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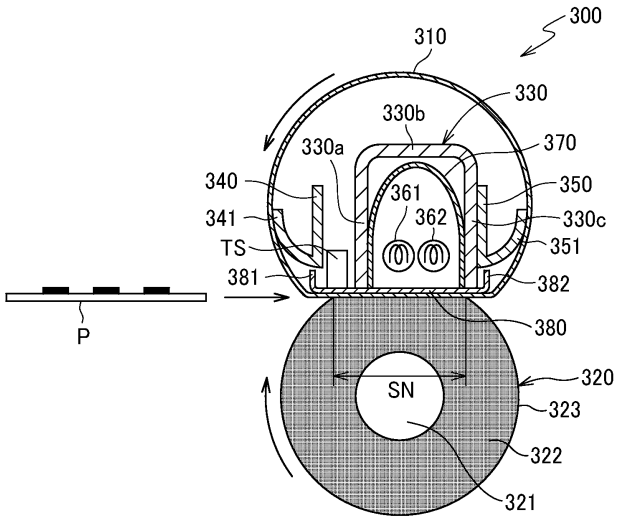
(54) HEATING DEVICE, FIXING DEVICE, AND IMAGE FORMING APPARATUS

(57) A heating device (300) includes a rotating member (310), heaters (361 and 362) inside a loop of the rotating member (310), a heating nip plate (380) disposed inside the loop of the rotating member (310) and heated by the heaters (361 and 362), an opposite member (320) opposite the rotating member (310), and a temperature detector (TS). The heaters (361 and 362) include a first heater (361) and a second heater (362). The first heater (361) extends in an axial direction of the rotating member (310). The second heater (362) is disposed to overlap, in a conveyance direction of a sheet to be heated, a center portion of the first heater (361) in an axial direction of the first heater (361). The temperature detector (TS) is disposed corresponding to the center portion of the first heater (361) in the axial direction of the first heater (361).

FIG. 2



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Description

BACKGROUND

Technical Field

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

Description of the Related Art

[0002] Electrophotographic image forming apparatuses use various types of fixing devices. In one type of fixing devices, a halogen heater heats a thin fixing belt having a low thermal capacity. For example, JP-2011-237523-A discloses such a fixing device. This type of fixing device includes an endless fixing belt, a heating nip plate inside a loop of the fixing belt, and a pressure roller outside the fixing belt, and the fixing belt is sandwiched between the heating nip plate and the pressure roller.

[0003] The halogen heater inside the loop of the fixing belt heats the heating nip plate, and the heating nip plate heats the fixing belt. The heating nip plate is supported by a metal stay having a channel-shaped cross section. A reflection member is disposed inside the stay to prevent overheating of the stay and improve thermal efficiency.

[0004] The fixing device disclosed on JP-2011-237523-A uses one halogen heater corresponding to a width of a maximum sheet of an A3 or A4 size, for instance. However, when an image forming apparatus using such a fixing device continuously performs printing on small size sheets such as B5 or postcard size sheets, a temperature in an end portion of the fixing belt rises, which prevents improvement of productivity. To improve the productivity, the fixing device includes a small heater corresponding to the small size sheet.

[0005] Generally, to improve the productivity when the image forming apparatus performs printing on the small size sheets, the fixing device includes end heaters disposed outside both ends of the small heater. When the fixing device includes end heaters and a central heater as described above, one temperature sensor is needed to control one heater.

[0006] However, in the fixing device using the heating nip plate, since the heating nip plate has high heat conductivity, the heating nip plate diffuses heat radiated from the central heater that is the small heater outward in the longitudinal direction of the heating nip plate, that is, heat-equalization effect occurs, which affects an end sensor. Therefore, accurate temperature control of each heater is difficult in a temperature control using a pair of one heater and one temperature sensor.

SUMMARY

[0007] Based on the view of the above-described situation, an object of the present disclosure is to improve productivity when an image forming apparatus performs printing on small size sheets, which is attained by using a plurality of heaters that have different lengths, and attaining an accurate temperature control of each heater by using one temperature sensor, which is attained by devising an arrangement of the heaters and the temperature sensor.

[0008] 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 heating device according to claim 1. Advantageous embodiments are defined by the dependent claims.

[0009] Advantageously, the heating device includes a rotating member in an endless form, heaters disposed inside a loop of the rotating member to emit radiant heat, a heating nip plate disposed inside the loop of the rotating member and heated by the radiant heat emitted by the heaters, an opposite member disposed opposite an outer circumferential surface of the rotating member and configured to sandwich the rotating member between the heating nip plate and the opposite member to form a nip through which a sheet to be heated passes, and a temperature detector. The heaters include a first heater and a second heater. The first heater extends in an axial direction of the rotating member. The second heater overlaps, in a conveyance direction of the sheet to be heated, a center portion of the first heater in an axial direction of the first heater. The temperature detector is disposed corresponding to the center portion of the first heater in the axial direction of the first heater.

[0010] According to the present disclosure, since the heating device includes the first heater extending in the axial direction of the rotating member and the second heater disposed so as to overlap the center portion of the first heater in the axial direction of the first heater, the second heater can improve the productivity when the image forming apparatus performs printing on small size sheets, and the temperature sensor disposed corresponding to the center portion of the first heater in the axial direction can accurately control the temperature of the first heater and the temperature of the second heater. In addition, the cost is reduced because one temperature sensor is used.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] 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 an explanatory diagram to describe an image forming apparatus according to an embodiment of the present disclosure;

FIG. 2 is a cross-sectional view illustrating a fixing device used in the image forming apparatus in FIG. 1;
FIG. 3 is a cross-sectional front view illustrating the fixing device in FIG. 2;
FIG. 4 is a top view of heaters and a heating nip plate viewed from above after a fixing belt is removed;
FIG. 5 is a graph illustrating a heat generation distribution of the heaters in an axial direction of the heaters;
FIG. 6 is a flow chart illustrating a control flow of the heaters; and
FIG. 7 is a timing chart illustrating a timing of On and Off of the heaters and a temperature detection timing of a temperature sensor.

[0012] 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

[0013] 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.

[0014] 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.

[0015] With reference to drawings, a description is given of a fixing device according to an embodiment of the present disclosure and an image forming apparatus such as a laser printer using the fixing device. The laser printer is just an example of the image forming apparatus, and thus the image forming apparatus is not limited to the laser printer.

[0016] That is, the image forming apparatus can be a copier, a facsimile machine, a printer, a plotter, and a multifunction peripheral having at least two of copying, printing, facsimile transmission, plotting, and scanning capabilities; or an inkjet recording apparatus.

[0017] It is to be understood that an identical or similar reference character is given to identical or corresponding parts throughout the drawings, and redundant descriptions are omitted or simplified below. The dimensions, material, shape, and relative position in a description for each constituent component are examples. Unless otherwise specifically described, the scope of the present disclosure is not limited to those.

[0018] Although a "recording medium" is described as a "sheet" in the following embodiments, the "recording medium" is not limited to the sheet. Examples of the "recording medium" include not only the sheet but also an overhead projector (OHP) transparency, a fabric, a metallic sheet, a plastic film, and a prepreg sheet including carbon fibers previously impregnated with resin.

[0019] Examples of the "recording medium" include all mediums to which developer or ink can adhere, and so-called recording paper and recording sheets. Examples of the "sheet" include thick paper, a postcard, an envelope, thin paper, coated paper (e.g., coat paper and art paper), and tracing paper, in addition to plain paper.

[0020] The term "image forming" used in the following description means not only giving an image having a meaning, such as a character or a figure, to a medium but also giving an arbitrary image having no meaning, such as a pattern, to a medium.

[0021] A configuration of the image forming apparatus according to an embodiment is described below.

[0022] FIG. 1 is an explanatory diagram to describe the laser printer as an example of an image forming apparatus 100 including the fixing device 300 according to the embodiment of the present disclosure. The image forming apparatus 100 includes an image bearer 2 such as a photoconductor drum and a photoconductor cleaner 3.

[0023] The image forming apparatus 100 further includes a charging device 4 as a charger that uniformly charges the surface of the image bearer, a developing device 5 as a developing unit that renders visible an electrostatic latent image on the image bearer, a transfer device TM disposed under the image bearer 2, a discharger, and the like.

[0024] An exposure device 7 is disposed above the image bearer 2. The exposure device 7 performs writing and scanning based on image data, that is to say, irradiates the image bearer 2 with laser light Lb emitted by a laser diode based on image data and reflected by a mirror 7a.

[0025] A sheet feeder 50 including a tray loaded with sheets P is disposed below the image forming apparatus 100. The sheet feeder 50 is configured as a recording-medium supply device and can house a sheaf of many recording media sheets P. The sheet feeder 50 is configured as one unit together with a sheet feeding roller 60 as a conveyor for the sheets P.

[0026] Downstream from the sheet feeding roller 60, a registration roller pair 250 as a separation and conveyance means is disposed. The registration roller pair 250 temporarily stops the sheet P fed from the sheet feeder 50. Temporarily stopping the sheet P causes slack on the leading-edge side of the sheet P and corrects a skew of the sheet P.

[0027] The registration roller pair 250 sends the sheet P that contacts the registration roller pair 250 and has the slack on the leading-edge side of the sheet P toward a transfer nip of the transfer device TM at a timing to suitably transfer a toner image on the image bearer 2

onto the sheet P. A bias applied at the transfer nip N electrostatically transfers the toner image formed on the image bearer 2 onto the sent sheet P at a desired transfer position.

[0028] The fixing device 300 is disposed downstream from the transfer nip N. The fixing device 300 includes a fixing belt 310 as a rotating member, a first halogen heater 361 as a first heater and a second halogen heater 362 as a second heater that emit radiant heat, which are disposed inside a loop of the fixing belt 310 and described below, and a pressure roller 320 as an opposite member that rotates while contacting an outer circumferential surface of the fixing belt 310 at a predetermined pressure.

[0029] Next, operation of the image forming apparatus 100 according to the present embodiment is described below.

[0030] The sheet feeding roller 60 rotates in response to a sheet feeding signal from a controller 101 of the image forming apparatus 100. The sheet feeding roller 60 separates the uppermost sheet from a sheaf of sheets P loaded in the sheet feeder 50 and sends the uppermost sheet out to a sheet feeding path.

[0031] After the sheet feeding roller 60 sends the sheet P, when the leading edge of the sheet P reaches a nip of the registration roller pair 250, the sheet P forms slack and temporarily stops. The registration roller pair 250 corrects the front-end skew of the sheet P and rotates in synchronization with an optimum timing to transfer a toner image on the image bearer 2 onto the sheet P.

[0032] The charging device 4 uniformly charges the surface of the image bearer 2 to high potential. The exposure device 7 irradiates the surface of the image bearer 2 with the laser light Lb based on the image data and reflected by the mirror 7a.

[0033] The surface of the image bearer 2 irradiated with the laser light Lb has an electrostatic latent image due to a drop in the potential of the irradiated portion. The developing device 5 includes a developer bearer 5a bearing a developer including toner and transfers unused black toner supplied from the toner bottle to the surface portion of the image bearer 2 having the electrostatic latent image, through the developer bearer.

[0034] The image bearer 2 to which the toner has been transferred forms (develops) a toner image on the surface of the image bearer 2. The transfer device TM transfers the toner image formed on the image bearer 2 onto the sheet P.

[0035] A cleaning blade 3a in the photoconductor cleaner 3 removes the residual toner adhering to the surface of the image bearer 2 after a transfer process. The removed residual toner is collected to a waste toner container.

[0036] The sheet P as a heated sheet bearing the toner image is conveyed to the fixing device 300. The sheet P conveyed to the fixing device 300 is sandwiched by the fixing belt 310 and the pressure roller 320. Then, heating and pressing fixes the unfixed toner image onto the sheet P. The sheet P fixed the toner image is sent out from the fixing device 300.

[0037] Next, a description is given of the fixing device 300 according to the present embodiment of the present disclosure.

[0038] As illustrated in FIGS. 2 and 3, the fixing device 300 includes a thin fixing belt 310 having low thermal capacity and a pressure roller 320. As illustrated in FIG. 3, a pair of right and left flanges 302 is fixed on side plates 301 and inserted in both lateral ends of the fixing belt 310 in the axial direction thereof, respectively, to rotatably support the fixing belt 310.

[0039] As illustrated in FIG. 2, a first belt guide 340 is disposed inside the fixing belt 310 upstream from a temperature sensor TS described below, and a second belt guide 350 is disposed inside the fixing belt 310 on an outer surface of a downstream side wall 330c of the stay 330. The belt guides 340 and 350 have arc-shaped guide portions 341 and 351 to guide the inner circumferential surface of the fixing belt 310, respectively. The guide portions 341 and 351 and a heating nip plate 380 between the guide portions 341 and 351 define the circular shape of the fixing belt 310 during rotation. The heating nip plate 380 is described below.

[0040] In order to decrease the thermal capacity of the fixing belt 310, the fixing belt 310 has a total thickness not greater than 1 mm and a loop diameter in a range of from 20 mm to 40 mm. In order to further decrease the thermal capacity, the fixing belt 310 may preferably have a total thickness not greater than 0.2 mm, and more preferably, not greater than 0.16 mm. Preferably, the loop diameter of the fixing belt 310 is not greater than 30 mm.

[0041] The fixing belt 310 may include an inner base layer having a thickness of 20 to 50 μm, an outer release layer having a thickness of 10 to 50 μm, and an intermediate elastic layer having a thickness of 100 to 300 μm. The inner base layer may be made of metal such as nickel or stainless steel (SUS) or resin such as polyimide to reduce the thermal capacity. The inner circumferential surface of the fixing belt 310 may be coated with polyimide or polytetrafluoroethylene (PTFE) as a slide layer.

[0042] The outer release layer enhances durability of the fixing belt 310, facilitates separation of the sheet P from the fixing belt 310, and may be made of fluororesin such as tetrafluoroethylene-perfluoroalkylvinylether copolymer (PFA), polytetrafluoroethylene (PTFE), or the like.

[0043] The intermediate elastic layer absorbs slight surface asperities of the fixing belt 310 and may be made of rubber such as silicone rubber, silicone rubber foam, or fluororubber. While the fixing belt 310 and the pressure roller 320 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 310, preventing variation in gloss of the toner image on the sheet P.

[0044] The pressure roller 320 having, for example, an outer diameter of 25 mm, includes a solid iron cored bar

321, an elastic layer 322 on the surface of the cored bar 321, and a release layer 323 formed on the outside of the elastic layer 322. The elastic layer 322 may be made of silicone rubber, solid rubber, or sponge rubber and have, for example, a thickness of 3.5 mm. Using the sponge rubber for the elastic layer 322 improves thermal insulation and decreases an amount of heat drawn from the fixing belt 310.

[0045] Preferably, the release layer 323 is formed by a fluororesin layer having, for example, a thickness of approximately 40 μm on the surface of the elastic layer 322 to improve releasability. A biasing member presses the pressure roller 320 against the fixing belt 310.

[0046] FIGS. 2 and 3 illustrate the pressure roller 320 as a solid roller. Alternatively, the pressure roller 320 may be a hollow roller. In a case in which the pressure roller 320 is the hollow roller, a heat source such as a halogen heater may be disposed inside the pressure roller 320.

[0047] A description is given of structures inside a loop of the fixing belt 310.

[0048] A stay 330 as a support member and the heating nip plate 380 extends axially inside the loop of the fixing belt 310. The stay 330 is formed of a metal channel material having a U-shaped cross section, and both ends in the longitudinal direction are supported by both side plates 301 of the fixing device 300.

[0049] The material of the stay 330 is preferably an iron-based metal such as stainless steel (SUS) or Steel Electrolytic Cold Commercial (SECC) that is electrogalvanized sheet steel ensure rigidity. Using such an iron-based material causes the stay 330 to reliably receive the pressing force (indicated by arrows in FIG. 3) of the pressure roller 320 acting on the heating nip plate 380 and stably form a nip SN.

[0050] The heating nip plate 380 transfers heat in an axial direction that is the width direction of the fixing belt 310 to uniformize temperature of the fixing belt 310 in the width direction, which is called heat-equalization effect. The heating nip plate 380 is made of a thin plate member having high thermal conductivity such as copper (398 W / mK), aluminum (236 W / mK) or silver to smoothly transfer the heat in the width direction. In consideration of cost, processing, and the like, the heating nip plate 380 is preferably made of a thin copper plate.

[0051] In order to improve the abrasion resistance and the slidability of the nip formation surface, the nip formation surface of the heating nip plate 380 may be treated with alumite or coated with fluororesin material. Additionally, a lubricant such as a fluorine-based grease may be applied to the nip formation surface to ensure slidability over time.

[0052] In FIGS. 2 and 3, the nip formation surface of the heating nip plate 380 is planar. Alternatively, the nip formation surface may define a recess or other shape. A recessed nip formation surface directs a leading edge of the sheet P toward the pressure roller 320 as the sheet P is ejected from the fixing nip SN, facilitating separation of the sheet P from the fixing belt 310 and preventing occurrence of jamming of the sheet P between the fixing belt 310 and the pressure roller 320.

[0053] A separator may be disposed downstream from the fixing device 300 in a sheet conveyance direction to separate the sheet P from the fixing belt 310. A pressurization assembly may press the pressure roller 320 against the heating nip plate 380 via the fixing belt 310 and release pressure exerted by the pressure roller 320 to the fixing belt 310.

[0054] Specifically, as illustrated in FIGS. 2 and 3, the stay 330 has an upstream side wall 330a, a ceiling wall 330b, and a downstream side wall 330c. The ceiling wall 330b couples the upper end of the upstream side wall 330a and the upper end of the downstream side wall 330c. Both ends of the heating nip plate 380 in a short-side direction that is a transverse direction in FIGS. 2 and 3 are fixed and supported on the lower end of the opening formed by the stay 330, that is, the lower end of the upstream side wall 330a and the lower end of the downstream side wall 330c. Both ends in the transverse direction of the heating nip plate 380 are bent upward, that is, toward the stay 330 to form L-shape portions 381 and 382.

[0055] Therefore, the stay 330 and the heating nip plate 380 form a closed space, that is, the space in which the upper, lower, left and right sides are closed, inside the stay 330. Supporting the heating nip plate 380 at two lower ends of the upstream side wall 330a and the downstream side wall 330c of the stay 330 does not increase the thermal capacity of the heating nip plate 380. Therefore, the above-described configuration can improve heat transfer efficiency, which can reduce electric power consumption.

[0056] The first halogen heater 361 as the first heater and the second halogen heater 362 as the second heater are arranged axially in the closed space inside the stay 330. Both side plates 301 of the fixing device 300 support both ends of the halogen heaters 361 and 362 as illustrated in FIG. 3.

[0057] As illustrated in FIGS. 2 and 4, the first halogen heater 361 and the second halogen heater 362 are arranged so that a center portion of the first halogen heater 361 in the axial direction of the first halogen heater 361 overlaps the second halogen heater 362 when the first halogen heater 361 and the second halogen heater 362 are viewed in a sheet conveyance direction. The radiant heat emitted by the halogen heaters 361 and 362 heats the heating nip plate 380, and the heating nip plate 380 heats the fixing belt 310.

[0058] The heights of the halogen heaters 361 and 362 with respect to the heating nip plate 380 are set to the same height. The above setting reduces can possibly reduce waste that one heater blocks the radiant heat emitted from the other heater and cause both heaters to irradiate the heating nip plate 380 with the same thermal efficiency.

[0059] The controller 101 controls outputs of the halogen heaters 361 and 362, for example, based on a tem-

perature of the surface of the heating nip plate 380 detected by the temperature sensor TS described below and disposed inside the loop of the fixing belt 310 and upstream from the heating nip plate in a belt rotation direction. The controller 101 determines whether the temperature detected by the temperature sensor TS is lower or not than the predetermined temperature and turns on or off the halogen heaters 361 and 362 based on the determined result to maintain the temperature of the fixing belt 310, which is called a fixing temperature, within a desired temperature range. The temperature sensor TS may be disposed outside the fixing belt 310.

[0060] Next, a description is given of the temperature sensor TS.

[0061] As illustrated in FIGS. 2 and 4, the temperature sensor TS as a temperature detector is disposed corresponding to the center portion (center part) of the first halogen heater 361 in the axial direction of the first halogen heater 361. The temperature sensor TS is disposed in contact with the surface of the heating nip plate 380 at a position immediately upstream of an entrance of the nip SN. Therefore, the temperature sensor TS indirectly detects a surface temperature on the fixing belt 310 immediately before the fixing belt 310 enters the nip SN, but the detection is correct.

[0062] The controller 101 controls the temperature of the fixing belt 310. That is, based on signals indicating the detected temperature from the temperature sensor TS, the controller 101 outputs switching devices in a temperature controller ON/OFF signals to turn on or off the first halogen heater 361 and the second halogen heater 362. The switching devices switch whether to supply currents from a commercial power supply to the first halogen heater 361 and the second halogen heater 362.

[0063] The temperature sensor TS is disposed closer to the first halogen heater 361 than the second halogen heater 362. This is because the safety device to detect abnormal temperature rise works earlier when the first halogen heater 361 abnormally raises the temperature for some reason.

[0064] That is, when the first halogen heater 361 keeps lighting because the controller 101 cannot control the first halogen heater 361, a temperature at a position in an end portion of the first halogen heater 361 becomes higher than a temperature at the center portion of the first halogen heater 361 because the temperature sensor TS is disposed at a center portion and not disposed at an end portion. In the above-described situation, if the temperature sensor TS is arranged at a position far from the first halogen heater 361, it takes time for the heat generated from the first halogen heater 361 to reach the temperature sensor TS.

[0065] Then, the temperature at the position in the end portion of the first halogen heater 361 when the safety device is activated to cut off the power to the first halogen heater 361 becomes higher than the original activation temperature. Therefore, the temperature sensor TS is preferably disposed closer to the first halogen heater 361 than the second halogen heater 362. As described below with reference to FIG. 5, when a heat generation amount that is a light emission amount at both end portions of the first halogen heater 361 is relatively larger than a heat generation amount at the center portion of the first halogen heater 361 to prevent a temperature drop at an end portion of the fixing belt 310, the arrangement in which the temperature sensor TS is disposed near the first halogen heater 361 becomes more important.

[0066] As illustrated in FIG. 2, a reflector 370 is disposed around the halogen heaters 361 and 362, that is, inside the stay 330. The reflector 370 has an elliptical cross-section, and both ends of the reflector 370 are fixed to the lower end of the upstream side wall 330a and the lower end of the downstream side wall 330c of the stay 330.

[0067] Centers of the filaments of the halogen heaters 361 and 362 is positioned near the focal positions of the ellipse of the reflector 370. In the above-described configuration, the heating nip plate 380 is directly irradiated with radiant heat radiated downward from the halogen heaters 361 and 362, while radiant heat radiated laterally or upward from the halogen heaters 361 and 362 is reflected by the reflector 370, and the heating nip plate 380 is irradiated with the reflected radiant heat. Therefore, the above-described configuration improves thermal efficiency and reduces temperature rise in parts around the heaters such as the stay 330.

[0068] The fixing device 300 is configured as described above. In FIG. 2, when the sheet P is conveyed in a direction indicated by a horizontal arrow and passes through the fixing nip SN, the sheet P is heated between the fixing belt 310 and the pressure roller 320 so that the toner image is fixed to the sheet P. At this time, the radiant heat from the halogen heaters 361 and 362 heats the fixing belt 310 through the heating nip plate 380.

[0069] Next, heating distribution of the halogen heaters 361 and 362 is described.

[0070] Since the fixing belt 310 has openings at both ends, the radiant heat that reaches the heating nip plate 380 from the first halogen heater 361 particularly tends to decrease at both end portions of the heating nip plate 380. Therefore, temperatures tend to decrease at both end portions of the heating nip plate 380 and the fixing belt 310, which is called temperature drops in end portions.

[0071] In FIGS. 4 and 5, the filament widths of the halogen heaters 361 and 362 are indicated by reference signs H1 and H2, respectively. As indicated by broken lines in FIG. 5, the end portions of the first halogen heater 361 having the filament width H1 generate less heat than the center portion. Therefore, heat generation amounts (that is, light emission amounts) in the end portions of the first halogen heater 361 are designed to be higher than the center portion. In the present disclosure, the end portion is a portion having a certain length outside the second heater 362 and not an edge.

[0072] Specifically, relatively increasing the number of

turns of the filament of the first halogen heater 361 at both end portions can increase the heat generation amounts. Heating distribution when the heat generation amounts at both end portions of the first halogen heater 361 are increased is illustrated by a solid curve line having the filament width H1 in FIG. 5. The above-described halogen heater can maintain a constant heat generation amount at the very end of the heater having the filament width H1. Additionally, the filament width H1 is set to be larger than a width of maximum sheet to pass through the fixing nip.

[0073] In a start-up operation after the fixing device 300 has been cooled and in a state in which the fixing device has been stopped for a long time, the temperature in the end portion of the fixing belt 310 particularly decreases due to heat radiation from the end portion of the fixing belt. To be balanced against the decrease of the temperature in the end portion of the fixing belt 310, the first halogen heater 361 that heats the entire area of the fixing belt 310 in the axial direction increases the amount of heat generated at both end portions than at the center portion. This is effective as a countermeasure. Since the second halogen heater 362 is hardly affected by the above-mentioned effects, the heat distribution of the second halogen heater remains uniform in the axial direction.

[0074] With reference to FIG. 6, a flow chat of temperature control in the above-described configuration is described.

[0075] The operation of the temperature control is repeated in every certain time, namely, T0 seconds. In step S1, the controller 101 determines whether T0 seconds have passed. In step S2, the controller 101 controls the temperature sensor TS to detect the temperature DT when T0 seconds have passed. The controller 101 compares the target temperature TA and the detected temperature DT in step S3. When the detected temperature DT is lower than the target temperature TA, the controller 101 turns on the first halogen heater 361 in step S4. When the detected temperature DT is not lower than the target temperature TA, the controller 101 turns off the first halogen heater 361 in step S5.

[0076] Next, the controller 101 determines whether the recording medium has a width of small size sheets in step S6. When the recording medium has the width of the small size sheets, the controller turns off the first halogen heater 361 and turns on the second halogen heater 362 in step S7. In step S8, the controller 101 controls a timer to measure time while the second halogen heater 362 turns on and determines whether the measured time becomes or exceeds T1 seconds. When the measured time becomes or exceeds T1 seconds, the controller 101 turns off the second halogen heater 362 in step S9. This control operation causes the second halogen heater 362 to supply more heat to the portion through which the small size recording medium passes than the portion through which the small size recording medium does not pass and compensate for heat taken away by the recording medium to make the temperature of the fixing belt substantially uniform. Therefore, this control operation prevents the temperature increase in the end portions through which the small size recording medium does not pass and avoids the occurrence of damage caused by the temperature increase in components around the heater.

[0077] FIG. 7 illustrates timings when the fixing device 300 fixes the toner image onto the recording medium having the width of small size sheets. The temperature sensor TS detects the temperature DT at regular intervals, that is, every T0 seconds. For example, when the detected temperature DT is lower than the target temperature TA in a first detection, the controller 101 may turn on the first halogen heater 361 and the second halogen heater 362 as an operation corresponding to a warming-up operation. Turning on the first halogen heater 361 and the second halogen heater 362 and heating the fixing belt can shorten a recovery time.

[0078] Next, after T1 seconds have passed, the controller 101 turns off the second halogen heater 362. In a second detection, when the detected temperature DT is lower than the target temperature TA, the controller 101 turns on the second halogen heater 362 again and keeps the first halogen heater 361 turned on. Next, after T1 seconds have passed, the controller 101 turns off the second halogen heater 362. In a third detection, when the detected temperature DT is not lower than the target temperature TA, the controller 101 turns off the first halogen heater 361 and keeps the second halogen heater 362 turned off. Thereafter, the controller 101 repeats the same operations described above.

[0079] In a standby state of the fixing device 300, the end portion of the fixing belt 310 radiates large heat. Therefore, turning on the first halogen heater 361 can uniformly heat the entire area of the fixing belt 310. Therefore, preferably, the controller 101 controls only the first halogen heater 361 to maintain the temperature in the standby state.

[0080] The present disclosure has been described above on the basis of the embodiments, but the present disclosure is not limited to the embodiments. Needless to say, various alterations can be made in the scope of the technical idea described in the scope of the claims. For example, although the reflector 370 is used in the above-described embodiments, instead of the reflector 370, a reflection film may be formed on the upper half of the surface of the quartz tube which is the bulb of the halogen heater 361. The reflection film may be formed by various methods such as vapor deposition, adhesion, and application of various heat-resistant reflective materials such as ceramics and metals (gold, silver, copper, and aluminum).

[0081] Although two halogen heaters 361 and 362 are used in the above-described embodiments, a third halogen heater shorter than the second halogen heater may be added. In such a case, using the temperature sensor TS opposite the center portion of the first halogen heater can perform the accurate temperature control of each

heater.

[0082] The plurality of halogen heaters may form a plurality of heating areas each of which corresponds to a sheet size in the longitudinal direction of the heater orthogonal to the sheet conveyance direction. The above-described structure can prevent overheating at both end portions of the fixing device when the fixing device fixes sheets smaller than the first halogen heater in the longitudinal direction, reduce thermal damage at the both end portions, avoid unnecessary heating, and improve heat efficiency. A heating device according to the embodiments of the present disclosure is applicable to not only the fixing device of the image forming apparatus but also a dryer installed in an inkjet printer.

[0083] 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 (300) comprising:

a rotating member (310) in an endless form;
a plurality of heaters (361 and 362) disposed inside a loop of the rotating member (310) to emit radiant heat;
the plurality of heaters (361 and 362) including:

a first heater (361) extending in an axial direction of the rotating member (310); and
a second heater (362) overlapping, in a conveyance direction of a sheet to be heated, a center portion of the first heater (361) in an axial direction of the first heater (361);

a heating nip plate (380) disposed inside the loop of the rotating member (310) and heated by the radiant heat emitted by at least one of the plurality of heaters (361 and 362);
an opposite member (320) disposed opposite an outer circumferential surface of the rotating member (310) and configured to sandwich the rotating member (310) between the heating nip plate (380) and the opposite member (320) to form a nip through which the sheet to be heated passes; and
a temperature detector (TS) disposed corresponding to the center portion of the first heater (361) in the axial direction of the first heater (361).

2. The heating device (300) according to claim 1,
wherein a distance from the heating nip plate (380) to the first heater (361) is equal to a distance from the heating nip plate (380) to the second heater (362).

3. The heating device (300) according to claim 1 or 2,
wherein the first heater (361) generates a larger amount of heat in both end portions in the axial direction of the first heater (361) than in the center portion.

4. The heating device (300) according to any one of claims 1 to 3,
wherein the temperature detector (TS) is disposed closer to the first heater (361) than to the second heater (362).

5. The heating device (300) according to any one of claims 1 to 4, further comprising a controller (101) to control the plurality of heaters (361 and 362),
wherein, in a standby state in which the sheet to be heated does not pass through the heating device (300), the controller (101) turns on the first heater (361).

6. The heating device (300) according to any one of claims 1 to 5, further comprising a controller (101) to control the plurality of heaters (361 and 362),
wherein the controller (101) turns on the second heater (362) when the sheet to be heated has a width equal to or smaller than a filament width (H2) of the second heater (362) and passes through the heating device (300).

7. The heating device (300) according to any one of claims 1 to 6, further comprising a controller (101) to control the plurality of heaters (361 and 362),
wherein the controller (101) turns on the first heater (361) and the second heater (362) at a time during a warming-up operation before the sheet to be heated passes through the heating device (300).

8. A fixing device (300) comprising the heating device according to any one of claims 1 to 7.

9. An image forming apparatus (100) comprising the fixing device (300) according to claim 8.

10. The heating device (300) according to any one of claims 1 to 7,
wherein a filament width (H1) of the first heater (361) is larger than a filament width (H2) of the second heater (362).

11. The heating device (300) according to any one of claims 1 to 7 and 10,
wherein the first heater (361) and the second heater (362) are halogen heaters, and
wherein a filament width (H1) of the first heater (361) is larger than a width of a maximum sheet to pass through the nip, and a filament width (H2) of the second heater (362) is smaller than the width of the maximum sheet.

12. The heating device (300) according to any one of claims 1 to 7, 10, and 11, further comprising a supporting member (330) provided inside the loop of the rotating member (310) and configured to support the heating nip plate (380).

13. The heating device (300) according to any one of claims 1 to 7 and 10 to 12, further comprising:

a supporting member (330) provided inside the loop of the rotating member (310) and configured to support the heating nip plate (380); and
a reflector (370) disposed around the plurality of heaters (361 and 362) inside the supporting member (330).

14. A fixing device (300) comprising the heating device according to any one of claims 10 to 13.

15. An image forming apparatus (100) comprising the fixing device (300) according to claim 14.

FIG. 1

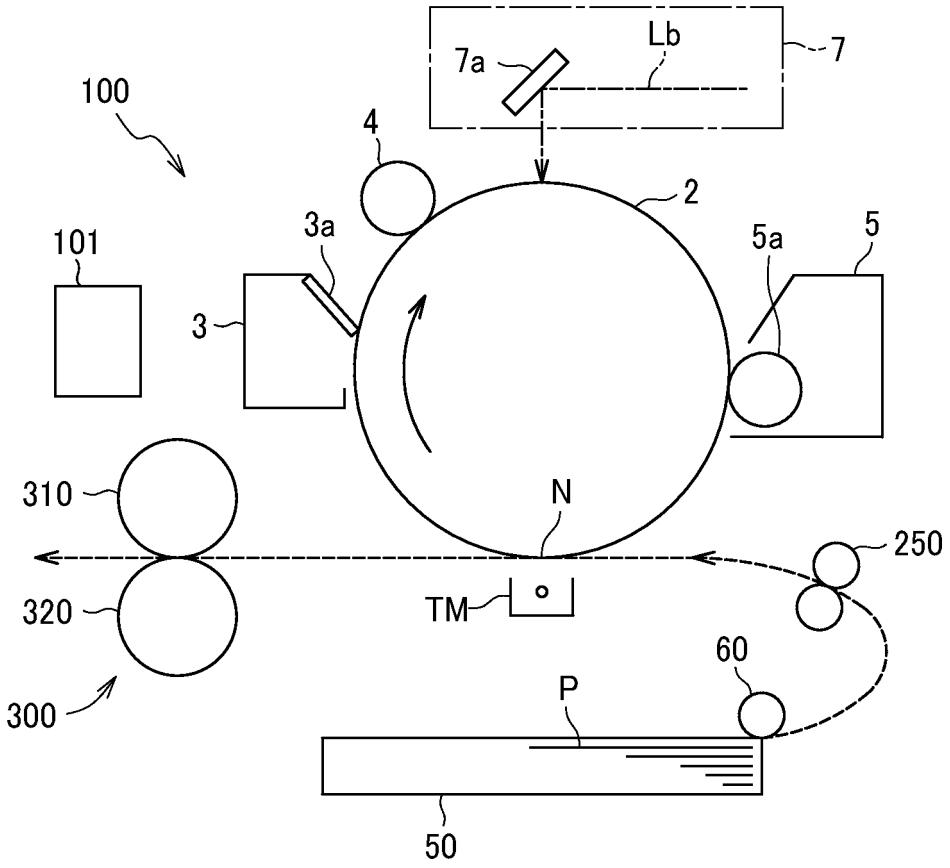


FIG. 2

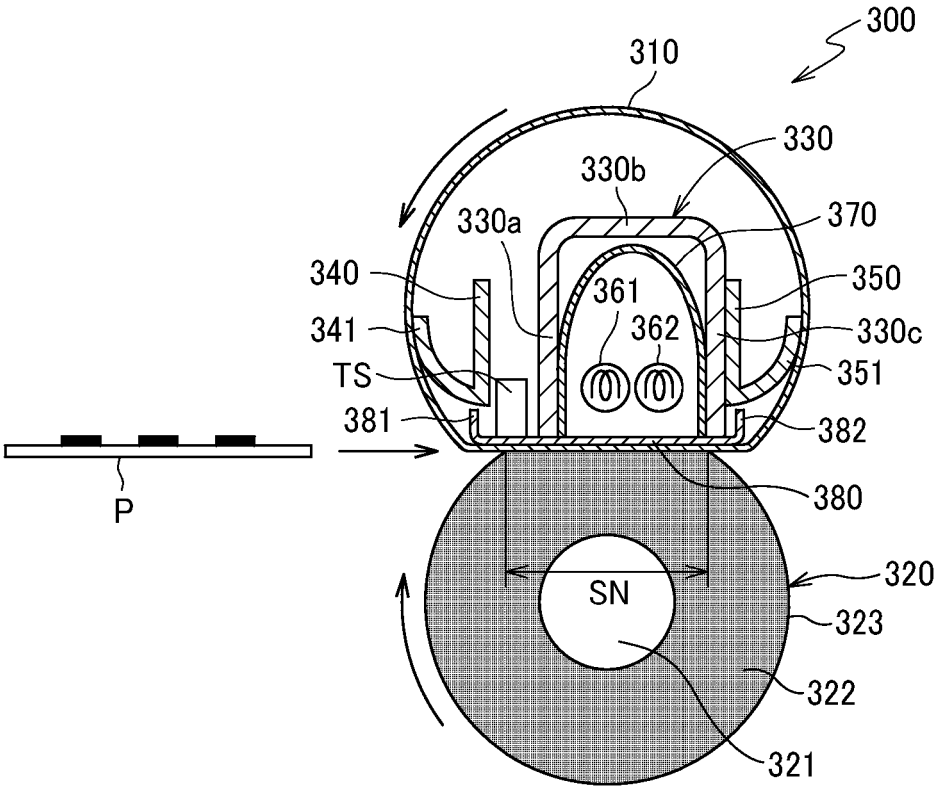

300
310
330
330b
370
330a
340
361
350
341
362
330c
TS
351
381
382
P
380
320
SN
323
322
321

FIG. 3

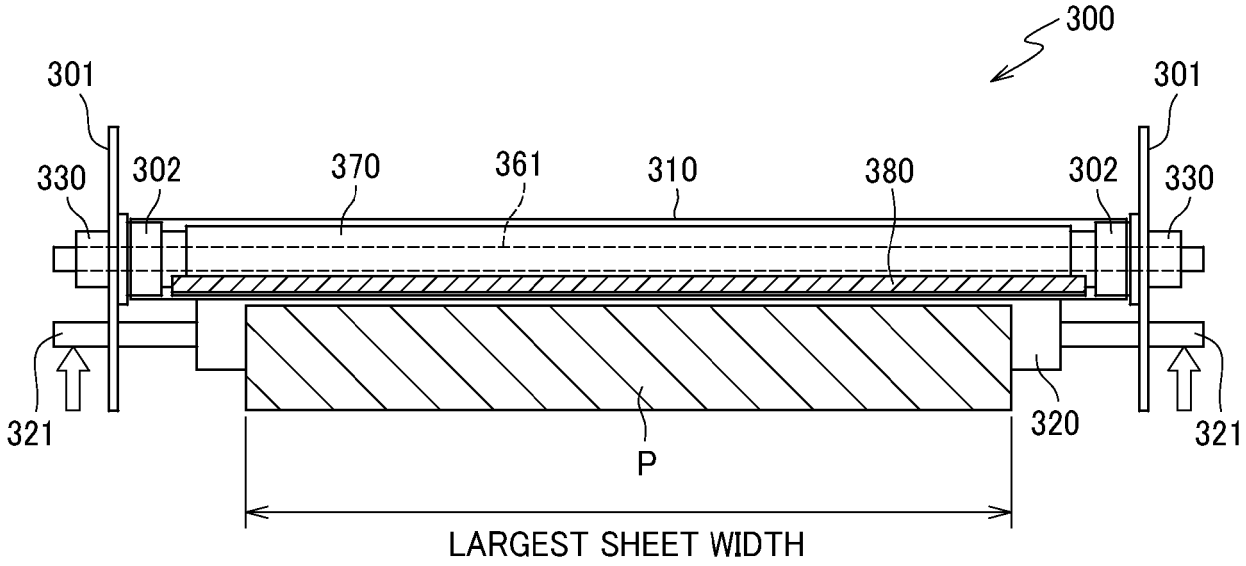

300
301
301
330
302
370
361
310
380
302
330
321
320
321
P
LARGEST SHEET WIDTH

FIG. 4

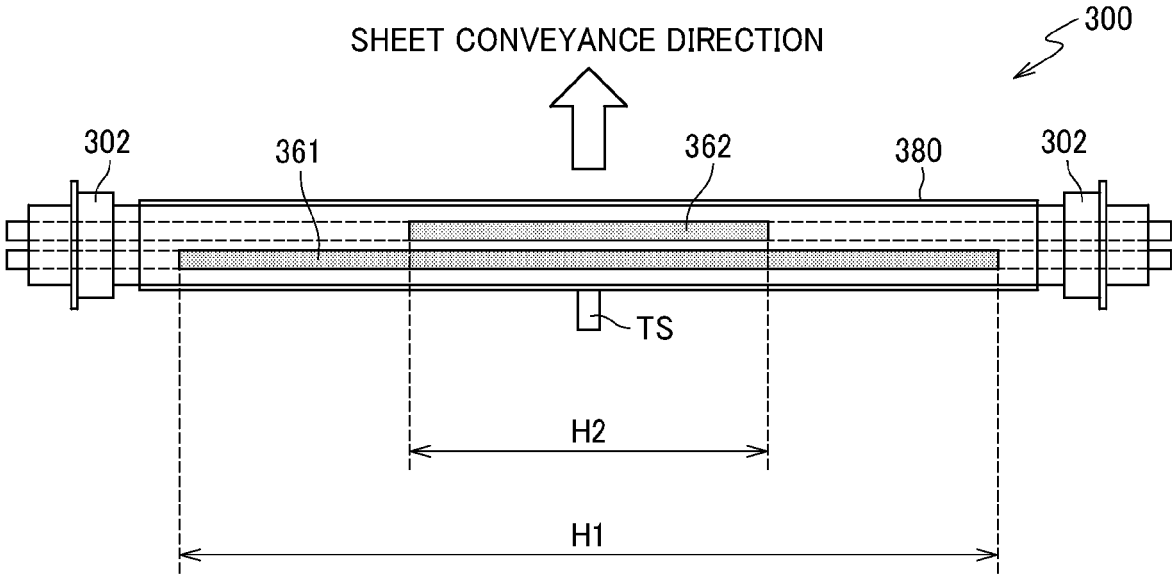

SHEET CONVEYANCE DIRECTION
300
302
361
362
380
302
TS
H2
H1

FIG. 5

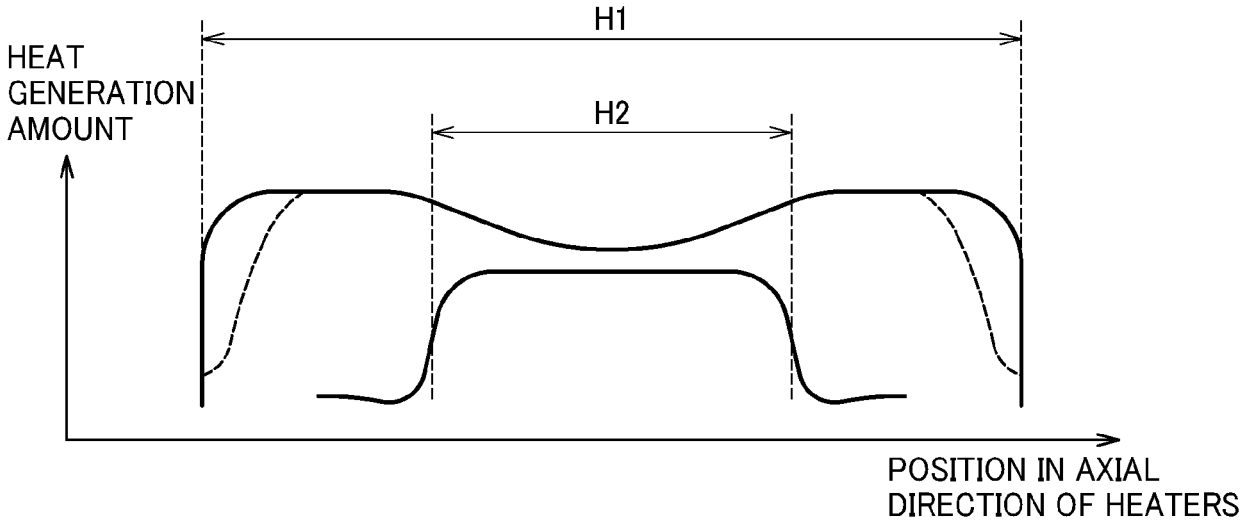

H1
H2
HEAT GENERATION AMOUNT
POSITION IN AXIAL DIRECTION OF HEATERS

FIG. 6

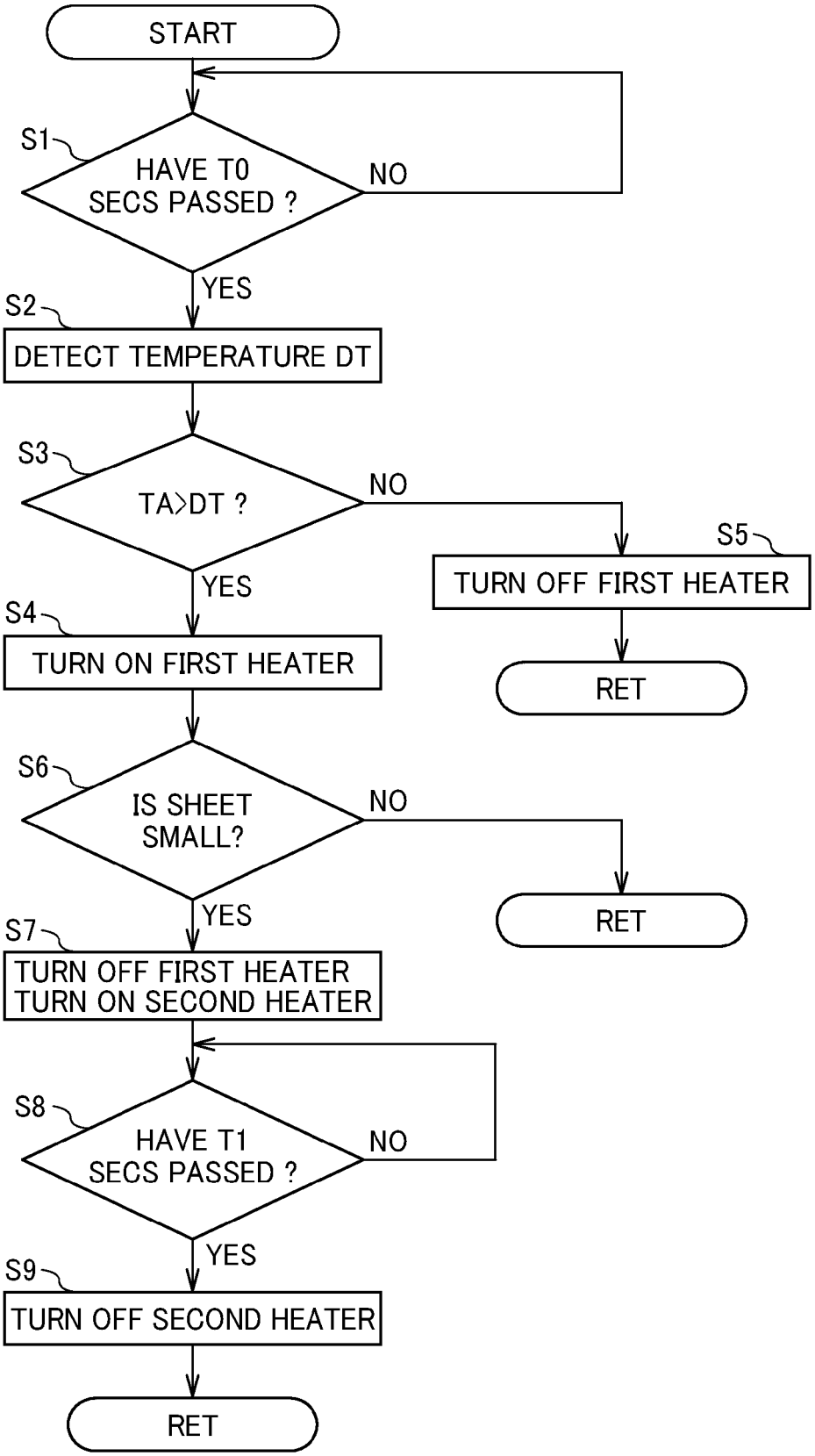
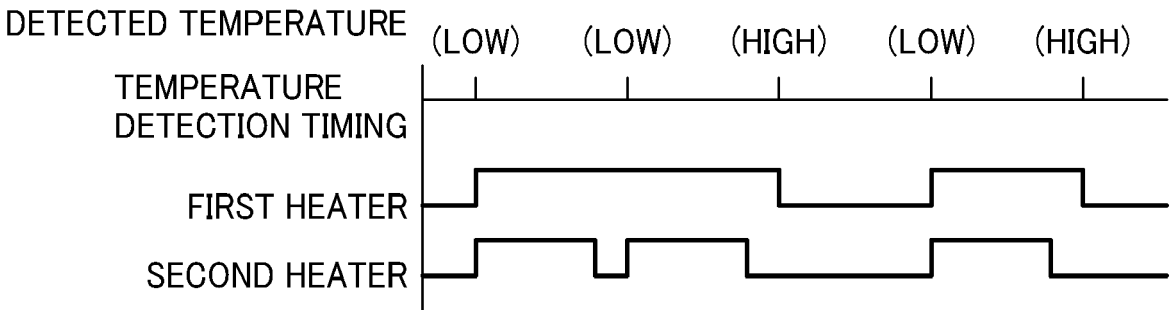

START
S1
HAVE T0 SECS PASSED ?
NO
YES
S2
DETECT TEMPERATURE DT
S3
TA>DT ?
NO
YES
S5
TURN OFF FIRST HEATER
RET
S4
TURN ON FIRST HEATER
S6
IS SHEET SMALL?
NO
YES
RET
S7
TURN OFF FIRST HEATER
TURN ON SECOND HEATER
S8
HAVE T1 SECS PASSED ?
NO
YES
S9
TURN OFF SECOND HEATER
RET

FIG. 7


DETECTED TEMPERATURE
(LOW)
(LOW)
(HIGH)
(LOW)
(HIGH)
TEMPERATURE DETECTION TIMING
FIRST HEATER
SECOND HEATER

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EUROPEAN SEARCH REPORT

Application Number
EP 20 16 1593

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	US 2013/183072 A1 (HASE TAKAMASA [JP] ET AL) 18 July 2013 (2013-07-18) * paragraph [0028] - paragraph [0116]; figures 1-10 *	1-3,7-15 4-6	INV. G03G15/20
X Y	JP H08 220930 A (RICOH KK) 30 August 1996 (1996-08-30) * paragraph [0019] - paragraph [0070]; figures 1-9 *	1-3, 8-12,14, 15 4-6	
Y	JP 2018 156054 A (RICOH CO LTD) 4 October 2018 (2018-10-04) * paragraphs [0013], [0017] - [0021], [0030]; figures 1-4 *	4-6	
A	US 2014/294419 A1 (MATSUNO TAKUJI [JP]) 2 October 2014 (2014-10-02) * the whole document *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC) G03G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 July 2020	Billmann, Frank

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28-07-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013183072 A1	18-07-2013	CN 103207554 A	17-07-2013
		CN 105116704 A	02-12-2015
		JP 5796714 B2	21-10-2015
		JP 2013164430 A	22-08-2013
		US 2013183072 A1	18-07-2013
		US 2015160591 A1	11-06-2015
		US 2016147185 A1	26-05-2016
		US 2017285542 A1	05-10-2017
		US 2019121271 A1	25-04-2019
		US 2020117126 A1	16-04-2020
JP H08220930 A	30-08-1996	JP 3418269 B2	16-06-2003
		JP H08220930 A	30-08-1996
JP 2018156054 A	04-10-2018	NONE	
US 2014294419 A1	02-10-2014	CN 104076666 A	01-10-2014
		JP 2014194445 A	09-10-2014
		US 2014294419 A1	02-10-2014

EPO FORM P0459

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Patent documents cited in the description

- JP 2011237523 A **[0002] [0004]**