upstream area G1 is larger than the light irradiated downstream area G2. Therefore, the heating energy radiated from the halogen heater 23 is applied to a larger area of the fixing belt 21 on the upstream portion than the downstream portion. The above-described configuration can efficiently heat the upstream portion of the fixing belt 21 in the sheet conveyance direction F and improve the heating efficiency.

[0053] The light irradiated upstream area G1 and the light irradiated downstream area G2 that are irradiated with the light on the fixing belt 21 change based on the position of the halogen heater 23, sizes of the openings 25d and 26d of the stay 25 and the reflector 26, and shapes of the stay 25 and the reflector 26 that are structures disposed between the halogen heater 23 and the fixing belt 21. In the present embodiment, to enlarge the light irradiated upstream area G1, as illustrated in FIG. 8, the halogen heater 23 is arranged upstream from the above-described center line M in the sheet conveyance direction F and above the upstream wall portions 25a and 26a of the stay 25 and the reflector 26 in FIG. 8. Arranging the halogen heater 23 at the above-described position can efficiently enlarge the light irradiated upstream area G1 on the fixing belt 21 and further improve the heating efficiency.

[0054] Additionally, in the present embodiment, the largely formed upstream portions of the openings 25d and 26d of the stay 25 and the reflector 26 in the sheet conveyance direction F enables easy temperature control of the fixing belt 21. For example, since a safety device such as a thermostat or a thermal fuse that detects overheating of the halogen heater and turns off the halogen heater is typically arranged to directly face the halogen heater, the stay and the reflector arranged around the halogen heater limits a space for the safety device. However, in the present embodiment, the largely formed upstream portions of the openings 25d and 26d of the stay 25 and the reflector 26 in the sheet conveyance direction F enables easily arranging the safety device at a position near the halogen heater 23 and upstream from the halogen heater 23 in the sheet conveyance direction F. The above-described arrangement enables quick detection of the temperature of the halogen heater 23, easily controlling the temperature of the fixing belt 21.

[0055] In a cross-section of the fixing device 5 at any position in the longitudinal direction of the fixing belt 21 that is the rotation axis direction X of the pressure roller 22, the fixing device 5 may have the above-described configuration to improve the heating efficiency of the upstream portion of the fixing belt 21 in the sheet conveyance direction F, that is, the configuration in which the distance K1 from the upstream end n1 of the nip N in the sheet conveyance direction F to the light irradiated area R is shorter than the distance K2 from the downstream end n2 of the nip N in the sheet conveyance direction F to the light irradiated area R, or the configuration in which the light irradiated upstream area G1 is larger than the light irradiated downstream area G2 on the fixing belt 21. Preferably, the fixing device 5 has the above-described configuration in the cross-section at the central position of the fixing belt 21 in the longitudinal direction of the fixing belt 21 because good heating efficiency at the central position of the fixing belt 21 corresponding to the central position of the toner image is preferable. The fixing device 5 may have the above-described configuration in a cross-section at a position corresponding to the temperature sensor 28 in the longitudinal direction of the fixing belt 21 that is the rotation axis direction X of the pressure roller 22. The fixing device 5 has the above-described configuration at least when the fixing belt 21 stops without rotation because the fixing device 5 having the above-described configuration when the fixing belt 21 stops has the above-described configuration even when the fixing belt 21 rotates.

[0056] Preferably, in entire sheet conveyance spans that are spans of sheets passing on the fixing belt 21, the fixing device 5 has the above-described configuration to improve the heating efficiency of the upstream portion of the fixing belt 21 in the sheet conveyance direction F. To make the above configuration, preferably, over the entire sheet conveyance span of the largest sheet on the fixing belt 21, the dimensions H1 and H3 of the upstream wall portions 25a and 26a in the direction orthogonal to the nip are formed to be shorter than the dimensions H2 and H4 of the downstream wall portions 25b and 26b in the direction orthogonal to the nip, respectively. To reduce a variation of the heat applied to the fixing belt 21, preferably, the dimensions H1 to H4 of the upstream wall portions 25a and 26a and the downstream wall portions 25b and 26b in the direction orthogonal to the nip are set to be the same over the entire sheet conveyance span of the largest sheet.

[0057] As described above, the largely formed openings 25d and 26d of the stay 25 and the reflector 26 can improve the heating efficiency but decrease cross-sectional areas of the stay 25 and the reflector 26. Therefore, stiffness of the stay 25 and the reflector 26 decreases. Since the stay 25 supports the nip formation member 24 against the pressing force from the pressure roller 22, the stay 25 is designed not to have too low stiffness. In the present embodiment, since springs as pressing means press both end portions of the pressure roller 22 in the rotation axis direction X against the stay 25, both end portions of the stay 25 in the longitudinal direction of the stay 25 have sufficient stiffness.

[0058] Therefore, in the present embodiment, to design both end portions of the stay 25 in the longitudinal direction of the stay 25 having sufficient stiffness, the dimensions H5 and H6 of the upstream wall portion 25a and the downstream wall portion 25b on the both end portions of the stay 25 in the direction Z orthogonal to the nip is designed longer than the dimensions H1 and H2 of the upstream wall portion 25a and the downstream wall portion 25b on the central position of the stay 25 in the direction Z orthogonal to the nip. The above-described configuration can secure the sufficient stiffness of the both end portions of the stay 25 in the longitudinal direction of the stay 25 against the pressing force of the pressure roller 22 and reliably decrease the bending of the nip formation member 24 in the longitudinal direction. In addition, in the present embodiment, similar to the stay 25, the reflector 26 has the upstream wall portion 26a and the downstream wall portion 26b that are formed so that both end portions in the longitudinal direction are longer in the direction Z orthogonal to the nip than the central portion.

[0059] Additionally, as illustrated in FIG. 7, the stay 25 in the present embodiment has connecting wall portions 25c that connect both end potions of the upstream wall portion 25a in the longitudinal direction and both end portions of the downstream wall portion 25b in the longitudinal direction. Similarly, the reflector 26 also has connecting wall portions 26c that connect both end potions of the upstream wall portion 26a in the longitudinal direction and both end portions of the downstream wall portion 26b in the longitudinal direction. As illustrated in FIG. 9, the above-described connecting wall portions 25c and 26c disposed opposite the nip formation member 24 with respect to the halogen heater 23 block the heating energy radiated from the halogen heater 23 to both end portions of the fixing belt 21 in the longitudinal direction of the fixing belt 21.

[0060] As described above, the connecting wall portions 25c and 26c function as end shields that block the heating energy radiated to the both 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, and for example, a concept including reflecting the heating energy and absorbing the heating energy. In a non-sheet conveyance area that is one of both end portions of the fixing belt 21 in the longitudinal direction of the fixing belt 21 and the portion over which the sheet does not pass, the heat of the fixing belt 21 is less likely to be consumed, and the fixing belt 21 may overheat. However, in the present embodiment, since the connecting wall portions 25c and 26c of the stay 25 and the reflector 26 block the heating energy radiated to both end portions of the fixing belt 21 as described above, overheating on the non-sheet conveyance area can be avoided.

[0061] When the reflector 26 has the connecting wall portions 26c as described above, a part of the heating energy reflected by the connecting wall portions 26c is applied to the nip formation member 24. Therefore, the amount of heating energy applied to both end portions of the nip formation member 24 in the longitudinal direction is larger than that to the center portion thereof. However, a local overheating on the both end portions is unlikely to occur because the nip formation member 24 has a larger thermal capacity than the fixing belt 21. In addition, the heat applied to both end portions of the nip formation member 24 in the longitudinal direction is transferred to the central portion of the nip formation member 24 along the nip formation member 24 and is effectively utilized as heat for the fixing process, improving the thermal energy efficiency.

[0062] The following is a description of a second embodiment of the present disclosure. Differences from the first embodiment are mainly described below, and descriptions similar to descriptions of the above-described embodiment are omitted below.

[0063] As illustrated in FIG. 10, the fixing device 5 according to the second embodiment of the present disclosure includes the reflector 26 having projected surface portions 33 that project toward the halogen heater 23 side and are disposed on surfaces facing the halogen heater 23 on the upstream wall portion 26a and the downstream wall portion 26b of the reflector 26.

[0064] The above-described projected surface portion 33 reflects a part of the heating energy radiated from the halogen heater 23. In the present embodiment, since each projected surface portion 33 is arranged closer to the nip N than the halogen heater 23, the projected surface portion 33 reflects a part of the heating energy radiated from the halogen heater 23 to the nip formation member 24. The heating energy reflected by the projected surface portion 33 is applied to the fixing belt 21 not to the nip formation member 24. That is, in comparison with the first embodiment, the configuration in the second embodiment reduces the heating energy applied to the nip formation member 24 and conversely increases the heating energy applied to the fixing belt 21.

[0065] The heating energy applied to the nip formation member 24 is transferred to the sheet via the fixing belt 21, but the heating energy applied to the fixing belt 21 is directly transferred to the sheet in the nip N. Therefore, from the viewpoint of heating efficiency, applying the heating energy to the fixing belt 21 is more preferable than applying the heating energy to the nip formation member 24. That is, increasing the ratio of the heating energy applied to the fixing belt 21 as in the second embodiment can effectively transfer the heat to the sheet and improve the heating efficiency.

[0066] However, the nip formation member 24 not heated at all absorbs the heating energy of the fixing belt 21 and obstructs sufficiently applying the heating energy to the sheet. Consideration of this point gives 5: 5 to 1: 9 as a preferable ratio of the reflection component α of the light reflected by the reflector 26 toward the fixing belt 21 and the reflection component β of the light reflected by the reflector 26 toward the nip formation member 24. Setting the ratio above can reduce heat transfer from the fixing belt 21 to the nip formation member 24 and apply sufficient heating energy to the sheet, improving the heating efficiency.

[0067] The reflection component α of the light reflected toward the fixing belt 21 and the reflection component β reflected toward the nip formation member 24 that are described above are reflection components due to the primary reflection of the reflector 26. The ratio of the primary reflection components can be estimated by a ratio of areas: a total area of surfaces facing the fixing belt 21 in a reflection surface of the reflector 26 and a total area of surfaces facing the nip formation member 24 in the reflection surface of the reflector 26. Therefore, setting the ratio of the total area of surfaces facing the fixing belt 21 in the reflection surface of the reflector 26 and the total area of surfaces facing the nip formation member 24 in the reflection surface of the reflector 26 to 5: 5 to 1: 9 gives the above described preferable ratio of the reflection components.

[0068] Additionally, in the embodiment illustrated in FIG. 10, disposing the projected surface portion 33 on the reflector 26 can reduce the heating energy reflected toward the halogen heater 23. The heating energy reflected toward the halogen heater 23 heats the halogen heater 23 itself and causes overheating and deterioration of the halogen heater 23. Reducing the heating energy reflected toward the halogen heater 23 can prevent the overheating and deterioration of the halogen heater 23.

[0069] Although the projected surface portion 33 in the present embodiment is formed to have a triangular cross-section and two planes inclined to each other, the cross-sectional shape of the projected surface portion 33 is not limited to the triangle. The projected surface portion 33 may have a curved surface or a spherical surface.

[0070] In the present embodiment, a projection amount J1 of the projected surface portion 33 disposed upstream in the sheet conveyance direction F is smaller than a projection amount J2 of the projected surface portion 33 disposed downstream in the sheet conveyance direction F, but the magnitude relation in the projection amounts may be opposite. Or the projection amount J1 may be the same as the projection amount J2.

[0071] In the configuration that obviates the reflector 26, the stay 25 may have such a projected surface portion 33.

[0072] The present disclosure is not limited to the details of the embodiments described above and various modifications and improvements are possible.

[0073] In the above-described embodiment, the stay 25 and the reflector 26 are described as the structures arranged upstream and downstream from the halogen heater 23, but such a structure is not limited to the stay 25 and the reflector 26 may be other parts such as a guide to guide the fixing belt 21 in the rotation direction. Or, such a structure may be only one of the stay 25 and the reflector 26. In any structure, as in the above-described embodiments, changing the configuration of the structures arranged upstream and downstream from the halogen heater 23 in the sheet conveyance direction F changes the light irradiated upstream area in the inner circumferential surface of the fixing belt 21 wider than the light irradiated downstream area in the sheet conveyance direction F and can improve the heating efficiency.

[0074] The shapes of the stay 25 and the reflector 26 are not limited to the shapes of the above-described embodiments and may be changed as appropriate. For example, in the stay 25 or the reflector 26, the connecting wall portions 25c and 26c may be omitted, and the upstream wall portions 25a and 26a and the downstream wall portions 25b and 26b may be configured separately.

[0075] The fixing device according to the present disclosure is not limited to the fixing device 5 that conveys the sheet in the horizontal direction as illustrated in FIG. 1. The location and construction of the fixing device 5 may be appropriately changed. For example, the present disclosure may be applicable to the fixing device 5 as illustrated in FIG. 11 that conveys the sheet in the vertical direction. In the above-described embodiments, the present disclosure is applied to the fixing device having, for example, a halogen heater as a heating member but may be applied to a fixing device having a carbon heater.

[0076] 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 on the surface of the sheet.

[0077] 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 rotating member (21);
    a rotatable opposite member (22) disposed opposite an outer peripheral surface of the rotating member (21);
    a nip formation member (24) disposed inside a loop of the rotating member (21) to form a nip (N) by sandwiching the rotating member (21) with the opposite member (22);
    a heater (23) disposed inside the loop of the rotating member (21) and configured to heat the rotating member (21) and the nip formation member (24); and
    a structure (25, 26) disposed inside the loop of the rotating member (21) and arranged upstream from the heater (23) and downstream from the heater (23) in a recording medium conveyance direction,
    the structure (25, 26) configured to block light radially irradiated from the heater (23) and form a light irradiated area (R) on an inner circumferential surface of the rotating member (21) to which the light is irradiated,
    the light irradiated area (R) formed, in a cross section intersecting a rotation axis direction of the opposite member (22), between:

        a point with a first distance (K1) from an upstream end of the nip (N) in the recording medium conveyance direction along the rotating member (21) in a direction opposite to a rotation direction of the rotating member (21) when a recording medium is conveyed; and
        a point with a second distance (K2) from a downstream end of the nip (N) in the recording medium conveyance direction along the rotating member (21) in the rotation direction of the rotating member (21) when the recording medium is conveyed,
        the second distance (K2) longer than the first distance (K1).

2. The heating device (5) according to claim 1, wherein the cross section intersecting the rotation axis direction of the opposite member (22) is a cross section at a central position of the rotating member (21) in the rotation axis direction of the opposite member (22).

3. The heating device (5) according to claim 1 or 2, further comprising
    a temperature sensor (28) disposed opposite the rotating member (21),
    wherein the cross section intersecting the rotation axis direction of the opposite member (22) is a cross section at a position at which the temperature sensor (28) is disposed in the rotation axis direction of the opposite member (22).

4. The heating device (5) according to any one of claims 1 to 3,
wherein the cross section intersecting the rotation axis direction of the opposite member (22) is a cross section existing over an entire recording medium conveyance span of a largest recording medium in the rotation axis direction of the opposite member (22).

5. The heating device (5) according to any one of claims 1 to 4,
wherein the structure (25, 26) includes an upstream wall portion (25a, 26a) disposed upstream from the heater (23) in the recording medium conveyance direction and
a downstream wall portion (25b, 26b) disposed downstream from the heater (23) in the recording medium conveyance direction,
wherein a dimension (H1, H3) of the upstream wall portion (25a, 26a) in a direction orthogonal to the nip (N) is shorter than a dimension (H2, H4) of the downstream wall portion (25b, 26b) in the direction orthogonal to the nip.

6. The heating device (5) according to claim 5,
wherein a dimension (H1, H3) of the upstream wall portion (25a, 26a) in the direction orthogonal to the nip (N) at a position corresponding to a central portion of the rotating member (21) in the rotation axis direction of the opposite member (22) is shorter than a dimension (H5) of the upstream wall portion (25a, 26a) in the direction orthogonal to the nip at a position corresponding to an end portion of the rotating member (21) in the rotation axis direction of the opposite member (22), and
a dimension (H2, H4) of the downstream wall portion (25b, 26b) in the direction orthogonal to the nip (N) at a position corresponding to the central portion of the rotating member (21) in the rotation axis direction of the opposite member (22) is shorter than a dimension (H6) of the downstream wall portion (25b, 26b) in the direction orthogonal to the nip at a position corresponding to the end portion of the rotating member (21) in the rotation axis direction of the opposite member (22).

7. The heating device (5) according to claim 5 or 6,
wherein the structure (25, 26) includes a connecting wall portion (25c, 26c) configured to connect the upstream wall portion (25a, 26a) and the downstream wall portion (25b, 26b) and disposed opposite the nip formation member (24) with respect to the heater (23) and inside a loop of an end portion of the rotating member (21) in the rotation axis direction of the opposite member (22).

8. The heating device (5) according to any one of claims 1 to 7,
wherein the structure (25, 26) includes a projected portion (33) projecting from a surface facing the heater (23) toward the heater (23).

9. The heating device (5) according to claim 8,
wherein the projected portion (33) is arranged to be closer to the nip (N) than the heater (23).

10. The heating device (5) according to any one of claims 1 to 9,
wherein the structure (25) is a support member (25) configured to support the nip formation member (24).

11. The heating device (5) according to any one of claims 1 to 9,
wherein the structure (26) is a reflector (26) configured to reflect light from the heater (23) to at least one of the rotating member (21) and the nip formation member (24).

12. The heating device (5) according to claim 11,
wherein a ratio of a reflection component of light reflected by the reflector (26) toward the rotating member (21) and a reflection component of light reflected by the reflector (26) toward the nip formation member (24) is 5 : 5 to 1 : 9.

13. A fixing device (5) comprising
the heating device (5) according to any one of claims 1 to 12.

14. An image forming apparatus (1) comprising:

an image forming device (2) configured to form an image on the recording medium; and
the fixing device (5) according to claim 13 configured to fix the image formed by the image forming device (2) onto the recording medium.

FIG. 1

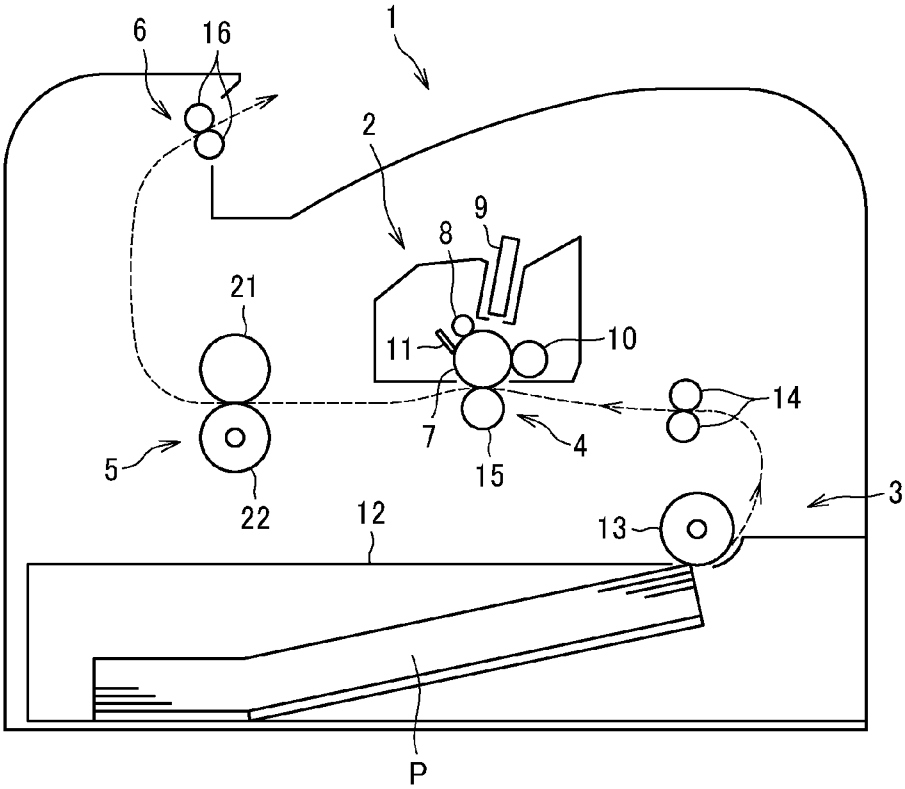
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FIG. 2

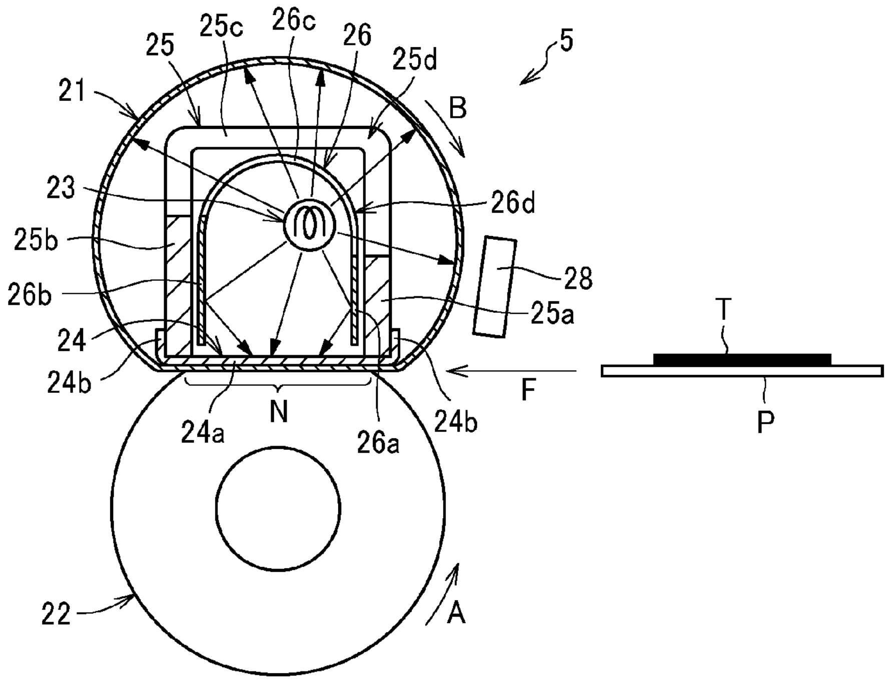
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FIG. 3

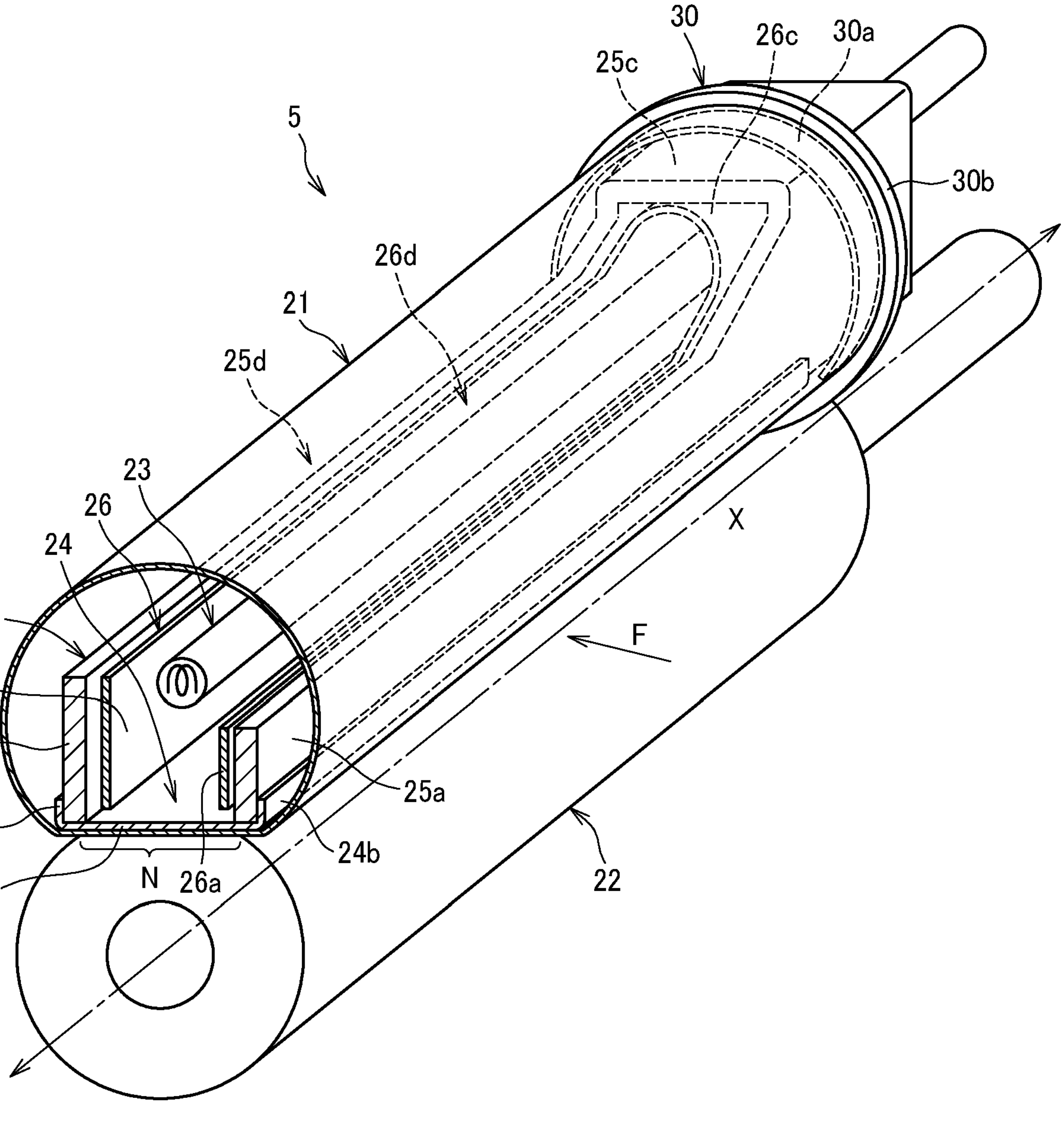
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FIG. 4

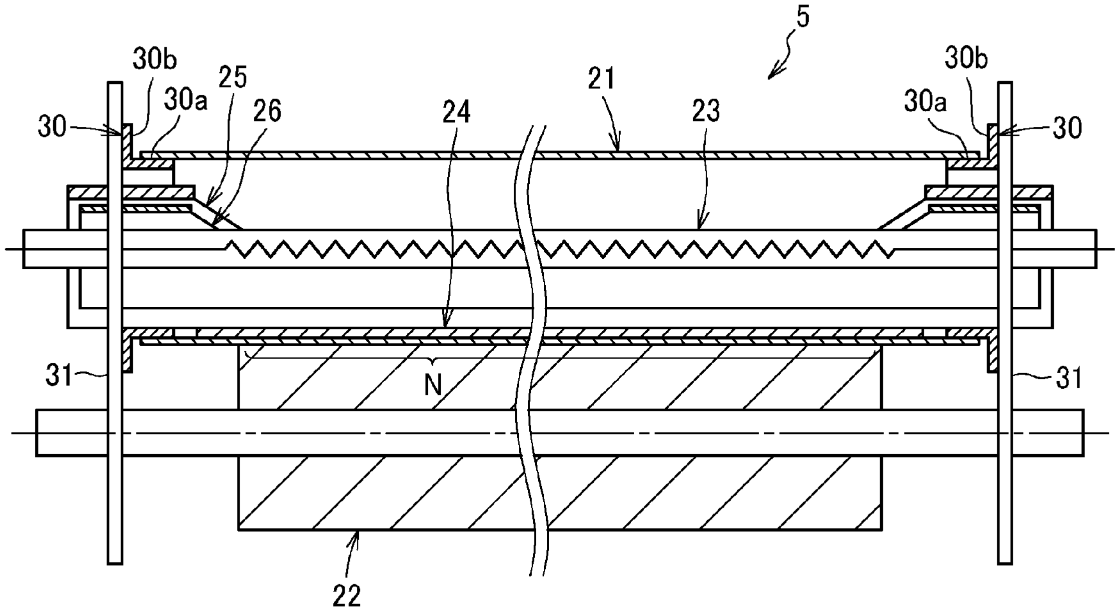

FIG. 5

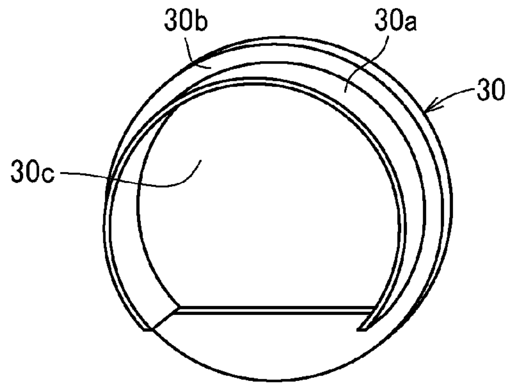

FIG. 6

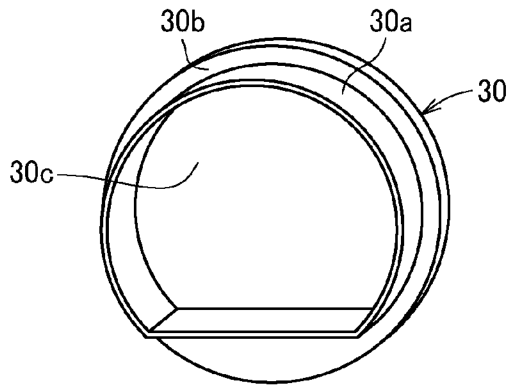

FIG. 7

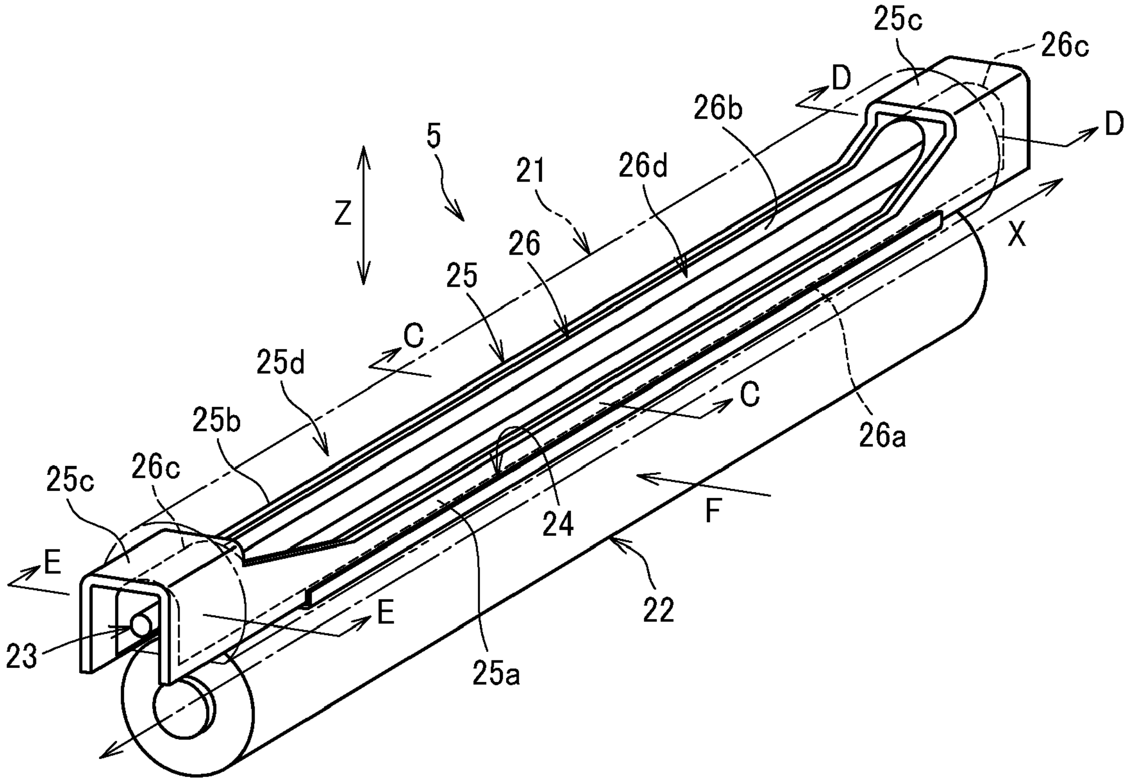
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FIG. 8

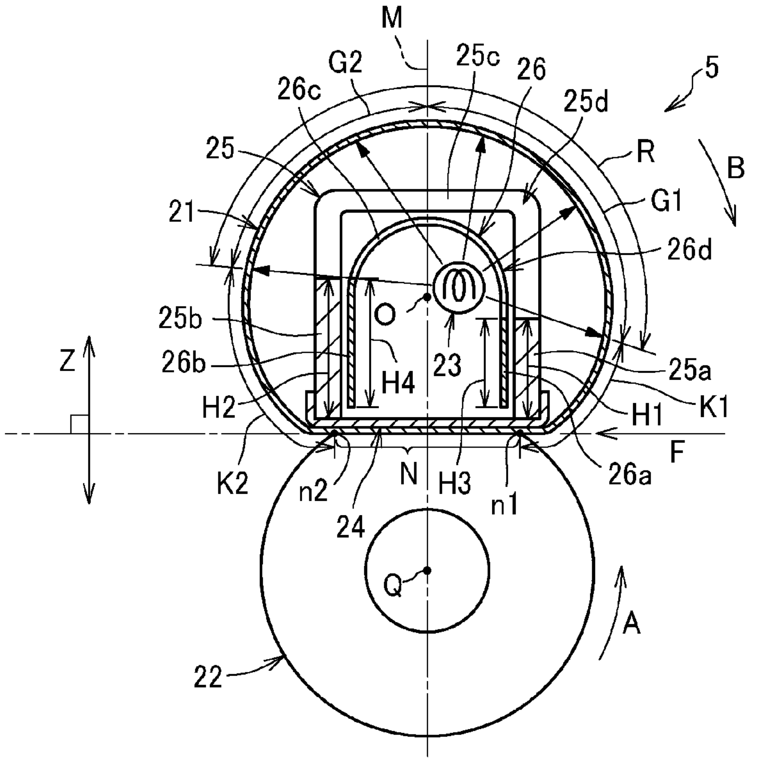
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FIG. 9

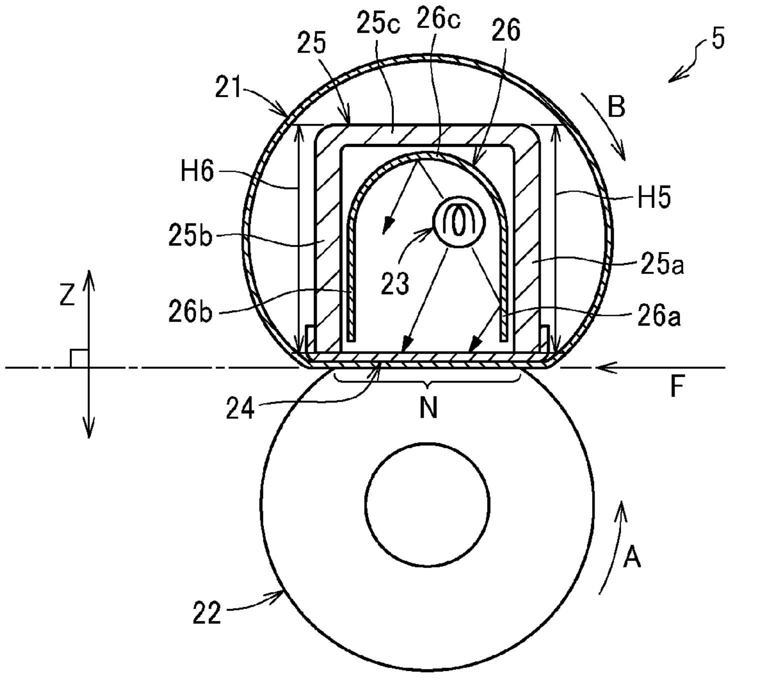
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FIG. 10

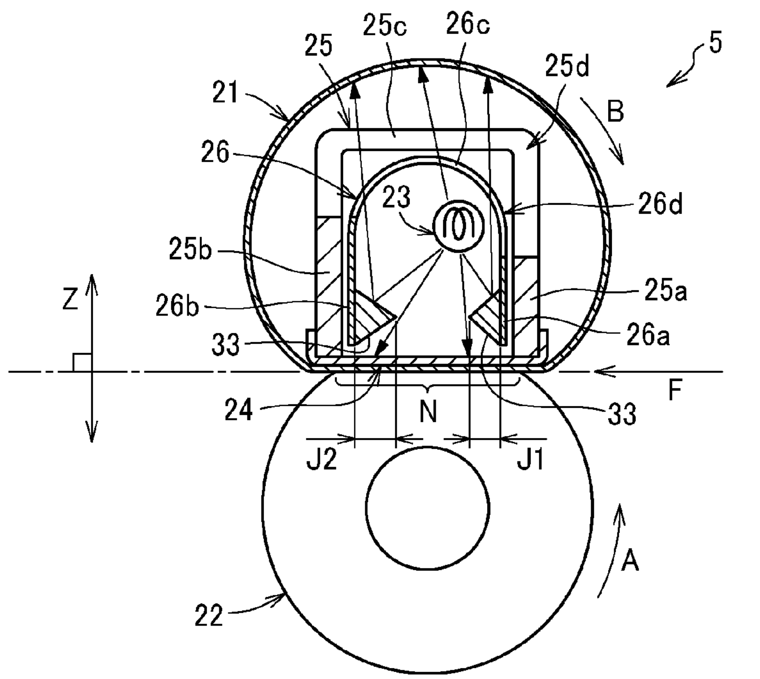
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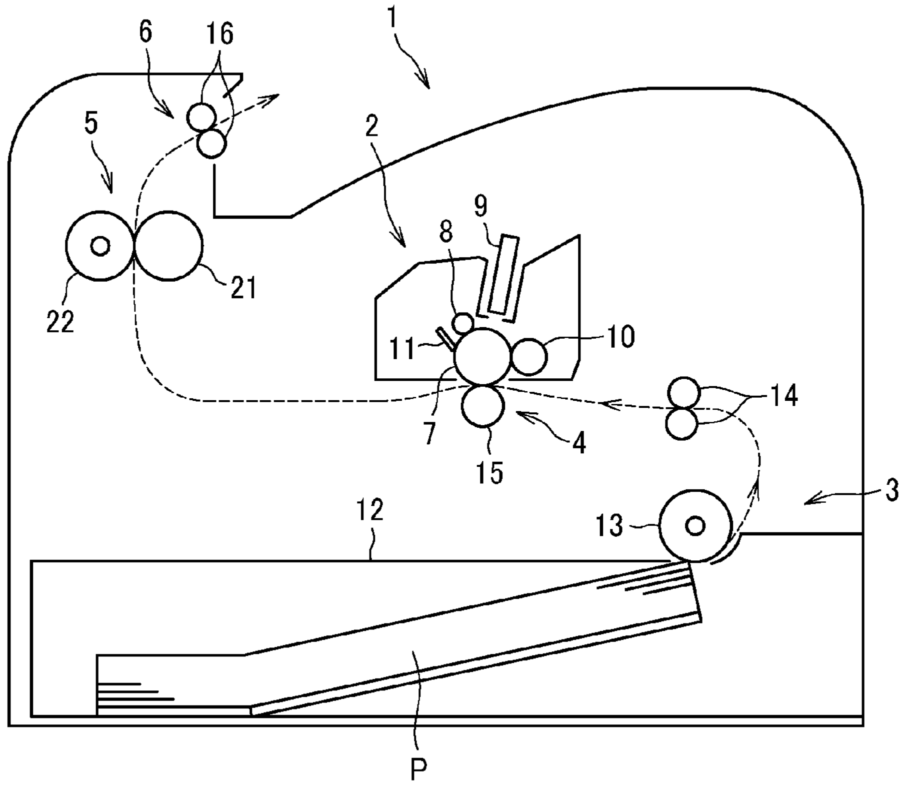
FIG. 11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EUROPEAN SEARCH REPORT

Application Number
EP 20 18 1344

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X A	EP 3 358 423 A1 (KONICA MINOLTA INC [JP]) 8 August 2018 (2018-08-08) * paragraph [0110] - paragraph [0128]; figures 11-14 *	1-11,13, 14 12	
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A	US 2018/356754 A1 (YOSHINAGA HIROSHI [JP] ET AL) 13 December 2018 (2018-12-13) * paragraph [0058] - paragraph [0063]; figure 2 *	1-14	TECHNICAL FIELDS SEARCHED (IPC) G03G B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 October 2020	Rubio Sierra, F

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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 18 1344

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30-10-2020

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