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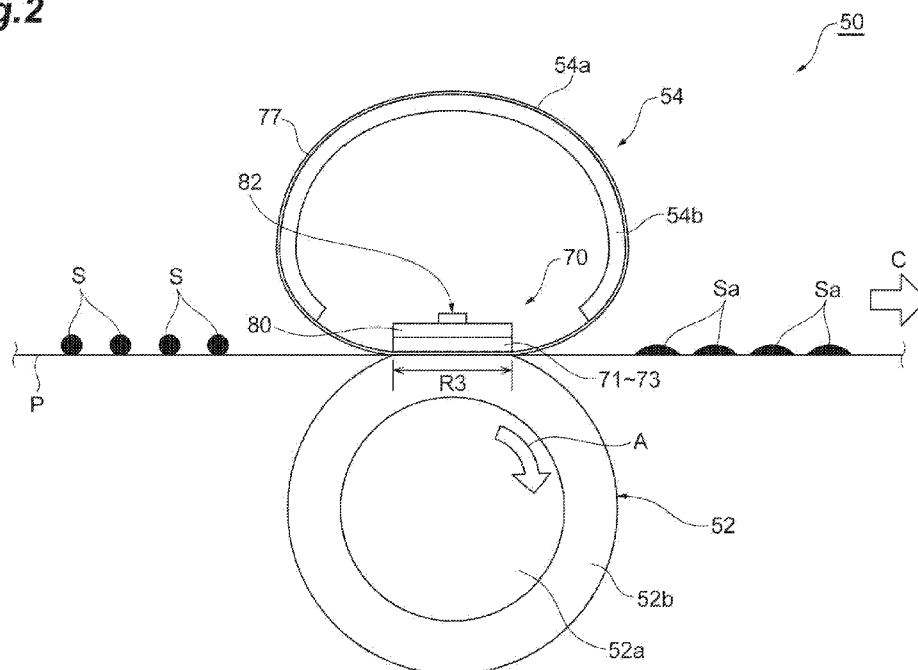
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(54) Title: FUSING DEVICE WITH CALIBRATION FOR HEATING DEVICE

Fig.2



(57) **Abstract:** A fusing device for an imaging system includes a conveyance device having a conveyance surface to convey a recording material in a conveying direction, at least two fuser heating elements to fix an image onto the recording material, a fuser power supply connected to each of the at least two fuser heating elements, a temperature acquisition device, a calibration heating device, and a calibration thermometer. The at least two fuser heating elements extend parallel to the conveyance surface and in a width direction of the conveyance device to align substantially with an entire width of the recording material in the width direction. The temperature acquisition device acquires a temperature of each of the at least two fuser heating elements based on information from the fuser power supply. The calibration heating device heats the at least two fuser heating elements. The calibration thermometer detects a temperature of the calibration heating device.

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FUSING DEVICE WITH CALIBRATION FOR HEATING DEVICE

BACKGROUND

[0001] Some imaging apparatuses include a fuser to fix an image onto a recording material, in which a fuser heater is divided into a plurality of heaters along a width direction of a conveying belt that conveys the recording material. Such an imaging apparatus controls a variation of heat in the width direction by the fuser heater so as to fix an image onto the recording material.

BRIEF DESCRIPTION OF DRAWINGS

[0002] FIG. 1 is a schematic diagram of an example imaging apparatus.

[0003] FIG. 2 is a schematic cross-sectional view of an example fuser.

[0004] FIG. 3 is a schematic perspective view of an example fuser heating device of the fuser shown in FIG. 2.

[0005] FIG. 4 is a schematic diagram of a calibration device for the fuser heating device shown in FIG. 3.

[0006] FIG. 5 is a schematic diagram of a belt facing surface of a central Positive Temperature Coefficient (PTC) heater.

[0007] FIG. 6 is a schematic diagram of a belt facing surface of an end PTC heater.

[0008] FIG. 7 is a graph of an example relationship of the electrical resistance-temperature characteristics of a PTC heater.

[0009] FIG. 8 is a flowchart of a processing for calibrating the electrical resistance-temperature characteristics of the fuser heating device, carried out by the calibration device shown in FIG. 4.

[0010] FIG. 9 is a graph of the relationship between a temperature of a heater and an elapsed time in calibration processing and fusing processing.

[0011] FIG. 10 is a flowchart of a fusing processing carried out by the PTC heater.

[0012] FIG. 11 is a schematic cross-sectional view of another example

fuser.

[0013] FIG. 12 is a schematic perspective view of an example fuser heating device of the fuser shown in FIG. 11.

[0014] FIG. 13 is a schematic diagram of an example calibration device for the fuser heating device shown in FIG. 12.

[0015] FIG. 14 is a flowchart of a calibration control of the fuser heating device carried out by the calibration device shown in FIG. 13.

[0016] FIG. 15 is a schematic perspective view of another example fuser heating device for the fuser shown in FIG. 11.

[0017] FIG. 16 is a schematic perspective view of another example fuser heating device for the fuser shown in FIG. 11.

[0018] FIG. 17 is a table of parameters associated with a calibration processing and a fusing processing carried out by the example fuser heating device illustrated in FIG. 16.

[0019] FIG. 18 is a schematic perspective view showing an example configuration of a calibration heating device for the fuser heating device shown in FIG. 16.

[0020] FIG. 19 is a schematic perspective view showing an example fuser.

[0021] FIG. 20 is a table showing an example of the electrical resistance-temperature characteristics stored in the example fuser shown in FIG. 19.

[0022] FIG. 21 is a schematic cross-sectional view of another example fuser.

[0023] FIG. 22 is a schematic plan view of an example fuser heating element.

DETAILED DESCRIPTION

[0024] Example imaging systems will be described with reference to the drawings. The imaging systems may be an imaging apparatus, such as a printer, or may be a device that is used in the imaging apparatus, such as a fuser, a fuser heating device or the like. In the following description, with reference to the drawings, the same reference numbers are assigned to the same components or

to similar components having the same function, and overlapping description is omitted.

[0025] With reference to FIG. 1, an example imaging apparatus 1 may form a color image with respective colors of magenta, yellow, cyan, and black. The example imaging apparatus 1 includes a conveying device 10 that conveys paper (or a sheet of paper) P which is a recording material, four image carriers 40 also referred to herein as electrostatic latent image carriers or photosensitive drums, each having a surface (e.g. a peripheral surface) on which an electrostatic latent image is to be formed, four development devices 20 that each develops the electrostatic latent image on an adjacent one of the four image carriers 40 with toner in order to form a single-color toner image, a transfer device 30 that secondarily transfers the single-color toner images onto the paper P as a composite toner image, a fuser 50 that fixes the composite toner image to the paper P, and an ejection device 60 that ejects the paper P. In the present disclosure, and the image carrier 40 may refer to one or more image carriers 40.

[0026] The conveying device 10 conveys the paper P as a recording material on which the composite toner image is to be formed, along a conveying route R1, for example. The paper P (e.g., sheets of paper) is stacked and accommodated in a cassette K, and is picked up by a paper feed roller 11 to be conveyed. The conveying device 10 conveys the paper P (e.g., one sheet of paper) to reach a transfer nip portion R2 through the conveying route R1 at a timing at which the toner image to be transferred onto the paper P reaches the transfer nip portion R2, for example.

[0027] The four development devices 20 are provided for the respective four colors of magenta, yellow, cyan, and black, and located adjacent the four image carriers 40, respectively. In the present disclosure, the development devices 20 may refer to one or more development devices 20. Each development device 20 includes, for example, a developer roller 24 to carry toner. The development device 20 uses a developer, for example, a two-component developer containing toner and carrier. According to examples, in the development device 20, the amounts of toner and of carrier are set to achieve a targeted mixing ratio, and the toner and the carrier are mixed and stirred to

disperse the toner in the mixture. Accordingly, an optimum amount of charge is achieved in the developer. This developer is carried on the developer roller 24. The developer roller 24 is rotated to transfer the developer to a region facing the adjacent one of the image carriers 40. At this region (e.g., a transfer region), the toner from the developer carried on the developer roller 24 is transferred to the electrostatic latent image formed on a peripheral surface of the image carrier 40, and the electrostatic latent image is developed to form a single-color toner image.

[0028] The transfer device 30 may receive the single-color toner images formed by the development devices 20 which are layered to form a composite toner image. The transfer device 30 may convey the composite toner image to the transfer nip portion R2 for secondarily transferring the composite toner image onto the paper P. The transfer device 30 includes, for example, a transfer belt 31 on which the single-color toner images are to be primarily transferred from the image carriers 40, suspension rollers 34, 35, 36, and 37 for supporting the transfer belt 31, four primary transfer roller 32 located adjacent the four image carriers 40, respectively, so as to position the transfer belt 31 between the primary transfer rollers 32 and the image carriers 40, and a secondary transfer roller 33 located adjacent the suspension roller 37 to position the transfer belt 31 between the secondary transfer roller 33 and the suspension roller 37.

[0029] The transfer belt 31 is, for example, an endless belt that is rotatable about the suspension rollers 34, 35, 36, and 37. The suspension roller 37 may be a driving roller that is rotationally driven to rotate the endless belt. The suspension rollers 34, 35, and 36 may be driven rollers that are driven to rotate by the rotational driving of the suspension roller 37 and the endless belt. Each of the primary transfer rollers 32 may be positioned to press against the image carrier 40 from an inner peripheral side of the transfer belt 31. The secondary transfer roller 33 may be disposed parallel to the suspension roller 37, and may be positioned to press against the suspension roller 37 from the outer peripheral side of the transfer belt 31, so as to form the transfer nip portion R2 between the secondary transfer roller 33 and the transfer belt 31, where the composite toner image is secondarily transferred to the paper P.

[0030] The four image carriers 40, also referred to as electrostatic latent

image carriers, photosensitive drums, or the like, are provided for the four colors, respective. The image carriers 40 may be arranged along a movement direction of the transfer belt 31. One of the development devices 20, a charging roller 41, and a cleaning device 43 are provided around each of the image carriers 40, and an exposure unit 42 is provided adjacent the four development devices 20.

[0031] The charging roller 41 may include charging means to charge the surface of the image carrier 40 to a predetermined potential. The charging roller 41 may move following a rotation of the image carrier 40. The exposure unit 42 may expose the surface of the image carrier 40 having been charged, according to an image to be formed on the paper P. Accordingly, the potential of a portion of the surface of the image carrier 40 that is exposed by the exposure unit 42 changes to form an electrostatic latent image. According to an example, each of the four development devices 20 develops the electrostatic latent image formed on the associated one of the image carriers 40 by using a toner supplied from a toner tank N located adjacent the development device 20, thereby generating single-color toner images. Accordingly, four toner tanks N are provided, to contain the magenta, yellow, cyan, and black toners, respectively. After the single-color toner image formed on the image carrier 40 is primarily transferred onto the transfer belt 31, the associated cleaning device 43 may recover toner remaining on the image carrier 40.

[0032] The fuser 50 may convey the paper P through a fusing nip portion R3 where the paper P including the composite toner image is heated and pressed, for example, so as to fix the composite toner image onto the paper P. The fuser 50 includes, for example, a pressing member 52 and a heating member 54 for heating the paper P. The pressing member 52 presses against the heating member 54. The fusing nip portion R3 is a contact region located between the pressing member 52 and the heating member 54, to fuse and fix the toner image onto the paper P when the paper P passes through the fusing nip portion R3.

[0033] The ejection device 60 may include ejection rollers 62 and 64 for ejecting the paper P having the toner image fixed by the fuser 50 to the outside of the device.

[0034] An example printing process carried out by the imaging apparatus

1 will be described. When the image signal of an image to be printed is input to the imaging apparatus 1, a controller of the imaging apparatus 1 rotates the paper feed roller 11 to pick up and convey the paper (or sheet of paper) P stacked in the cassette K. In a charging operation, the charging roller 41 uniformly charges the surface of the image carrier 40 to a predetermined potential. In an exposure operation, the exposure unit 42 irradiates the surface of the image carrier 40 with laser light based on the received image signal so as to form an electrostatic latent image on the surface of the image carrier 40.

[0035] In a development operation, the development device 20 develops the electrostatic latent image to form the single-color toner image. In a primary transfer operation, the single-color toner image formed in this manner is primarily transferred from the image carrier 40 to the transfer belt 31 at a region where the image carrier 40 faces the transfer belt 31. The toner images formed on the four image carriers 40 are sequentially layered on the transfer belt 31 to form the single composite toner image. In a secondary transfer operation, the composite toner image is secondarily transferred onto the paper P that is conveyed from the conveying device 10 to the transfer nip portion R2 where the suspension roller 37 faces the secondary transfer roller 33.

[0036] The paper P onto which the composite toner is secondarily transferred is conveyed to the fuser 50. In a fixing operation, the fuser 50 fuses and fixes the composite toner image onto the paper P by heating and pressing the paper P between the pressing member 52 and the heating member 54 when the paper P passes through the fusing nip portion R3. The ejection rollers 62 and 64 then eject the paper P to the outside of the imaging apparatus 1.

[0037] An example fuser is illustrated in FIG. 2. The example fuser 50 includes the pressing member 52 and the heating member 54.

[0038] The pressing member (or pressing roller) 52 is a roller member disposed so as to be biased toward the heating member 54 by a pressing mechanism to be in pressure contact with the heating member 54. The pressing member 52 cooperates with the heating member 54 to apply a pressure to a toner image (or unfixed toner image) S (e.g. a composite toner image) that is formed on the paper P (e.g., sheet of paper). The pressing member 52 includes a cored

bar 52a formed of a metal material, such as stainless steel, in a cylindrical shape, and an elastic layer 52b laminated on the outer periphery of the cored bar 52a. The elastic layer 52b is formed of an elastic material, such as silicone rubber or fluororubber. In some examples, a release layer may be further laminated on the outer periphery of the elastic layer 52b. The release layer may be formed of, for example, a releasable material including a fluororesin film or a fluororesin coating, such as Perfluoroalkoxy alkane (PFA) or Polytetrafluoroethylene (PTFE). The pressing member 52 may rotate clockwise as indicated by an arrow A, for example, by a driving unit connected to the rotating shaft through a gear. A region where the pressing member 52 is in pressure contact with the heating member 54 forms the fusing nip portion R3.

[0039] The heating member 54 is disposed so as to face the pressing member 52, and cooperates with the pressing member 52 to thermally fix the toner image S onto the paper P. The heating member 54 includes a fuser belt 54a that is a belt-shaped member, a guide member 54b that guides the rotation of the fuser belt 54a, and a fuser heating device 70 that heats the paper P. In some examples, the heat generated by the fuser heating device 70 is transferred to the toner image S on the paper P through the fuser belt 54a, so as to thermally fix the toner image S onto the paper P when passing through the fusing nip portion R3, so as to obtain a fixed toner image Sa. the fuser heating device 70 includes a fuser heating member for thermally fixing the toner image S that is divided into a plurality of fuser heating elements (e.g. Positive Temperature Coefficient (PTC) heaters 71 to 73) that are arranged in a width direction W of the fuser belt 54a (cf. FIG. 3). The plurality of fuser heating elements are controlled so as to be heated independently. Accordingly, the amount of heat generation that can change in the width direction W may be controlled to fix an image onto the paper P so that the amount of heat generation applied to the paper P is even (or uniform) in the width direction W.

[0040] FIG. 3 is a schematic perspective view of the example fuser heating device 70 of the fuser shown in FIG. 2. FIG. 4 is a schematic diagram illustrating the fuser heating device 70 including a calibration device 80. As shown in FIGS. 3 and 4, the fuser heating device 70 includes a central PTC heater 71, end PTC

heaters 72 and 73, a fuser power supply 74, a temperature acquisition device 75, a fuser controller 76, a calibration heating device 81, a calibration power supply 82, a thermometer 83, and a calibration controller 84. The width direction W shown in FIG. 3 is a direction that is parallel to the surface of paper conveyed by the fuser 50 and orthogonal (or perpendicular) to a conveying direction C in which the paper is conveyed.

[0041] The central PTC heater 71 is a fuser heating element for thermally fixing the toner image on the paper, and is disposed substantially at a central portion of the fuser belt 54a in the width direction W. The central PTC heater 71 is a main part among the fuser heating elements of the fuser heating device 70. The central PTC heater 71 extends along the width direction W, and may have a length of 150 mm to 160 mm, according to examples. FIG. 5 is a schematic diagram showing a lower surface (e.g., belt facing surface) of an example of the central PTC heater 71. With reference to FIG. 5, the central PTC heater 71 includes a pair of resistance heating elements 71a and 71b, a pair of outer electrodes 71c and 71d provided on the outer sides of the resistance heating elements 71a and 71b, and a common inner electrode 71e provided on the inner sides of the resistance heating elements 71a and 71b. Each of the resistance heating elements 71a and 71b, the outer electrodes 71c and 71d, and the common inner electrode 71e extends in the width direction W.

[0042] In the central PTC heater 71, the common inner electrode 71e is provided so as to be in contact with the resistance heating elements 71a and 71b in the conveying direction C of the paper P for electrical conduction therewith. The heating element 71a is positioned between the outer electrode 71c and the common inner electrode 71e in the conveying direction C, and the heating element 71b is positioned between the outer electrode 71d and the common inner electrode 71e in the conveying direction C. The outer electrode 71c is in contact with the resistance heating element 71a to provide electrical conduction therewith, and the outer electrode 71d is in contact with the resistance heating element 71b to provide electrical conduction therewith. By supplying electric power from the fuser power supply 74 via the outer electrodes 71c and 71d to the common inner electrode 71e, the resistance heating elements 71a and 71b generate heat due

to electrical resistance. The resistance heating elements 71a and 71b may include a conductive material mainly containing ruthenium oxide (RuO₂), glass, and the like, and have a positive temperature coefficient (PTC) characteristic. With this characteristic, the central PTC heater 71 prevents the heater from overheating, so that the fusing temperature can be more easily controlled within a predetermined range. The outer electrodes 71c and 71d and the common inner electrode 71e are formed of a metal such as silver. The central PTC heater 71 may have a protective film that covers the pair of resistance heating elements 71a and 71b and the electrodes 71c to 71e.

[0043] The end PTC heaters 72 and 73 are fuser heating elements for fixing the toner image on the paper together with the central PTC heater 71, and are disposed at both ends of the central PTC heater 71 in the width direction W. In some examples, the end PTC heater 72, the central PTC heater 71, and the end PTC heater 73 are arranged in this order in the width direction W, so as to extend substantially along the entire width of the paper P in the width direction W. The entire width may correspond to a width of the fuser belt 54a. The entire width may refer, according to examples, to the entire width of paper having the largest width in the width direction W in the paper P on which an image is to be formed by the imaging apparatus 1. There may be a slight (or slim) gap B between each of the end PTC heaters 72 and 73 and the central PTC heater 71. The gap B has a negligible width that does not affect the uniformity of the temperature in the width direction W in fuser heating by the PTC heaters 71 to 73. The end PTC heaters 72 and 73 are auxiliary portions of the fuser heating elements of the fuser heating device 70, and have a length of, for example, 30 mm to 40 mm along the width direction W. The end PTC heaters 72 and 73 may be controlled so as not to be heated when the width of the paper P that is a target of fuser heating is narrow, for example, when the width of the paper P is equal to or less than the width of the central PTC heater 71.

[0044] FIG. 6 is a schematic plan view of a lower surface (belt facing surface) of each of the end PTC heaters 72 and 73. Each of the end PTC heaters 72 and 73 has a similar configuration to the central PTC heater 71. The end PTC heater 72 includes resistance heating elements 72a and 72b, a pair of outer

electrodes 72c and 72d, and a common inner electrode 72e. Similarly, the end PTC heater 73 includes resistance heating elements 73a and 73b, a pair of outer electrodes 73c and 73d, and a common inner electrode 73e. By supplying the electric power from the fuser power supply 74 from the outer electrodes 72c and 72d (or 73c and 73d), respectively, to the common inner electrode 72e (or 73e), the respective resistance heating elements 72a and 72b (or 73a and 73b) generate heat due to electrical resistance. The resistance heating elements 72a and 72b and the resistance heating elements 73a and 73b may include a conductive material mainly containing ruthenium oxide, glass, and the like, and have a PTC characteristic. Accordingly, the end PTC heaters 72 and 73 are also prevented from overheating by the heaters.

[0045] The fuser power supply 74 is electrically connected to each of the central PTC heater 71, the end PTC heater 72 and the end PTC heater 73, and supplies predetermined electric power to each of the PTC heaters 71 to 73 independently to heat the PTC heaters 71 to 73. The fuser power supply 74 is, for example, a constant voltage driving power supply, to supply predetermined electric power to each of the PTC heaters 71 to 73 based on a control instruction from the fuser controller 76. The fuser power supply 74 detects the application current or (applied current) I supplied to each of the central PTC heater 71, the end PTC heater 72, and the end PTC heater 73. The fuser power supply 74 provides the information of each application current I detected to the temperature acquisition device 75.

[0046] The temperature acquisition device 75 calculates an electrical resistance value R for each of the PTC heaters 71 to 73 based on the information of an instruction voltage V from the fuser controller 76, and on the application current I supplied from the fuser power supply 74, and the like. Additionally, the temperature acquisition device 75 acquires the temperature of each of the PTC heaters 71 to 73 from the electrical resistance value R using the PTC characteristic of the resistance heating element of each of the PTC heaters 71 to 73. The temperature acquisition device 75 receives the information of the instruction voltages V from the fuser controller 76 and the information of the application currents I , for each of the PTC heaters 71 to 73 from the fuser power

supply 74. The temperature acquisition device 75 calculates the electrical resistance value R of each of the PTC heaters 71 to 73 by dividing the instruction voltage V by the application current I ($R = V/I$). Then, the calculated electrical resistance value R is compared with the PTC characteristic of the resistance heating element of each of the PTC heaters 71 to 73 to calculate the temperature of each of the PTC heaters 71 to 73 at the time of the measurement.

[0047] A member having a PTC characteristic has a predetermined temperature coefficient of resistance (TCR) correlating the electrical resistance value R with the temperature T . Based on the TCR value (hereinafter referred to as "coefficient α "), the temperature T can be determined based on the electrical resistance value R at the Curie temperature T_c or higher. FIG. 7 illustrates a graph of such electrical resistance-temperature characteristics. As shown in FIG. 7, for example, when the electrical resistance value R of the PTC heater 71 acquired by the temperature acquisition device 75 is R_r , the temperature of the PTC heater 71 can be calculated as T_r . The information of the electrical resistance-temperature characteristics of the resistance heating elements of the PTC heaters 71 to 73 may be stored in a storage device of the temperature acquisition device 75, or may be stored in a storage device of the fuser controller 76 or the like. The following Equation (1) representing the graph and its coefficient value may be stored as data.

[0048] Electrical resistance value R (Ω) = $R_0(1 + \alpha T)$ (1)

[0049] where $\alpha > 0$.

[0050] The coefficient αR_0 indicates the inclination of the linear portion in the graph of FIG. 7, R_0 (Ω) indicates the electrical resistance value at a temperature of 0°C of a linear extrapolation of the linear portion of the graph, and T ($^\circ\text{C}$) indicates a temperature at the time of measurement. In addition, the amount of heat generation P (W) at the temperature T can be expressed by the following Equation (2), and the fuser heating device 70 may be controlled by operating this.

[0051] Amount of heat generation P (W) = V^2/R (2)

[0052] The term V represents a voltage applied to the resistance heating element, and R is an electrical resistance value of the resistance heating element.

In a conventional method of controlling the fuser heating device 70 by operating the voltage, if the electrical resistance of the fuser heating device 70 varies, the amount of heat generation P also varies. On the other hand, a current can be constantly monitored to control the fuser heating device 70 while adjusting the voltage so that the amount of heat generation P does not vary. Accordingly, it is also possible to perform more stable temperature control without being affected by the change in the electric resistance of the fuser heating device 70.

[0053] According to examples, the PTC heaters 71 to 73 may be formed of the same material and have the same configuration so that the electrical resistance-temperature characteristics are the substantially the same. In other examples, or the PTC heaters 71 to 73 may be formed of different materials and/or have individual configurations. The temperature acquisition device 75 outputs the acquired temperature information of the PTC heaters 71 to 73 at the time of measurement, to the fuser controller 76.

[0054] The fuser controller 76 is a device that controls processing for the fuser 50 to fix the toner image S onto the paper P . The fuser controller 76 may be a part of the overall controller that controls the operation of each component (rotation of a photosensitive drum, rotation of a feed roller, or the like) of the imaging apparatus 1. The fuser controller 76 controls which of the PTC heaters 71 to 73 is to be heated according to the width of the paper (or sheet of paper) P . The fuser controller 76 controls electric power supplied from the fuser power supply 74 to the PTC heaters 71 to 73 so that the temperature of each of the PTC heaters 71 to 73 acquired from the temperature acquisition device 75 at predetermined periods reaches a target temperature. The fuser power supply 74 may supply a constant voltage driving power supply, to more easily suppress overheating of the PTC heaters 71 to 73. However, the temperature tends to decrease in a portion of the PTC heaters 71 to 73 where the amount of heat absorption increases due to the passage of the paper P , while no heat is absorbed and the temperature tends to rise in a portion of the PTC heaters 71 to 73 where the paper P does not pass. The fuser controller 76 controls the fuser power supply 74, so as to correct such non-uniformity (or unevenness) of the temperature distribution, that is, to make the temperature distribution uniform based on the

temperature information from the temperature acquisition device 75. Namely, the fuser controller 76 controls the fuser power supply 74 so that each of the PTC heaters 71 to 73 can be independently heated to a target temperature.

[0055] The calibration heating device 81 forms part of the calibration device 80 which calibrates the electrical resistance-temperature characteristics when the electrical resistance-temperature characteristics of the PTC heaters 71 to 73 described above deviate from the initial setting values, which may occur due to factors, such as a change over time, a difference in use environment, and a variation between devices. The calibration device 80 is configured to include the calibration power supply 82, the thermometer 83, and the calibration controller 84 in addition to the calibration heating device 81.

[0056] The calibration heating device 81 is a heat transfer member that collectively heats the PTC heaters 71 to 73. The calibration heating device 81 is a plate-shaped member extending along the width direction W, and is provided on the PTC heaters 71 to 73 so as to substantially cover the entire PTC heaters 71 to 73 in the width direction W. According to examples, the calibration heating device 81 is provided on the PTC heaters 71 to 73 so as to position the PTC heaters 71 to 73 between the paper P and the calibration heating device 81. The calibration heating device 81 is formed of, for example, aluminum, iron, copper, or the like having a suitable thermal conductivity.

[0057] The calibration heating device 81 may be bonded to installation surfaces 71f to 73f of the PTC heaters 71 to 73 with heat conductive adhesives 81a to 81c containing an inorganic filler in epoxy resin or the like, for example. The heat conductive adhesives 81a to 81c may be adhesives containing ceramics with high thermal conductivity, such as aluminum oxide (alumina), aluminum nitride, or silicon carbide, as an inorganic filler. The heat conductive adhesives 81a to 81c may include tape shaped adhesives. The calibration heating device 81 may be bonded to the PTC heaters 71 to 73 so as to be electrically insulated from the PTC heaters 71 to 73. In this case, the heat conductive adhesives 81a to 81c can be formed of an insulating material. The calibration heating device 81 is formed of a material having suitable thermal conductivity and is bonded or adhered to each of the PTC heaters 71 to 73 with a heat conductive adhesive.

This also tends to even out the temperatures of the PTC heaters 71 to 73 at the time of fusing processing. For example, the calibration heating device 81 may serve as a heat sink (heat conduction member), such that a rapid temperature rise in a portion (for example, both ends) where no paper pass at the time of fusing processing is brought close to the same temperature as other portions (central portion) by heat transfer, heat radiation, or the like. In some examples, the calibration heating device 81 may be directly mounted onto the installation surfaces 71f to 73f of the PTC heaters 71 to 73 without using the heat conductive adhesive described above.

[0058] The calibration power supply 82 is a power supply that is electrically connected to the heating elements inside the calibration heating device 81 and supplies electric power to the heating elements inside the calibration heating device 81 to heat the calibration heating device 81 to a predetermined temperature. In some examples, the calibration heating device 81 may have a configuration without any heating element. In this case, however, the calibration heating device 81 mainly provides the above-described temperature evening (or uniformizing) function. According to an example, the calibration heating device 81 includes a heating element therein. Based on a control instruction from the calibration controller 84, the calibration power supply 82 supplies electric power so that the calibration heating device 81 reaches a set temperature. The calibration heating device 81 is heated to a predetermined temperature by the electric power supplied from the calibration power supply 82. Accordingly, each of the PTC heaters 71 to 73, to which the calibration heating device 81 is attached through the heat conductive adhesives 81a to 81c, is also heated to the same temperature as the calibration heating device 81. The calibration power supply 82 is configured to raise the temperature of the calibration heating device 81, for example, in the range of 50°C to 100°C. This temperature (calibration temperature) may be within a range from the Curie temperature T_c to the fusing temperature of the fusing processing. Accordingly, the calibration temperature may be equal to or greater than the Curie temperature T_c and/or less than the fusing temperature of the fusing processing. This calibration control is performed at the time of non-fusing, so that the heating member 54 does not rotate. Since

the calibration temperature is lower than the fusing temperature, the temperatures of the PTC heaters 71 to 73 reach the calibration temperature accurately after a certain period of time.

[0059] The thermometer 83 includes a sensor to detect the temperature of the calibration heating device 81. The thermometer 83 is provided on the upper surface 81d of the calibration heating device 81, for example. The upper surface 81d is a surface opposite to a lower surface 81e facing the installation surfaces 71f to 73f of the PTC heaters 71 to 73. The thermometer 83 is disposed at the center in the width direction W on the upper surface 81d of the calibration heating device 81. The thermometer 83 may be provided on a surface other than the upper surface 81d of the calibration heating device 81. Since the calibration heating device 81 is formed of a material having relatively high thermal conductivity, the temperature detected by the thermometer 83 can be considered as the temperature of any portion of the calibration heating device 81. The PTC heaters 71 to 73 having been heated by the calibration heating device 81 can also be considered as having the temperature detected by the thermometer 83 when the PTC heaters 71 to 73 are not heated by the fuser power supply 74 but are heated by the calibration heating device 81 having been heated. The thermometer 83 outputs the detected temperature to the calibration controller 84.

[0060] The calibration controller 84 may control a calibration processing for calibrating the electrical resistance-temperature characteristics of the PTC heaters 71 to 73 when the electrical resistance-temperature characteristics of the PTC heaters 71 to 73 deviate from the initial setting values, which may occur due to factors, such as a change over time, a difference in use environment, and a variation between devices. In this example calibration processing, the calibration controller 84 controls the electric power supplied from the calibration power supply 82 to raise the temperature of the calibration heating device 81 from the room temperature to the first temperature T1 (for example, 60°C). The calibration controller 84 controls the electric power supplied from the calibration power supply 82 to the calibration heating device 81 based on the temperature of the calibration heating device 81 detected by the thermometer 83, so that the temperature of the calibration heating device 81 is adjusted to reach the first

temperature T1. The calibration controller 84 controls the electric power supplied from the calibration power supply 82 to raise the temperature of the calibration heating device 81 from the first temperature T1 (for example, 60°C) to the second temperature T2 (for example, to 90°C obtained by an addition of 30°C). At this time, the calibration controller 84 controls the electric power supplied from the calibration power supply 82 to the calibration heating device 81 based on the temperature of the calibration heating device 81 detected by the thermometer 83, so that the temperature of the calibration heating device 81 is adjusted to reach the second temperature T2.

[0061] When the calibration heating device 81 does not include any heating element therein, that is, when the calibration heating device 81 is a calibration heat conduction member, the calibration controller 84 first heats the central PTC heater 71 having a greatest length using the fuser controller 76 so that the calibration heat conduction member is heated to the first temperature T1. The heated calibration heat conduction member then heats the two end PTC heaters 72 and 73 to the first temperature T1. Although it takes more time, this method allows for the temperatures of all the heating elements to be uniform (e.g., substantially the same temperature), it is also possible to raise the temperature to the first temperature T1. Similarly, the calibration heat conduction member further heats the central PTC heater 71 having a greatest length using the fuser controller 76, so that the calibration heat conduction member is heated from the first temperature T1 to the second temperature T2. The heated calibration heat conduction member then heats the two end PTC heaters 72 and 73 to the second temperature T2. As described above, the central PTC heater 71 or the end PTC heaters 72 and 73 can also be set to a predetermined temperature by the calibration heat conduction member including no heating element therein. In this case, the structure of the calibration heating device 81 can be simplified.

[0062] Examples of calibration processing in which the calibration heating device 81 has an internal heating element and examples in which the calibration heating device 81 does not have any internal heating element will be further described. The calibration controller 84 acquires a first electrical resistance value R1 of each of the PTC heaters 71 to 73 at the first temperature T1 and a second

electrical resistance value R_2 of each of the PTC heaters 71 to 73 at the second temperature T_2 through the fuser power supply 74, the temperature acquisition device 75, and the fuser controller 76. For the acquisition of the first electrical resistance values R_1 and the second electrical resistance values R_2 , in the same manner as described for the function of the temperature acquisition device 75, a relatively low electric power for calibration is supplied to each of the PTC heaters 71 to 73 at each of the first temperature T_1 and the second temperature T_2 , so as to calculate the first electrical resistance value R_1 and the second electrical resistance value R_2 of each of the PTC heaters 71 to 73, from the application current (or applied current) I and the application voltage (or applied voltage) V supplied at that time. The calibration controller 84 may receive the application current I and the application voltage V of each of the PTC heaters 71 to 73 at the first temperature T_1 and the second temperature T_2 instead of the first electrical resistance value R_1 and the second electrical resistance value R_2 , so as to calculate and acquire the first electrical resistance value R_1 and the second electrical resistance value R_2 .

[0063] The calibration controller 84 acquires the new calibrated electrical resistance-temperature characteristics of each of the PTC heaters 71 to 73 based on the first temperature T_1 , the first electrical resistance values R_1 , the second temperature T_2 , and the second electrical resistance values R_2 acquired as described above. The calibration controller 84 may acquire the new calibrated electrical resistance-temperature characteristics of each of the PTC heaters 71 to 73 by performing calibration processing using the first temperature T_1 and the first electrical resistance values R_1 or the second temperature T_2 and the second electrical resistance values R_2 and the initial electrical resistance-temperature characteristics (or the electrical resistance-temperature characteristics calibrated at the previous calibration). When the calibration has been performed three times or more (e.g., a first previous calibration, a second previous calibration and the current calibration), the calibration equation may be determined by using, for example, a least square method, in order to eliminate the error in calibration by the averaging effect. The calibration controller 84 overwrites or separately records the calibrated electrical resistance-temperature characteristics (including the

coefficient shown in Equation (1)) in a storage device or the like as the normal electrical resistance-temperature characteristics of each of the PTC heaters 71 to 73, so as to calibrate the electrical resistance-temperature characteristics of the PTC heaters 71 to 73.

[0064] With reference to FIGS. 8 to 10, examples of processing for calibrating the electrical resistance-temperature characteristics and fusing processing of the PTC heaters 71 to 73 by the above-described fuser heating device 70, will be described. FIG. 8 is a flowchart of the processing for calibrating the electrical resistance-temperature characteristics of each one of the PTC heaters. FIG. 9 is a graph showing a relationship between the temperature of a heater and the elapsed time in the calibration processing and the fusing processing. FIG. 10 is a flowchart of the fusing processing by each PTC heater. The calibration processing in the fuser heating device 70 may be performed at predetermined periods (the number of times of printing, date, or the like), or may be performed at a selected timing. According to an example, a calibration processing is performed each time before fuser heating. The calibration processing is performed in a state where the temperature distribution of the heaters in the width direction W before fixing the toner image S onto the paper P (before the passage of paper) is uniform.

[0065] First, when the calibration controller 84 in the fuser heating device 70 receives an instruction to start the processing for calibrating the electrical resistance-temperature characteristics of each of the PTC heaters 71 to 73 from the controller of the imaging apparatus 1, the calibration controller 84 detects the current temperature of the calibration heating device 81 using the thermometer 83. At operation S1, a predetermined electric power is supplied from the calibration power supply 82 to the calibration heating device 81 so that the temperature of the calibration heating device 81 reaches the first temperature T1 (for example, 60°C), thereby raising the temperature. At this time, the electric power supplied from the calibration power supply 82 is adjusted based on the temperature of the calibration heating device 81 detected by the thermometer 83. If the detected temperature is a predetermined target temperature (for example, 60°C), the measured temperature is stored in the storage device as the first

temperature T1, and the process proceeds to operation S2.

[0066] At operation S2, the fuser controller 76 acquires the first electrical resistance value R1 of each of the PTC heaters 71 to 73 at the first temperature T1. The fuser controller 76 controls the fuser power supply 74 to supply a predetermined low electric power to each of the PTC heaters 71 to 73, and acquires the first electrical resistance value R1 of each of the PTC heaters 71 to 73 at the first temperature T1. At this time, the electric power supplied to the PTC heaters 71 to 73 is so low that the temperature of each of the PTC heaters 71 to 73 does not rise relative to the first temperature T1.

[0067] At operation S3, when the first electrical resistance value R1 at the first temperature T1 is acquired, the calibration controller 84 supplies predetermined electric power from the calibration power supply 82 to the calibration heating device 81 so that the temperature of the calibration heating device 81 reaches the second temperature T2 (for example, 90°C). At this time, the electric power supplied from the calibration power supply 82 is adjusted based on the temperature of the calibration heating device 81 detected by the thermometer 83. The second temperature T2 is a temperature raised from the first temperature T1 within a predetermined range, and is, for example, a temperature obtained by adding 30°C to the first temperature T1. A suitable temperature range between the first temperature T1 and the second temperature T2 may be set to calibrate the electrical resistance-temperature characteristics of the PTC heaters 71 to 73 with greater accuracy. For example, the difference between the first temperature T1 and the second temperature T2 may be 20°C or more.

[0068] At operation S4, the fuser controller 76 acquires the second electrical resistance value R2 of each of the PTC heaters 71 to 73 at the second temperature T2. As in the case of the first temperature T1, the fuser controller 76 controls the fuser power supply 74 to supply a predetermined low electric power to each of the PTC heaters 71 to 73, and acquires the second electrical resistance value R2 of each of the PTC heaters 71 to 73 at the second temperature T2. At this time, the electric power supplied to the PTC heaters 71 to 73 is so low that the temperature of each of the PTC heaters 71 to 73 does not rise from the

second temperature T2.

[0069] At operation S5, the fuser controller 76 calculates the calibrated electrical resistance-temperature characteristics of each of the PTC heaters 71 to 73 based on the first temperature T1, the first electrical resistance values R1, the second temperature T2, and the second electrical resistance values R2 acquired. For example, for each of the PTC heaters 71 to 73, in a region corresponding to the linear portion of the electrical resistance-temperature characteristics in the graph of FIG. 7, a point where the first temperature T1 and the first electrical resistance value R1 intersect, is plotted and a point where the second temperature T2 and the second electrical resistance value R2 intersect is plotted to generate new electrical resistance-temperature characteristics. When generating the new characteristics, the calibration processing may correct a part of the initial electrical resistance-temperature characteristics to reflect the above-mentioned plotted points in a selected portion of the initial electrical resistance-temperature characteristics of each of the PTC heaters 71 to 73. As the calibrated electrical resistance-temperature characteristics, the calibration values of "coefficient α " and "R0" in the above Equation (1) may be calculated. Since the above-described first temperatures T1 and T2 are the temperatures of the calibration heating device 81 but heat is efficiently transferred from the calibration heating device 81 to each of the PTC heaters 71 to 73, the first temperature T1 and the second temperature T2 can be considered as the temperatures of each of the PTC heaters 71 to 73.

[0070] At operation S6, the fuser controller 76 transmits the calibrated electrical resistance-temperature characteristics (or "coefficient α " and "R0" in Equation (1)) of each of the PTC heaters 71 to 73 having been calculated, to the temperature acquisition device 75. The temperature acquisition device 75 stores the updated information on the calibrated electrical resistance-temperature characteristics in a storage device. The end of the calibration processing corresponds to elapsed time t_2 shown in FIG. 9.

[0071] With reference to FIG. 10, when the calibration processing ends, the fusing processing is carried out. At operation S10, the fuser controller 76 sets a target temperature Tref for the fusing processing. According to an example

fusing processing, all of the PTC heaters 71 to 73 are used for the fusing processing. In other examples where the fusing processing is performed by the central PTC heater 71 exclusively, the following operations are performed for a heater that performs the fusing processing.

[0072] At operation S12, when the target temperature T_{ref} is set, the fuser controller 76 compares the temperature of each of the PTC heaters 71 to 73 acquired from the temperature acquisition device 75 with the target temperature T_{ref} , and adjusts the electric power supplied from the fuser power supply 74 based on the deviation to start the control so that the temperature of each of the PTC heaters 71 to 73 reaches the target temperature. In this temperature control, the electrical resistance-temperature characteristics of each of the PTC heaters 71 to 73 calibrated by the above-described calibration processing are used. For example, the temperature acquisition device 75 acquires the electrical resistance value R of each of the PTC heaters 71 to 73 from the application current I and the application voltage V supplied from the fuser power supply 74 to each of the PTC heaters 71 to 73, compares each electrical resistance value R with the calibrated electrical resistance-temperature characteristics, and acquires the temperature at that time.

[0073] At operation S13, after it is confirmed that the PTC heaters 71 to 73 have been adjusted to the target temperature, the paper P (e.g., sheet of paper) having the toner image S is supplied to the fuser 50, so that the paper P passes between the pressing member 52 and the heating member 54, in order to fix the toner image S onto the paper P . Subsequently, the fusing processing on the next sheet of paper P is carried out while performing the temperature control in operation S12, to continue the fusing processing.

[0074] As described above, the fuser heating device 70 can perform fuser heating according to the width of the paper P by independently controlling the PTC heaters 71 to 73. In addition, in the imaging apparatus 1 including the fuser heating device 70, the electrical resistance-temperature characteristics used for the temperature control of the PTC heaters 71 to 73 may deviate from the initial setting values due to factors, such as changes over time in the electrical resistance-temperature characteristics of the PTC heaters 71 to 73 due to

continued use, a difference in use environment, and a variation between devices. According to the imaging apparatus 1 of the example described above, the fuser heating device 70 includes the calibration device 80, so that the electrical resistance-temperature characteristics of each of the plurality of PTC heaters 71 to 73 can be calibrated at predetermined periods or at selected times. Thus, the processing for fixing the toner image S onto the paper P by the fuser heating device 70 can be made more stable over a long period of time.

[0075] The PTC heaters 71 to 73 of the fuser heating device 70 are arranged along the width direction W, and the calibration heating device 81 extends along the width direction W to collectively heat the PTC heaters 71 to 73. With this configuration, the heat of the calibration heating device 81 can be evenly (or uniformly) transferred to the PTC heaters 71 to 73 when performing the calibration processing, so as to achieve a more accurate calibration.

[0076] The calibration heating device 81 is disposed on the PTC heaters 71 to 73 so as to position the PTC heaters 71 to 73 between the paper P and the calibration heating device 81, so that heat of the heated calibration heating device 81 transferred directly to the PTC heaters 71 to 73, to achieve a more accurate calibration.

[0077] The thermometer 83 is disposed on the upper surface 81d opposite to the lower surface 81e facing the installation surfaces 71f to 73f of the calibration heating device 81, to more reliably detect the temperature of the calibration heating device 81. The temperature of each of the PTC heaters 71 to 73 can also be easily measured in an indirect manner through the calibration heating device 81. According to some examples, the thermometer 83 may be disposed on a surface other than the upper surface 81d.

[0078] According to examples, the calibration heating device 81 may be bonded to the PTC heaters 71 to 73 with the heat conductive adhesives 81a to 81c, respectively, so as to evenly (or uniformly) heat the PTC heaters 71 to 73 with a relatively simple configuration of the calibration heating device 81. Thus, the calibration processing described above can be easily manufactured. The heat conductive adhesives 81a to 81c may have insulation properties to form insulation between each of the PTC heaters 71 to 73 and the calibration heating device 81,

so as to prevent mutual electrical influences.

[0079] According to examples, the calibration controller 84 controls the calibration power supply 82 to heat the calibration heating device 81 so that the temperature of each of the PTC heaters 71 to 73 changes from the room temperature to the first temperature T1 and changes from the first temperature T1 to the second temperature T2, and receives the first temperature T1 and the second temperature T2 from the thermometer 83. The first electrical resistance value R1 measured at the first temperature T1 of each of the PTC heaters 71 to 73, and the second electrical resistance value R2 measured at the second temperature T2 of each of the PTC heaters 71 to 73 are received from the temperature acquisition device 75. Subsequently, the calibration controller 84 calibrates the electrical resistance-temperature characteristics of each of the PTC heaters 71 to 73 based on the first temperature T1, the first electrical resistance values R1, the second temperature T2, and the second electrical resistance values R2. Accordingly, the electrical resistance-temperature characteristics of the PTC heaters 71 to 73 can be calibrated by a relatively simple processing as described above, to stabilize the processing for fixing the toner image onto the paper over a long period of time.

[0080] Although the PTC heaters 71 to 73 are disposed along the width direction W orthogonal (or perpendicular) to the conveying direction C in the examples described above, the PTC heaters 71 to 73 may be disposed differently. For example, the PTC heaters 71 to 73 may be arranged in a direction that is parallel to the surface of the paper P and angular or oblique with respect to the width direction W (e.g., in a direction along the paper conveying plane that forms a non-zero angle with the direction W). In addition, at least two or more of the PTC heaters 71 to 73 may be disposed, or five or seven PTC heaters may be provided.

[0081] An example fuser 150 will be described with reference to FIG. 11. The example fuser 150 includes a pressing member 52 and a heating member 154. The pressing member 52 has a similar configuration to the fuser 50 (cf. FIG. 2).

[0082] The heating member 154 faces the pressing member 52 and

cooperates with the pressing member 52 to thermally fix the toner image (or unfixed toner image) S to the paper P. The heating member 154 includes a heating belt 160 that is a belt-shaped member, rollers 161 and 162 that rotate the heating belt 160 in a circumferential direction D, and a heat insulating pressing member 170 for pressing the paper P. The heating belt 160 is a belt that may include polyimide containing carbon to reduce electrical resistance, and is configured to generate heat with Joule heating due to electrical resistance by electric power supplied from the outside (e.g., from the pressing member 170). For example, a portion of the heating belt 160 to which electric power is supplied (e.g., a heating portion) generates heat, and the toner image S is fixed onto the paper P by the generated heat. The heat generation of the heating belt 160 can be performed by a predetermined heating control.

[0083] With further reference to FIG. 12, a portion of the heating belt 160 facing a heating device 171 of the pressing member 170 generates heat by an electric power supplied from the electrode of the pressing member 170, and the heat is transferred to the toner image S on the paper P conveyed on the heating belt 160. The heating member 154 thermally fixes the unfixed toner image S on the paper P passing through the fusing nip portion R3 to form the fixed toner image Sa. Accordingly, the heating belt 160 operates as a fuser heating member for thermally fixing the toner image S. Regions 160d to 160f are arranged in the width direction W between a plurality of individual fuser electrodes 173a to 173c and a common electrode 172. The plurality of individual fuser electrodes 173a to 173c are configured to supply electric power to the heating belt 160 independently of each other, and are controlled so that the regions 160d to 160f of the heating belt 160 are independently heated. Accordingly, the heating member 154 may control the amount of heat generation that can vary in the width direction W so that the amount of heat generation applied to the paper P is substantially equal (or substantially uniform) in the width direction W, to fix the image onto the paper P.

[0084] FIGS. 12 and 13 illustrate the pressing member 170 from an underside of the heating belt 160 illustrated in FIG. 11. The pressing member 170 includes a heating device 171 and a calibration device 180. The width direction

W shown in FIG. 12 is a direction that is parallel to the surface of the heating belt 160 (or the paper P conveyed by the fuser 150) and orthogonal (or perpendicular) to the conveying direction C of the paper P (e.g., along the circumferential direction D in which the heating belt 160 rotates).

[0085] The heating device 171 supplies a predetermined electric power to a fuser heating portion of the heating belt 160 to generate heat that fixes the toner image S onto the paper P. The heating device 171 includes a common fuser electrode 172, a fuser electrode unit 173 including an individual central fuser electrode 173a and individual end fuser electrodes 173b and 173c, an individual fuser power supply 174, a temperature acquisition device 175, and a fuser controller 176.

[0086] The fuser heating portion of the heating belt 160 is a portion located between the common fuser electrode 172 and the fuser electrode unit 173 in the circumferential direction D. In FIG. 13, some portions 160d to 160f of the heating belt 160 are shown as fuser heating portions. However, since the heating belt 160 rotates and moves in the circumferential direction D at a predetermined speed, the fuser heating portion frequently moves to the rear side of the heating belt 160 in the circumferential direction D. For example, the portions 160d to 160f move forward along the circumferential direction D, and portions behind the portions 160d to 160f move between the common fuser electrode 172 and the fuser electrode unit 173 to sequentially become fuser heating portions. The heating belt 160 returns to the same position after making one full rotation. For example, the portions 160d to 160f become fuser heating portions again, and are located between the common fuser electrode 172 and the fuser electrode unit 173. As shown in FIG. 12, the portion 160d indicates a part of a region 160a located substantially at a center portion of the heating belt 160 in the width direction W, and the portions 160e and 160f indicate parts of regions 160b and 160c located at both ends (e.g., opposite edges) of the heating belt 160 in the width direction W, respectively.

[0087] The common fuser electrode 172 thermally fixes the toner image S onto the paper P that is conveyed on the heating belt 160. In order to fix the toner image S, a predetermined electric power is supplied between the common fuser

electrode 172 and the fuser electrode unit 173 through the resistance heating element in the heating belt 160 to generate heat in the fuser heating portions (portions 160d to 160f) of the heating belt 160 between the common fuser electrode 172 and the fuser electrode unit 173 in the circumferential direction D. The common fuser electrode 172 is positioned to face and contact the heating belt 160 along the width direction W of the heating belt 160. The length of the common fuser electrode 172 along the width direction W is set to be approximately equal to or slightly greater than the width of the heating belt 160, and is, for example, 180 mm to 210 mm. The common fuser electrode 172 extends in the width direction W adjacent the individual central fuser electrode 173a and the individual end fuser electrodes 173b and 173c in the circumferential direction D. The common fuser electrode 172, the individual central fuser electrode 173a, and the individual end fuser electrodes 173b and 173c are formed of metal, such as silver for example.

[0088] The individual central fuser electrode 173a thermally fixes the toner image S onto the paper P on the heating belt 160 in cooperation with the common fuser electrode 172. The individual central fuser electrode 173a is positioned substantially at a center portion of the heating belt 160 in the width direction W so as to be in contact with the heating belt 160 and face the common fuser electrode 172 in the circumferential direction D. The individual central fuser electrode 173a thermally fixes the toner image S onto the paper P. In order to fix the toner image S, a predetermined electric power is supplied between the individual central fuser electrode 173a and the common fuser electrode 172 through the resistance heating element in the heating belt 160 to generate heat in the fuser heating portion (portion 160d) in the region 160a of the heating belt 160 between the individual central fuser electrode 173a and the common fuser electrode 172 in the circumferential direction D. The individual central fuser electrode 173a is a main part of the fuser electrode unit 173, extends along the width direction W, and has a length of, for example, 150 mm to 160 mm.

[0089] The individual end fuser electrodes 173b and 173c thermally fix the toner image S onto the paper P on the heating belt 160 in cooperation with the common fuser electrode 172, and are positioned at both ends of the individual

central fuser electrode 173a in the width direction W of the heating belt 160 so as to be in contact with the heating belt 160 and face the common fuser electrode 172 in the circumferential direction D. In order to fix the toner image S onto the paper P on the heating belt 160, a predetermined electric power is supplied between the individual end fuser electrodes 173b and 173c and the common fuser electrode 172 through the resistance heating element in the heating belt 160 to generate heat in the fuser heating portions (portions 160e and 160f) in the regions 160b and 160c of the heating belt 160 between the individual end fuser electrodes 173b and 173c and the common fuser electrode 172 in the circumferential direction D.

[0090] The individual end fuser electrode 173b, the individual central fuser electrode 173a, and the individual end fuser electrode 173c may be arranged in this order in the width direction W, and they may be spaced apart from each other to form a slight (or slim) gap between each of the individual end fuser electrodes 173b and 173c and the individual central fuser electrode 173a. The gap has a small width that does not affect the uniformity of the temperature in the width direction W in fuser heating by the electric power supplied from each of the individual fuser electrodes 173a to 173c. The individual end fuser electrodes 173b and 173c are auxiliary portions of the fuser heating device in the pressing member 170, and have a length of, for example, 30 mm to 40 mm along the width direction W. The individual end fuser electrodes 173b and 173c may be controlled to avoid heating the heating belt 160 when the width of the paper P that is a target of the fuser heating is narrower than the heating belt, for example, when the width of the paper P is equal to or less than the width of the individual central fuser electrode 173a.

[0091] The individual fuser power supply 174 is electrically connected to each of the common fuser electrode 172, the individual central fuser electrode 173a, the individual end fuser electrode 173b, and the individual end fuser electrode 173c and supplies predetermined electric power to the resistance heating element of the fuser belt independently through each of the individual fuser electrodes 173a to 173c, to heat the fuser heating portions (portions 160d to 160f). The individual fuser power supply 174 is, for example, a constant voltage

driving power supply, and supplies predetermined electric power to the fuser heating portion of the heating belt 160 through each of the individual fuser electrodes 173a to 173c based on a control instruction from the fuser controller 176. The individual fuser power supply 174 detects the application current I supplied through the individual central fuser electrode 173a, the individual end fuser electrode 173b, and the individual end fuser electrode 173c. The individual fuser power supply 174 provides the information of the application current I detected to the temperature acquisition device 175.

[0092] The temperature acquisition device 175 calculates the electrical resistance value R of the fuser heating portion (for example, the portions 160d to 160f) of the heating belt 160 between the common fuser electrode 172 and each of the individual fuser electrodes 173a to 173c based on an instruction voltage V output from the fuser controller 176 and each application current I supplied from the individual fuser power supply 174. The temperature acquisition device 175 further acquires the temperature of the fuser heating portion (portions 160d to 160f) of the heating belt 160 corresponding to each of the individual fuser electrodes 173a to 173c from the electrical resistance value R , based on the characteristics of the resistance heating element of the fuser heating portion (portions 160d to 160f) of the heating belt 160 corresponding to each of the individual fuser electrodes 173a to 173c. In the example fuser 150, the electrical resistance-temperature characteristics of the regions 160a to 160c of the heating belt 160 are set for each of the subdivided portions (for example, the portions 160d to 160f) having predetermined widths (or dimensions) along the circumferential direction D and the width direction W . For example, the resolution may correspond to 1000 points for one loop of the heating belt 160. On the other hand, without subdivision in the circumferential direction, subdivision may be made such that the electrical resistance-temperature characteristics of the regions 160a to 160c in the heating belt 160 are constant in the circumferential direction D , and the electrical resistance-temperature characteristics may be set for each of the three portions. In the initial value, all the electrical resistance-temperature characteristics of the heating belt 160 may be adjusted to be constant in both the width direction W and the circumferential direction D .

[0093] When the information of the instruction voltage V is provided from the fuser controller 176 and the information of the application current I of each of the individual end fuser electrodes 173a to 173c is provided from the individual fuser power supply 174, the temperature acquisition device 175 calculates the electrical resistance value R of each fuser heating portion (for example, the portions 160d to 160f) of the heating belt 160 corresponding to each of the individual end fuser electrodes 173a to 173c from the electrical resistance value $R = V/I$. Each calculated electrical resistance value R is compared with the characteristics of the resistance heating element of the fuser heating portion (portions 160d to 160f) of the heating belt 160 corresponding to each of the individual fuser electrodes 173a to 173c, and the temperature of the fuser heating portion (portions 160d to 160f) of the heating belt 160 at the time of the measurement is calculated. Similarly to the PTC heaters 71 to 73 described above, the heating belt 160 has a predetermined temperature resistance coefficient between the electrical resistance value R and the temperature T for each fuser heating portion (portions 160d to 160f), so that the temperature T of each fuser heating portion (portions 160d to 160f) can each be calculated from the corresponding electrical resistance value R based on the corresponding TCR value. The temperature acquisition device 175 outputs to the fuser controller 176 the acquired temperature information at the time of measurement of the fuser heating portion (portions 160d to 160f) of the fuser belt corresponding to each of the individual fuser electrodes 173a to 173c.

[0094] The fuser controller 176 controls processing for fixing the toner image S onto the paper P by the fuser 150. The fuser controller 176 controls to which of the individual fuser electrodes 173a to 173c heating power is to be supplied, according to the width of the paper P . The fuser controller 176 controls electric power, which is supplied from the individual fuser power supply 174 to each of the individual fuser electrodes 173a to 173c, so that the temperature of the fuser heating portion (portions 160d to 160f) of the heating belt 160 acquired from the temperature acquisition device 175 becomes a target temperature. When the individual fuser power supply 174 is a constant voltage driving power supply, it is easy to suppress overheating of the fuser heating portions (portions

160d to 160f) of the heating belt 160 corresponding to the individual fuser electrodes 173a to 173c. However, the temperature tends to decrease in a portion of the heating belt 160 where the amount of heat absorption increases due to the passage of the paper P, while a portion where the paper P does not pass (e.g., no contact with the paper P), the temperature increases as the heat is not absorbed by the paper P. The fuser controller 176 performs control to correct such non-uniformity of the temperature distribution, namely, to make the temperature distribution more uniform based on the temperature information from the temperature acquisition device 175. For example, the fuser controller 176 may control the individual fuser power supply 174 to supply electric power independently so that the fuser heating portion of the heating belt 160 corresponding to each of the individual fuser electrodes 173a to 173c reaches the target temperature.

[0095] Still with reference to FIGS. 12 and 13, the example calibration device 180 calibrates the information of the electrical resistance-temperature characteristics of the heating belt 160, and includes a first common calibration electrode 181, a first calibration heating device 182, a first thermometer 183, a first individual calibration electrode unit 184 including a first individual central calibration electrode 184a and first individual end calibration electrodes 184b and 184c, a first individual power supply 189a, a first calibration power supply 190a, a first calibration controller 191a, a second common calibration electrode 185, a second calibration heating device 186, a second thermometer 187, a second individual calibration electrode unit 188 including a second individual central calibration electrode 188a and second individual end calibration electrodes 188b and 188c, a second individual power supply 189b, a second calibration power supply 190b, and a second calibration controller 191b. The first common calibration electrode 181, the first calibration heating device 182, the first thermometer 183, the first individual calibration electrode unit 184, the first individual power supply 189a, the first calibration power supply 190a, and the first calibration controller 191a form a first calibration mechanism (or first calibration device). The second common calibration electrode 185, the second calibration heating device 186, the second thermometer 187, the second individual

calibration electrode unit 188, the second individual power supply 189b, the second calibration power supply 190b, and the second calibration controller 191b form a second calibration mechanism (or second calibration device). The first calibration mechanism and the second calibration mechanism have a similar basic configuration. The first common calibration electrode 181, each electrode of the first individual calibration electrode unit 184, the second common calibration electrode 185, and each electrode of the second individual calibration electrode unit 188 are formed of metal, such as silver.

[0096] According to examples, the calibration device 180 calibrates the electrical resistance-temperature characteristics of the respective portions (for example, the portions 160d to 160f that are fuser heating portions) of the heating belt 160 when the electrical resistance-temperature characteristics of the heating belt 160 deviate from the initial setting values due to factors, such as a change over time, a difference in use environment, and a variation between devices. The portion to be calibrated is each portion obtained by subdivision along the circumferential direction D and the width direction W of the heating belt 160. In the following example, the portions 160d to 160f will be described as examples, and a similar description applies to the calibration of other portions of the heating belt 160.

[0097] The first common calibration electrode 181 supplies predetermined calibration power (low power) through the resistance heating element in the heating belt 160 together with each electrode of the first individual calibration electrode unit 184. The first common calibration electrode 181 is disposed so as to face the heating belt 160 in contact therewith along the width direction W of the heating belt 160. The length of the first common calibration electrode 181 along the width direction W is set to be approximately equal to or slightly greater than the width of the heating belt 160. For example, the width may be 180 mm to 210 mm. The first common calibration electrode 181 extends in the width direction W adjacent the electrodes of the first individual calibration electrode unit 184 in the circumferential direction D.

[0098] The first calibration heating device 182 is a heat transfer member for heating the first common calibration electrode 181. The first calibration heating

device 182 is a plate-shaped member extending along the width direction W, and is provided on the first common calibration electrode 181 so as to cover the entire first common calibration electrode 181 in the width direction W. The first calibration heating device 182 may be formed of, for example, aluminum, iron, or copper having a suitable thermal conductivity. The first calibration heating device 182 may be bonded to the installation surface of the first common calibration electrode 181 with a heat conductive adhesive containing an inorganic filler in epoxy resin, for example. The first calibration heating device 182 may be bonded to the first common calibration electrode 181 so as to be electrically insulated from the first common calibration electrode 181. When the first calibration heating device 182 heats the first common calibration electrode 181, the downstream side of the first common calibration electrode 181 in the conveying direction C, namely, the regions 160a to 160c (moved portions 160d to 160f) of the heating belt 160 between the first common calibration electrode 181 and the electrodes of the first individual calibration electrode unit 184, is heated. The first calibration heating device 182 may be integrated with the first common calibration electrode 181.

[0099] The first thermometer 183 detects the temperature of the first calibration heating device 182. The first thermometer 183 is provided, for example, on the upper surface 182a of the first calibration heating device 182. The first thermometer 183 is disposed at the center in the width direction W on the upper surface 182a of the first calibration heating device 182. In other examples, the first thermometer 183 may be provided on a surface other than the upper surface 182a of the first calibration heating device 182. The first calibration heating device 182 is formed of a material having a suitable thermal conductivity, the temperature detected by the first thermometer 183 can be considered as the temperature of any portion of the first calibration heating device 182. Portions (for example, the portions 160d to 160f to be calibrated) of the heating belt 160 in contact with the first common calibration electrode 181 heated by the first calibration heating device 182 can also be considered as having the temperature detected by the first thermometer 183. The first thermometer 183 outputs the detected temperature to the first calibration controller 191a.

[00100] The first individual central calibration electrode 184a is associated

with the individual central fuser electrode 173a, and calibrates the electrical resistance-temperature characteristics in a portion (for example, the portion 160d) of the heating belt 160 provided for fuser heating between the common fuser electrode 172 and the individual central fuser electrode 173a. The first individual central calibration electrode 184a is a main part of the first individual calibration electrode unit 184. The first individual central calibration electrode 184a extends along the width direction W, and may have a length of 150 mm to 160 mm, for example. The first individual central calibration electrode 184a is disposed so as to be in contact with the heating belt 160 substantially at a central portion in the width direction W and to face the first common calibration electrode 181 in the conveying direction C.

[00101] The first individual end calibration electrodes 184b and 184c are calibration electrodes corresponding to the individual end fuser electrodes 173b and 173c, respectively, and similarly to the first individual central calibration electrode 184a, are electrodes for calibrating the electrical resistance-temperature characteristics in portions (for example, the portion 160e and the portion 160f) of the heating belt 160 provided for fuser heating between the common fuser electrode 172 and the individual end fuser electrodes 173b and 173c. The first individual end calibration electrodes 184b and 184c are disposed respectively at both ends of the first individual central calibration electrode 184a in the width direction W. For example, the first individual end calibration electrode 184b, the first individual central calibration electrode 184a, and the first individual end calibration electrode 184c are arranged in this order in the width direction W. There may be a small gap between each of the first individual end calibration electrodes 184b and 184c and the first individual central calibration electrode 184a. The first individual end calibration electrodes 184b and 184c are auxiliary portions of the first individual calibration electrode unit 184 in the calibration device 180. The first individual end calibration electrodes 184b and 184c may have a length of 30 mm to 40 mm, for example, along the width direction W.

[00102] The second common calibration electrode 185 is a member for supplying predetermined calibration power (low power) through the resistance heating element in the heating belt 160 together with each electrode of the second

individual calibration electrode unit 188. The second common calibration electrode 185 is disposed so as to face the heating belt 160 in contact therewith along the width direction W of the heating belt 160. The length of the second common calibration electrode 185 along the width direction W is approximately equal to or slightly larger than the width of the heating belt 160, and is, for example, 180 mm to 210 mm. The second common calibration electrode 185 extends in the width direction D adjacent the electrodes of the second individual calibration electrode unit 188 in the circumferential direction D.

[00103] The second calibration heating device 186 is a heat transfer member for heating the second common calibration electrode 185. The second calibration heating device 186 is a plate-shaped member extending along the width direction W, and is provided on the second common calibration electrode 185 so as to cover the entire second common calibration electrode 185 in the width direction W. Similarly to the first calibration heating device 182, the second calibration heating device 186 may be formed of, for example, aluminum, iron, or copper having a suitable thermal conductivity. In addition, the second calibration heating device 186 may be bonded to the installation surface of the second common calibration electrode 185 with a heat conductive adhesive containing an inorganic filler in epoxy resin, for example. The second calibration heating device 186 may be bonded to the second common calibration electrode 185 so as to be electrically insulated from the second common calibration electrode 185. When the second calibration heating device 186 heats the second common calibration electrode 185, the downstream side of the second common calibration electrode 185 in the conveying direction C, namely, the regions 160a to 160c (moved portions 160d to 160f) of the heating belt 160 between the second common calibration electrode 185 and the electrodes of the second individual calibration electrode unit 188 is heated. The second calibration heating device 186 may be integrated with the second common calibration electrode 185.

[00104] The second thermometer 187 is a sensor that detects the temperature of the second calibration heating device 186. The second thermometer 187 is provided, for example, on the upper surface 186a of the second calibration heating device 186. The second thermometer 187 is disposed

at the center in the width direction W on the upper surface 186a of the second calibration heating device 186. The second thermometer 187 may be provided on a surface other than the upper surface 186a of the second calibration heating device 186. The second calibration heating device 186 may be formed of a material having a suitable thermal conductivity, and the temperature detected by the second thermometer 187 can be considered as the temperature of any portion of the second calibration heating device 186. Portions (for example, the portions 160d to 160f to be calibrated) of the heating belt 160 in contact with the second common calibration electrode 185 heated by the second calibration heating device 186 can also be considered as having the temperature detected by the second thermometer 187. The second thermometer 187 outputs the detected temperature to the second calibration controller 191b.

[00105] The second individual central calibration electrode 188a is a calibration electrode corresponding to the individual central fuser electrode 173a and the first individual central calibration electrode 184a, and is an electrode for calibrating the electrical resistance-temperature characteristics in a portion (for example, the portion 160d) of the heating belt 160 provided for fuser heating between the common fuser electrode 172 and the individual central fuser electrode 173a. The second individual central calibration electrode 188a is a main part of the second individual calibration electrode unit 188. The second individual central calibration electrode 188a extends along the width direction W, and may have a length of, for example, 150 mm to 160 mm. The second individual central calibration electrode 188a is disposed so as to be in contact with the heating belt 160 substantially at the center in the width direction W and face the second common calibration electrode 185 in the conveying direction.

[00106] The second individual end calibration electrodes 188b and 188c are associated with the individual end fuser electrodes 173b and 173c and the first individual end calibration electrodes 184b and 184c, respectively. The second individual end calibration electrodes 188b and 188c cooperate with the second individual central calibration electrode 188a for calibrating the electrical resistance-temperature characteristics in portions (the portion 160e and the portion 160f) of the heating belt 160, provided for fuser heating between the

common fuser electrode 172 and the individual end fuser electrodes 173b and 173c. The second individual end calibration electrodes 188b and 188c are disposed at both ends of the second individual central calibration electrode 188a in the width direction W. For example, the second individual end calibration electrode 188b, the second individual central calibration electrode 188a, and the second individual end calibration electrode 188c are arranged in this order in the width direction W. There may be a slight (or slim) gap between each of the second individual end calibration electrodes 188b and 188c and the second individual central calibration electrode 188a. The second individual end calibration electrodes 188b and 188c are auxiliary portions of the second individual calibration electrode unit 188 in the calibration device 180. The second individual end calibration electrodes 188b and 188c may have a length of, for example, 30 mm to 40 mm along the width direction W.

[00107] The first individual calibration power supply 189a is a constant voltage power supply for supplying a first calibration power between the first common calibration electrode 181 and each electrode of the first individual calibration electrode unit 184 based on an instruction from the first calibration controller 191a. The second individual calibration power supply 189b is a constant voltage power supply for supplying a second calibration power between the second common calibration electrode 185 and each electrode of the second individual calibration electrode unit 188 based on an instruction from the second calibration controller 191b. The first individual calibration power supply 189a supplies respective application currents I_1 to flow through portions (portions 160d to 160f) corresponding to the regions 160a to 160c of the heating belt 160 located between the first common calibration electrode 181 and the electrodes of the first individual calibration electrode unit 184, to the first calibration controller 191a based on the electric power supplied between the first common calibration electrode 181 and each electrode of the first individual calibration electrode unit 184. Similarly, the second individual calibration power supply 189b supplies respective application currents I_2 to flow through portions (portions 160d to 160f) corresponding to the regions 160a to 160c of the heating belt 160 located between the second common calibration electrode 185 and the electrodes of the

second individual calibration electrode unit 188, to the second calibration controller 191b based on the electric power supplied between the second individual calibration electrode 185 and each electrode of the second individual calibration electrode unit 188. In the first calibration controller 191a, the first electrical resistance value $R1$ of each calibration portion (for example, the portions 160d to 160f to be calibrated) in the regions 160a to 160c of the heating belt 160 between the first common calibration electrode 181 and an associated one among the electrodes of the first individual calibration electrode unit 184 is acquired from the corresponding application current I supplied from the first individual calibration power supply 189a and the application voltage V supplied from the first individual calibration power supply 189a. In the second calibration controller 191b, the second electrical resistance value $R2$ of each calibration portion (for example, the portions 160d to 160f to be calibrated) in the regions 160a to 160c of the heating belt 160 between the second common calibration electrode 185 and an associated one among the electrodes of the second individual calibration electrode unit 188 is acquired from the corresponding application current I supplied from the second individual calibration power supply 189b and the application voltage V supplied from the second individual calibration power supply 189b.

[00108] The first calibration power supply 190a is electrically connected to the first calibration heating device 182 and supplies electric power to the first calibration heating device 182 based on an instruction from the first calibration controller 191a to heat the first calibration heating device 182 to a predetermined temperature. The first individual calibration power supply 190a supplies electric power so that the first calibration heating device 182 reaches a predetermined target temperature based on a control instruction from the first calibration controller 191a. The first calibration heating device 182 is heated to a predetermined target temperature by the electric power supplied from the first calibration power supply 190a, which causes the first common calibration electrode 181 to be heated. In response to this temperature rise, the portions (portions 160d to 160f to be calibrated) of the heating belt 160 between the first common calibration electrode 181 and each electrode of the first individual

calibration electrode unit 184 is heated to the first temperature T1. The second calibration power supply 190b is electrically connected to the second calibration heating device 186 and supplies electric power to the second calibration heating device 186 based on an instruction from the second calibration controller 191b to heat the second calibration heating device 186 to a predetermined temperature. The second calibration power supply 190b supplies electric power so that the second calibration heating device 186 reaches a predetermined target temperature based on a control instruction from the second calibration controller 191b. The second calibration heating device 186 is heated to a predetermined target temperature by the electric power supplied from the second calibration power supply 190b, which causes the second common calibration electrode 185 to be heated. In response to this temperature rise, the portions (portions 160d to 160f to be calibrated) of the heating belt 160 between the second common calibration electrode 185 and each electrode of the second individual calibration electrode unit 188 is heated to the second temperature T2. The first temperature T1 and the second temperature T2 are, for example, in the range of 50°C to 100°C, as in the example described above. This temperature may be lower than the fusing temperature of the fusing processing.

[00109] The calibration controllers 191a and 191b control calibration processing for calibrating the electrical resistance-temperature characteristics of portions (for example, the portions 160d to 160f) in the regions 160a to 160c of the heating belt 160 when the electrical resistance-temperature characteristics of the portions (for example, the portions 160d to 160f) in the regions 160a to 160c of the heating belt 160 deviate from the initial setting values due to factors, such as a change over time, a difference in use environment, and a variation between devices. In this calibration processing, the first calibration controller 191a controls the electric power supplied from the first calibration power supply 190a to raise the temperature of the first calibration heating device 182 to the first temperature T1 (for example, 60°C). At this time, the calibration controller 191a controls the electric power supplied from the first calibration power supply 190a to the first calibration heating device 182 based on the temperature of the first calibration heating device 182 detected by the first thermometer 183, so that the temperature

of the first calibration heating device 182 is adjusted to reach the first temperature T1. In this calibration processing, the second calibration controller 191b controls the electric power supplied from the second calibration power supply 190b to raise the temperature of the second calibration heating device 186 to the second temperature T2 (for example, 90°C). At this time, the second calibration controller 191b controls the electric power supplied from the second calibration power supply 190b to the second calibration heating device 186 based on the temperature of the second calibration heating device 186 detected by the second thermometer 187, so that the temperature of the second calibration heating device 186 is adjusted to reach the second temperature T2.

[00110] The calibration controllers 191a and 199b acquire, from the first individual calibration power supplies 189a and 189b, the application voltage V and the first current I flowing through the portions (portions to be calibrated 160d to 160f) in the regions 160a to 160c of the heating belt 160 between the first common calibration electrode 181 and the electrodes of the first individual calibration electrode unit 184, and additionally acquire the application voltage V and the second current I flowing through the portions (portions to be calibrated 160d to 160f) in the regions 160a to 160c of the heating belt 160 between the second common calibration electrode 185 and the electrodes of the second individual calibration electrode unit 188. The first calibration controller 191a acquires, from the first current I and the application voltage V, the first electrical resistance value R1 of each calibration portion (portions 160d to 160f to be calibrated) in the regions 160a to 160c of the heating belt 160 between the first common calibration electrode 181 and the electrodes of the first individual calibration electrode unit 184. The second calibration controller 191b acquires, from the second current I and the application voltage V, the second electrical resistance value R2 of each calibration portion (portions 160d to 160f to be calibrated) in the regions 160a to 160c of the heating belt 160 between the second common calibration electrode 185 and the electrodes of the second individual calibration electrode unit 188. The first electrical resistance value R1 is a resistance value when the temperature of the corresponding portion is set to the first temperature T1 under the control of the first calibration controller 191a, and

the second electrical resistance value R_2 is a resistance value when the temperature of the corresponding portion is set to the second temperature T_2 under the control of the second calibration controller 191b. The calibration controllers 191a and 191b may perform calibration when the portions 160d to 160f to be calibrated, which are located between the first common calibration electrode 181 and the electrodes of the first individual calibration electrode unit 184 when acquiring the first electrical resistance values R_1 , are moved so as to be located between the second common calibration electrode 185 and the electrodes of the second individual calibration electrode unit 188 when acquiring the second electrical resistance value R_2 . In a case where no paper passes through the position of the calibration device, when the portions 160d to 160f are moved so as to be located between the common fuser electrode 172 and the electrodes of the individual fuser electrode unit 173 when performing fixing onto the paper, the fixing may be performed using the calibration result.

[00111] The calibration controllers 191a and 191b acquire the new calibrated electrical resistance-temperature characteristics of the calibration portions (for example, the portions 160d to 160f to be calibrated) in the regions 160a to 160c of the heating belt 160 based on the first temperature T_1 , the first electrical resistance values R_1 , the second temperature T_2 , and the second electrical resistance values R_2 acquired as described above. The calibration controllers 191a and 191b overwrite or separately record the calibrated electrical resistance-temperature characteristics (including the coefficient shown in Equation (1)) in a storage device of the temperature acquisition device 175 or the like as the normal electrical resistance-temperature characteristics of the calibrated portions (portions 160d to 160f) of the heating belt 160. Accordingly, the electrical resistance-temperature characteristics of the portions (portions 160d to 160f) in the regions 160a to 160c of the heating belt 160 are calibrated. The calibration processing is performed in the same manner in portions other than the portions 160d to 160f of the heating belt 160, so that update processing is performed on the entire heating belt 160.

[00112] With reference to FIG. 14, an example processing for calibrating the electrical resistance-temperature characteristics of portions in the regions 160a

to 160c of the heating belt 160 by the above-described example pressing member 170, will be described. In the following description, the calibration of the electrical resistance-temperature characteristics in some portions 160d to 160f of the heating belt 160 will be described, and the calibration processing in other portions may be the same or similar.

[00113] First, the heating belt 160 is conveyed at a fusing speed when calibration and fixing are simultaneously performed, and conveyed at a predetermined constant speed when only the calibration is performed. Calibration is performed when the paper does not pass (at the time of fixing). At operation S21, when the calibration controllers 191a and 191b receive an instruction to start the processing for calibrating the electrical resistance-temperature characteristics of the regions 160a to 160c of the heating belt 160 from the controller of the imaging apparatus 1, the first calibration controller 191a supplies predetermined electric power from the first calibration power supply 190a to the first calibration heating device 182 so that the temperature of the first calibration heating device 182 reaches the first temperature T1 (for example, 60°C). At this time, the electric power supplied from the first calibration power supply 190a is adjusted based on the temperature of the first calibration heating device 182 detected by the first thermometer 183. The first temperature T1 may be 50°C or more, for example, 60°C. This temperature is stored in the storage device as the first temperature T1, and the process proceeds to operation S22. The first temperature T1 detected herein is the temperature of the first common calibration electrode 181.

[00114] At operation S22, the first calibration controller 191a outputs to the first individual calibration power supply 189a an instruction to acquire the first electrical resistance value R1 of each of the portions 160d to 160f of the heating belt 160 at the first temperature T1. Upon receiving this instruction, the first individual calibration power supply 189a supplies a predetermined low calibration power from the first individual calibration electrode unit 184 to the portions 160d to 160f of the heating belt 160, and acquires the first electrical resistance value R1 of each of the portions 160d to 160f at the first temperature T1. The first individual calibration power supply 189a transmits the acquired first electrical resistance value R1 to the first calibration controller 191a. At this time, the electric

power supplied to the portions 160d to 160f of the heating belt 160 is so low that the temperature of each of the portions 160d to 160f does not rise from the first temperature T1. Thus, the temperature of the heating belt 160 heated to the first temperature T1 by the first common calibration electrode 181 does not change between the first common calibration electrode 181 and the first individual calibration electrode unit 184.

[00115] Subsequently, the second calibration controller 191b supplies predetermined electric power from the second calibration power supply 190b to the second calibration heating device 186 so that the temperature of the calibration heating device 186 becomes the second temperature T2 (operation S23). At this time, the electric power supplied from the second calibration power supply 190b is adjusted based on the temperature of the second calibration heating device 186 detected by the second thermometer 187. The second temperature T2 is a temperature raised from the first temperature T1 within a predetermined range, and is, for example, a temperature (90°C) obtained by adding 30°C to the first temperature T1. By securing a range between the first temperature T1 and the second temperature T2 to some extent, the electrical resistance-temperature characteristics of the portions 160d to 160f of the heating belt 160 can be calibrated with greater accuracy.

[00116] Subsequently, the second calibration controller 191b checks that the second calibration heating device 186 has reached the second temperature T2 using the second thermometer 187, and it is assumed that the second common calibration electrode 185 has also reached the second temperature T2 in the portion of the heating belt 160 between the second common calibration electrode 185 and the second individual calibration electrode unit 188. The elapse of a predetermined time during which each of the portions 160d to 160f of the heating belt 160 moves between the second common calibration electrode 185 and the second individual calibration electrode unit 188 is awaited, and an instruction to acquire the second electrical resistance value R2 of each of the portions 160d to 160f at the second temperature T2 is output to the second individual calibration power supply 189b (operation S24).

[00117] Upon receiving the instruction to acquire the second electrical

resistance value R2 in each of the portions 160d to 160f of the heating belt 160, as in the case of the first temperature T1, the second individual calibration power supply 189b supplies a predetermined low power to each of the portions 160d to 160f of the heating belt 160 through the second individual calibration electrode unit 188 or the like and acquires the second electrical resistance value R2 of each of the portions 160d to 160f at the second temperature T2. At this time, the calibration power supplied to the portions 160d to 160f is so low that the temperature of each of the portions 160d to 160f of the heating belt 160 does not rise from the second temperature T2. The second individual calibration power supply 189b transmits the acquired second electrical resistance value R2 to the second calibration controller 191b.

[00118] At operation S25, when the first temperature T1, the first electrical resistance values R1, the second temperature T2, and the second electrical resistance values R2 are acquired, the fuser controller 176 calculates the calibrated electrical resistance-temperature characteristics of each of the portions 160d to 160f of the heating belt 160 based on the above acquired information. The calculation method may be the same or similar as that in the example described above. When the calibrated electrical resistance-temperature characteristics (or "coefficient α " and "R0" in Equation (1)) of each of the portions 160d to 160f of the heating belt 160 are calculated, the fuser controller 176 transmits the calibrated electrical resistance-temperature characteristics to the temperature acquisition device 175. At operation S26, upon receiving the calibrated electrical resistance-temperature characteristics, the temperature acquisition device 175 stores the calibrated electrical resistance-temperature characteristics in a predetermined storage device. Accordingly, the calibration processing on the portions 160d to 160f of the heating belt 160 ends. Subsequently, operations S21 to S26 are repeated for portions other than the portions 160d to 160f of the heating belt 160, so as to carry out the calibration processing on the entire heating belt 160.

[00119] When the calibration processing on the entire heating belt 160 is completed, the fuser controller 176 performs temperature control based on the calibrated electrical resistance-temperature characteristics to perform fusing

processing. The fusing processing is the same as in the examples described above.

[00120] In the above-described example fuser 150 including the pressing member 170, the heating belt 160 is divided into the regions 160a to 160c and independently controls individual electrodes for supplying electric power to the regions 160a to 160c, so that the fuser heating can be performed according to the width of the paper P. In addition, in examples of the imaging apparatus 1 including the pressing member 170, the electrical resistance-temperature characteristics used for the temperature control of the respective portions of the regions 160a to 160c may deviate from the initial setting values due to factors, such as changes over time in the electrical resistance-temperature characteristics of the respective portions of the regions 160a to 160c of the heating belt 160 due to continued use, a difference in use environment, and a variation between devices. However, according to the example imaging apparatus 1 described above, the pressing member 170 includes the calibration device 180, so that the electrical resistance-temperature characteristics of the respective portions (for example, the portions 160d to 160f) in the plurality of regions 160a to 160c can be calibrated at predetermined periods or selectively, so as to stabilize, the processing for fixing the toner image S onto the paper P by the pressing member 170 over long periods of time.

[00121] With reference to FIG. 15, an example fuser 271 may further include a measurement portion 260 for performing pre-measurement heating in addition to the normal heating device 171. The measurement portion 260 has individual measurement electrodes 271a to 271c, so that a predetermined measurement voltage is applied between the individual measurement electrodes 271a to 271c and the common fuser electrode 172 that functions as a common measurement electrode. The measurement voltage value set for the pre-measurement heating is, for example, about 30% to 70% of the voltage value set for fixing. The measurement voltage value may be set so that the measurement portion 260 does not to exceed the target fusing temperature T_{ref} via this pre-measurement heating alone. The individual measurement electrodes 271a to 271c are associated with the individual fuser electrodes 173a to 173c, respectively, and the

individual temperature acquisition device measures the temperature of the heating portion of the measurement portion 260 of the heating belt 160 from the voltage and current supplied from the individual power supply between the individual measurement electrodes 271a to 271c and the common fuser electrode 172.

[00122] In addition, the controller measures the integrated value (amount of heat) of the electric power supplied to the heating portion of the measurement portion 260 of the heating belt 160 from the voltage and current supplied from the individual power supply between the individual measurement electrodes 271a to 271c and the common fuser electrode 172. The amount of heat is obtained by multiplying electric power value, which is obtained by multiplying the voltage value by the current value, by the time which is obtained by dividing the distance between each of the individual measurement electrodes 271a to 271c and the common fuser electrode 172 by the conveying speed of the heating belt. The controller further calculates, from the amount of heat and the measured temperature, how much heat is required until the target fusing temperature T_{ref} is reached. From this, the controller determines a voltage to be applied between the individual fuser electrodes 173a to 173c and the common fuser electrode 172 by the heating device 171 that performs fixing in the latter half. Consequently, even if there is a variation in the electrical resistance value of the heating belt 160 or a variation in the heat capacity of the paper, fixing can be performed more reliably at the fusing temperature T_{ref} as a final target.

[00123] With reference to FIG. 16, the heating member 154 (cf. FIG. 11) may include a pressing member 370 in which a fuser and a calibration device are integrated into a single device. In the pressing member 370, a set of heating devices 371 carry out three functions, including a fusing function similarly to the heating device 171 in the pressing member 170 illustrated in FIG. 12, a calibration function similarly to the first calibration mechanism of the calibration device 180 illustrated in FIG. 12, and a calibration function similarly to the second calibration mechanism of the calibration device 180 by individual controllers. For example, in the pressing member 370, a common electrode 372 carries out functions corresponding substantially to those of the common fuser electrode 172, the first

common calibration electrode 181, and the second common calibration electrode 185 of the pressing member 170 (cf. FIG. 12). An individual central electrode 373a carries out functions corresponding substantially to those of the individual central fuser electrode 173a, the first individual central calibration electrode 184a, and the second individual central calibration electrode 188a of the pressing member 170 (cf. FIG. 12). The individual end electrode 373b carries out functions corresponding substantially to those of the individual end fuser electrode 173b, the first individual end calibration electrode 184b, and the second individual end calibration electrode 188b. The individual end electrode 373c carries out functions corresponding substantially to those of the individual end fuser electrode 173c, the first end calibration electrode 184c, and the second individual end calibration electrode 188c. A calibration heating device 383 carries out functions corresponding substantially to those of the first calibration heating device 182 and the second calibration heating device 186 in the above-described example.

[00124] In a further modification example still with reference to FIG. 16, in the case of fusing processing, a predetermined electric power is supplied from an individual power supply 374 to the fuser heating portion of the heating belt 160 between the common electrode 372 and each of the individual electrodes 373a to 373c of the individual electrode portion 373 through these electrodes, so that predetermined fusing processing is performed while controlling the fusing temperature, similarly to the pressing member 170 (cf. FIG. 12). On the other hand, in the case of calibration processing performed when the paper does not pass, the calibration heating device 383 is heated to the first temperature T1 by the electric power from a calibration power supply 375, so that the common electrode 372 is heated to the first temperature T1. The heating belt 160 is heated to the first temperature T1 while passing through the common electrode 372. Since the distance from the common electrode 372 to each of the individual electrodes 373a to 373c is short, the temperature T1 is substantially maintained. At the first temperature T1, a predetermined voltage (low voltage for calibration) is applied from the individual power supply 374 to each region of the heating belt 160 between the common electrode 372 and the individual electrodes 373a to 373c to acquire the first electrical resistance value R1 of each region of the

heating belt 160.

[00125] Subsequently, the calibration heating device 383 is heated to the second temperature T2 by the electric power from the calibration power supply 375, so that the common electrode 372 is heated to the second temperature T2. The heating belt 160 is heated to the second temperature T2 while passing through the common electrode 372. Since the distance from the common electrode 372 to each of the individual electrodes 373a to 373c is short, the temperature T2 is substantially maintained. At the second temperature T2, a predetermined voltage (low voltage for calibration) is applied from the individual power supply 374 to each region of the heating belt 160 between the common electrode 372 and the individual electrodes 373a to 373c to acquire the second electrical resistance value R2 of each region of the heating belt 160. When raising the temperature, the heating belt 160 may be rotated once so that the same portion (portions 160d to 160f) is located between the common electrode 372 and the individual electrodes 373a to 373c, and then the temperature may be increased to the second temperature T2 and/or the second electrical resistance value R2 may be acquired. After acquiring the first temperature T1, the first electrical resistance values R1, the second temperature T2, and the second electrical resistance values R2, the processing for calibrating the electrical resistance-temperature of the heating belt 160 by the pressing member 370 may be similar as for the example pressing member 170 described above.

[00126] With further reference to the table illustrated in FIG. 17, the calibration processing and the fusing processing using the pressing member 370 will be described. In a "first round" corresponding to a first rotation of the heating belt 160, calibration target portions (portions 160d to 160f illustrated in FIG. 12) of the heating belt 160 are moved between the common electrode 372 and the individual electrode portion 373. Then, electric power (control voltage is V1) from the calibration power supply 375 is supplied to the calibration heating device 383 to heat the calibration heating device 383, and the calibration target portions of the heating belt 160 are heated to the first temperature T1. The first temperature T1 is measured by a calibration thermometer 184. Then, a low calibration current I_n for measurement is supplied from the individual power supply 374 to the

calibration target portions (portions 160d to 160f) of the heating belt 160 having the first temperature T1 (voltage is a calibration voltage V), and the first electrical resistance value R1 that is a resistance value at that time is acquired for each individual electrode of the individual electrode portion 373.

[00127] When the first electrical resistance values R1 at the first temperature T1 are acquired, the heating belt 160 is rotated once, and in a second round, the calibration target portions (portions 160d to 160f) of the heating belt 160 are located again between the common electrode 372 and the individual electrode portion 373. Then, electric power (e.g., control voltage corresponding to V2) from the calibration power supply 375 is supplied to the calibration heating device 383 to heat the calibration heating device 383, and the calibration target portions of the heating belt 160 are heated to the second temperature T2. The second temperature T2 is measured by the calibration thermometer 184. Then, a low calibration current 2n for measurement is supplied from the individual power supply 374 to the calibration target portions (portions 160d to 160f) of the heating belt 160 having the second temperature T2 (voltage is the calibration voltage V), and the second electrical resistance value R2 that is a resistance value at that time is acquired for each individual electrode of the individual electrode portion 373.

[00128] Subsequently, as described above, based on the first temperature T1, the first electrical resistance values R1, the second temperature T2, and the second electrical resistance values R2, processing for calibrating the electrical resistance-temperature of the calibration target portions of the heating belt 160 is performed. A similar calibration processing may be performed on other calibration target portions of the heating belt 160. When the processing for calibrating the electrical resistance-temperature characteristics of all or required portions of the heating belt 160 is completed, fusing processing is performed based on the calibrated resistance-temperature characteristics as a third round. The fusing temperature T3 at this time is higher than the first temperature T1 and the second temperature T2. A different fusing voltage Vn is applied from the individual power supply 374 to each individual electrode, and at the same time, a fusing current I is measured.

[00129] In the example pressing member 370, a set of heating devices perform three functions including a function of the heating device 171 in the pressing member 170, a function of the first calibration mechanism of the calibration device 180, and a function of the second calibration mechanism of the calibration device 180 by an individual controller. Accordingly, the device configuration can be simplified and the number of devices can be reduced, and consequently, the size of the pressing member 370 can be reduced.

[00130] With reference to FIG. 18, an example calibration heating device 383 includes a heating element electrode 383a connected to the calibration power supply 375 and a pair of heating elements 383b that generate heat by the electric power from the heating element electrode 383a, in order to further reduce the size of the pressing member 370.

[00131] In the pressing members 170, 270 and 370, the position of the calibration target portion of the heating belt 160 may be measured, for example, based on the amount (length) of the heating belt 160 that is fed (displaced) by the rollers 161 and 162. In order to measure the absolute position of each portion more accurately, for example, a configuration shown in FIG. 19 may be adopted and applied to any one of the pressing members 170, 270, and 370. As shown in FIG. 19, a detector 470 for detecting positions along the circumferential direction of the heating belt 160 rotated by rollers 461 and 462 is provided, so that the absolute position of each of the regions 160a to 160c of the heating belt 160 along the circumferential direction D is detected. In this detection, the rotation amount (movement amount) of at least one of the rollers 461 and 462 for rotating the heating belt 160 is detected by an encoder 480 or the like, and the rotation amount and the positioner 470 are interlocked with each other in order to detect the absolute position of the heating belt 160 in the circumferential direction D. The fusing processing or the calibration processing may be performed by more finely controlling the electrical resistance-temperature characteristics of the heating belt 160 based on the detected position information. FIG. 20 shows such an example. For example, the heating belt 160 may be divided into three sections (X1 to X3), such as the regions 160a to 160c, in the width direction W and 1000 sections (Y1 to Y1000) in the circumferential direction D, so that the heating belt 160 is divided

into, for example, 3000 portions, and the electrical resistance-temperature characteristics of each portion may be stored and the above-described calibration may be performed and used for temperature control at the time of fixing.

[00132] With reference to FIG. 21, an example fuser 550 will be described. In the above-described example of the pressing member 370, the heating device 171 and the calibration device 180 are integrated and disposed in the pressing member 370. In the example fuser 550, a fuser 570 and a calibration device 575 may be disposed as separate devices to form a heating unit 554. The fuser 570 has a configuration and a function corresponding to, for example, the heating device 171, and the calibration device 575 has a configuration and a function corresponding to, for example, the calibration device 180. In this example, the calibration device 575 is disposed on the upstream side of the pressing roller 52 in the conveying direction C (circumferential direction D of the heating belt 160), and the fuser 570 is disposed downstream of the calibration device 575. Since the fuser 570 and the calibration device 575 are separately configured, the fuser 550 can be designed more freely. In another example, the calibration device 575 may be disposed on the downstream side of the pressing roller 52 in the conveying direction C (circumferential direction D of the heating belt 160), and the fuser 570 may be disposed on the upstream side of the calibration device 575.

[00133] With reference to FIG. 22, an example fuser heating element 670 will be described. Although the common electrode 372 or the electrodes 373a to 373c of the individual electrode portion 373 in the example pressing member 370 and the like illustrated in FIG. 16, extend longitudinally along the width direction W, other examples may include different configurations. For example, as shown in FIG. 22, the example fuser heating element 670 includes an individual electrode 672 corresponding substantially to the common electrode 372 and an individual electrode unit 673 corresponding substantially to the individual electrode unit 373. The individual electrode 672 and electrodes 673a and 673b of the individual electrode unit 673 may extend obliquely with respect to the width direction W, that is, in a direction crossing the conveying direction C or the circumferential direction D. In the example shown in FIG. 22, a plurality of electrodes are oriented obliquely relative to the width direction W. In other

examples, the common electrode 372 or the electrodes 373a to 373c of the individual electrode unit 373 shown in FIG. 16 may extend so as to cross the conveying direction C or the circumferential direction D, that is, so as to be oriented obliquely with respect to the conveying direction C or the circumferential direction D. Similarly, in the fuser heating device 70 shown in FIG. 3 and the like, each electrode or the calibration heating device may be disposed obliquely.

[00134] Additionally, although the central PTC heater 71 in the above-described in the fuser heating device 70 is longer than the end PTC heaters 72 and 73, in other examples, the three heaters 71 to 73 may have the same length or the central PTC heater 71 may be shorter than the end PTC heaters 72 and 73. In other examples, a fuser heating device does not include the three PTC heaters. In some examples, a fuser heating device may include five PTC heaters or seven PTC heaters, or the like. According to examples, a fuser heating device includes two or more heaters, so as to more finely by the fuser heating device.

[00135] It is to be understood that not all aspects, advantages and features described herein may necessarily be achieved by, or included in, any one particular example. Indeed, having described and illustrated various examples herein, it should be apparent that other examples may be modified in arrangement and detail is omitted.

CLAIMS

1. A fusing device for an imaging system, comprising:
 - a conveyance device having a conveyance surface to convey a recording material in a conveying direction;
 - at least two fuser heating elements to fix an image onto the recording material, wherein the at least two fuser heating elements extend parallel to the conveyance surface of the conveyance device, and further extend in a width direction of the conveyance device that is orthogonal to the conveying direction so as to align substantially with an entire width of the recording material in the width direction;
 - a fuser power supply connected to each of the at least two fuser heating elements;
 - a temperature acquisition device to acquire a temperature of each of the at least two fuser heating elements based on information from the fuser power supply;
 - a calibration heating device to heat the at least two fuser heating elements;
 - and
 - a calibration thermometer to detect a temperature of the calibration heating device.
2. The fusing device according to claim 1, wherein the at least two fuser heating elements are arranged along the width direction of the conveyance device, and the calibration heating device extends along the width direction to collectively heat the at least two fuser heating elements.
3. The fusing device according to claim 1, wherein the calibration heating device is disposed on the at least two fuser heating elements such that the at least two fuser heating elements are located between the conveyance surface and the calibration heating device.
4. The fusing device according to claim 1,

wherein the two fuser heating elements are disposed on an installation surface of the calibration heating device, and

wherein the calibration thermometer is disposed on a surface of the calibration heating device, that is different from the installation surface.

5. The fusing device according to claim 1, wherein the calibration heating device is bonded to the at least two fuser heating elements with a heat conductive adhesive.

6. The fusing device according to claim 1, comprising:

a controller to:

control the calibration heating device to generate heat, so that a temperature of each of the at least two fuser heating elements varies from a first temperature to a second temperature,

receive the first temperature and the second temperature from the calibration thermometer,

acquire a first electrical resistance value of at least one fuser heating element of the at least two fuser heating elements measured at the first temperature and a second electrical resistance value of the at least one fuser heating element measured at the second temperature, and

calibrate the temperature acquisition device from the first temperature, the first electrical resistance value, the second temperature, and the second electrical resistance value.

7. A fusing device for an imaging system, comprising:

a heating belt having a conveyance surface to convey a recording material along a conveying route, wherein the heating belt includes a heating portion to generate heat in response to a supply of electric power, in order to fix an image onto the recording material; and

at least one heating device to heat the heating belt, wherein each of the at least one heating device includes:

at least two individual electrodes that extend parallel to the

conveyance surface of the heating belt and that additionally extend in a width direction of the heating belt that is orthogonal to the conveying route so as to align substantially with an entire width of the recording material in the width direction;

a common electrode extending adjacent the set of individual electrodes, wherein the heating portion is located between the at least two individual electrodes and the common electrode;

a individual power supply connected to the at least two individual electrodes and the common electrode; and

an individual temperature acquisition device to acquire a temperature of the heating portion of the heating belt, based on information from the individual power supply,

wherein at least one among the at least one heating device forms a calibration device to calibrate a fusing processing to be carried out by the heating belt to fix the image onto the recording material, wherein the calibration device includes a calibration heating device to heat the common electrode and a calibration thermometer to detect a temperature of the calibration heating device, the calibration device to calibrate the fusing processing based on the temperature detected.

8. The fusing device according to claim 7,

wherein the at least one heating device includes a first heating device to fix the image via the fusing processing, and a second heating device which includes the calibration device, and

wherein the first heating device is located adjacent to the heating belt on the conveying route of the recording material, and the second heating device is located adjacent to the heating belt and is located at a position other than the conveying route.

9. The fusing device according to claim 7,

wherein the at least one heating device includes a first heating device to fix the image via the fusing processing, and a second heating device including

the calibration device, and

wherein the first heating device and the second heating device are located adjacent to the heating belt on the conveying route of the recording material.

10. The fusing device according to claim 7, wherein the at least one heating device includes:

a first heating device which is a measurement heating device to fix the image onto the recording material via the fusing processing, wherein the first heating device includes an individual measurement power supply, an individual measurement electrode and a common measurement electrode;

a second heating device which is a fuser heating device located downstream of the first heating device relative to a conveyance direction of the heating belt, wherein the second heating device includes an individual fuser power supply, an individual fuser electrode and a common fuser electrode; and

a third heating device that is a calibration heating device including the calibration device,

wherein the heating portion of the heating belt is located between the individual measurement electrode and the common measurement electrode of the first heating device to receive a predetermined measurement voltage from the individual measurement power supply in order to generate heat, and

wherein a heating voltage applied between the individual fuser heating electrode and the common fuser heating electrode in the individual heating power supply of the second heating device is determined based on information from the individual measurement power supply.

11. The fusing device according to claim 7, comprising:

a controller to:

control the calibration heating device to generate heat so that a temperature of the heating portion of the heating belt is varied from a first temperature to a second temperature,

receive the first temperature and the second temperature from the calibration thermometer,

acquire a first electrical resistance value between at least one individual electrode of the at least two individual electrodes of the calibration device and the common electrode of the calibration device when the temperature of the heating portion is at the first temperature, and a second electrical resistance value between the at least one individual electrode and the common electrode when the temperature of the heating portion is at the second temperature, and

calibrate the individual temperature acquisition device based on the first temperature, the first electrical resistance value, the second temperature, and the second electrical resistance value.

12. The fusing device according to claim 7, wherein the common electrode and the calibration heating device to calibrate the fusing processing are integrally formed into a single component.

13. The fusing device according to claim 7, comprising:

a detector to detect an absolute position of a portion of the heating belt;
and

a storage device to store information on the electrical resistance-temperature characteristics corresponding to the absolute position of each portion of the heating belt.

14. A fusing device for an imaging system, comprising:

a conveyance device having a conveyance surface to convey a recording material in a conveying direction;

at least two individual heating elements that extend parallel to the conveyance surface of the conveyance device and that additionally extend in a width direction of the conveyance device that is orthogonal to the conveying direction of the conveyance device, so as align substantially with an entire width of the recording material in the width direction, in order to fix an image onto the recording material or to carry out calibration of a heating operation of the at least two individual heating elements;

an individual power supply connected to each of the at least two individual heating elements;

an individual temperature acquisition device to acquire an individual temperature of each of the at least two individual heating elements based on information from the individual power supply;

a calibration heat conduction member that is in contact with the at least two individual heating elements and that extends in a direction transversal to the conveying direction; and

a calibration thermometer to detect a calibration temperature of the calibration heat conduction member.

15. The fusing device according to claim 14, comprising:

a controller to:

control at least one individual heating element of the at least two individual heating elements to heat the calibration heat conduction member so that the calibration temperature varies from a first temperature to a second temperature,

receive the first temperature and the second temperature from the calibration thermometer,

acquire a first electrical resistance value of at least one individual heating element of the at least two individual heating elements measured at the first temperature, and a second electrical resistance value of the at least one individual heating element measured at the second temperature, and

calibrate the individual temperature acquisition device based on the first temperature, the first electrical resistance value, the second temperature, and the second electrical resistance value.

Fig.1

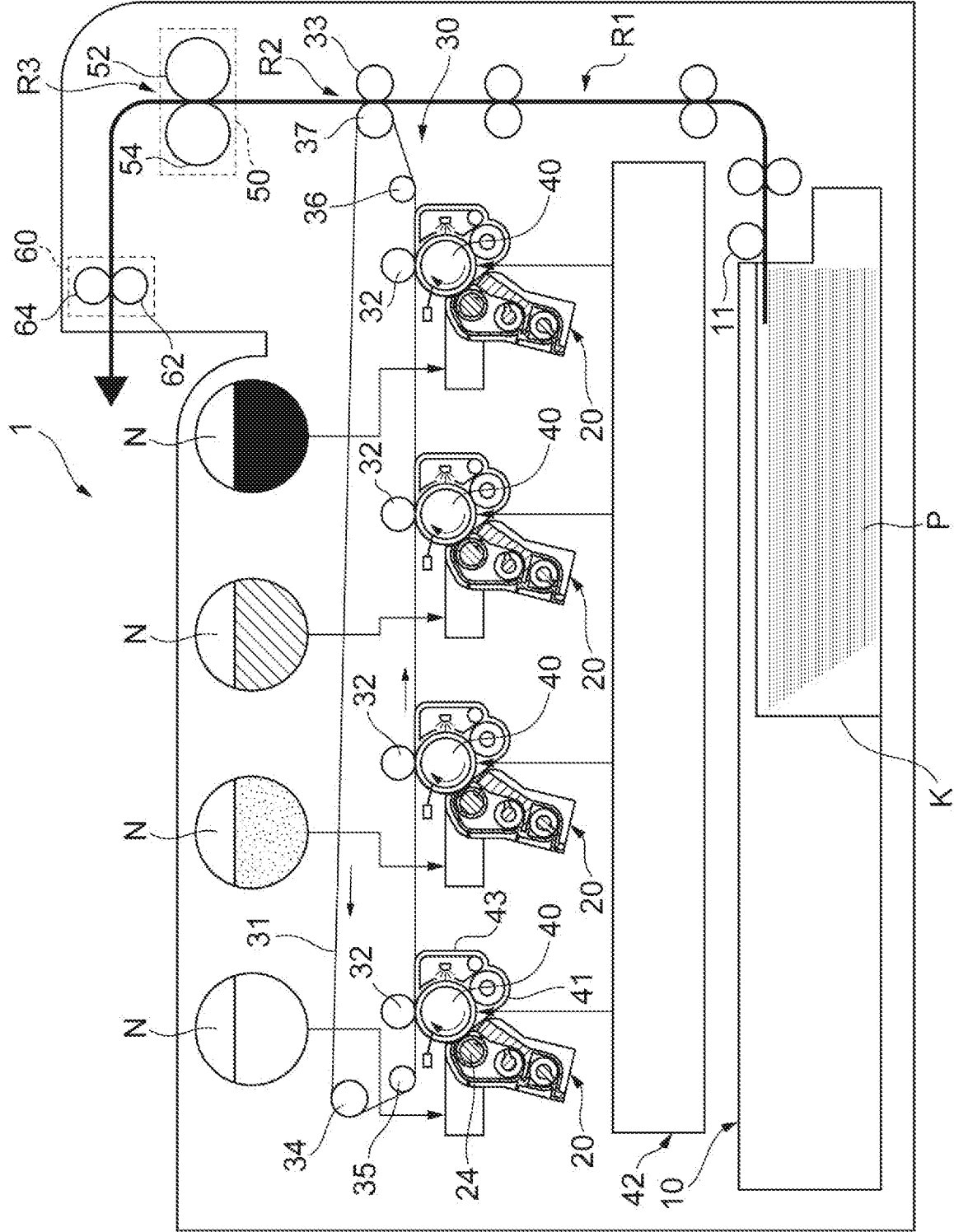


Fig.2

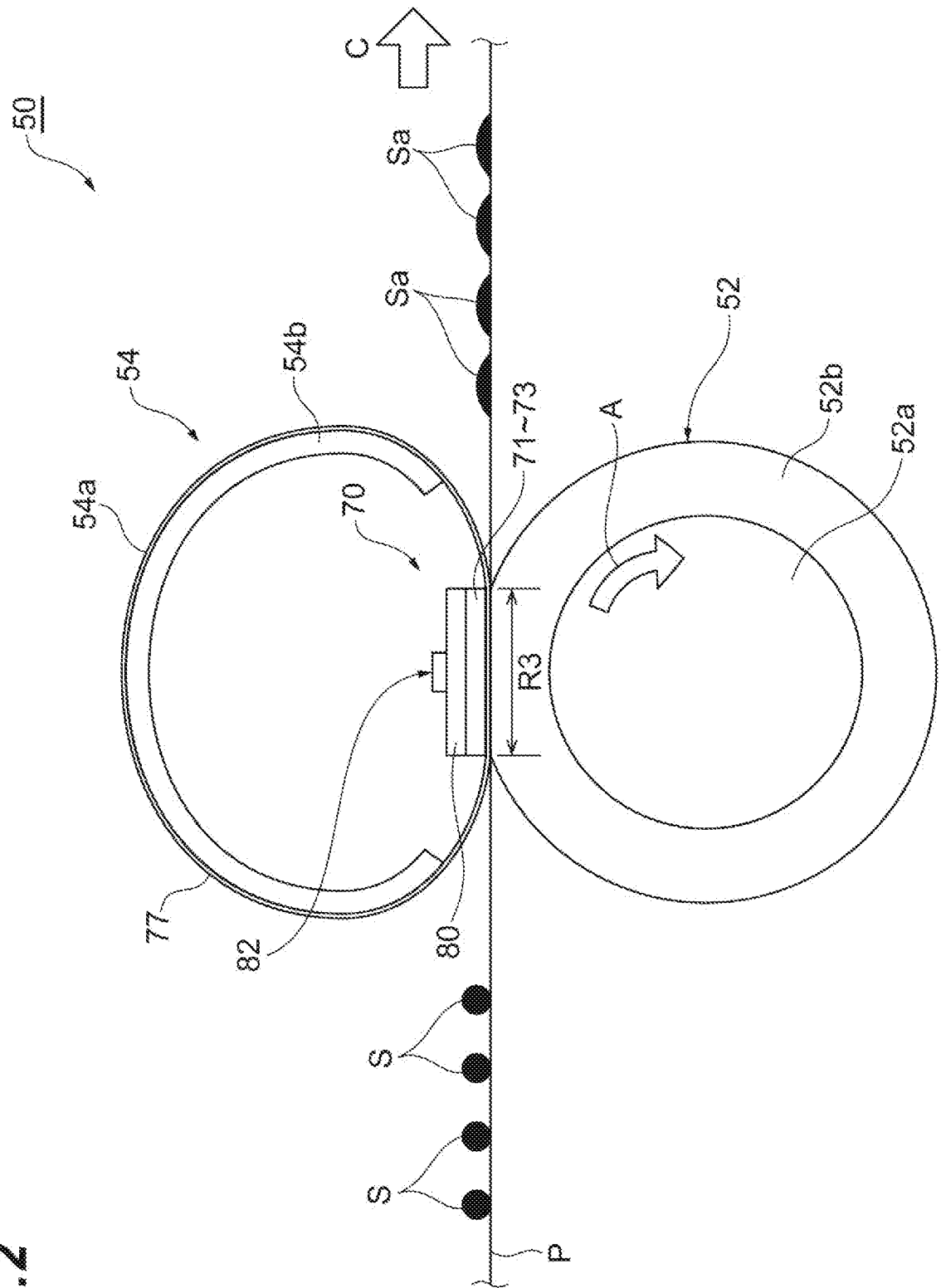


Fig.3

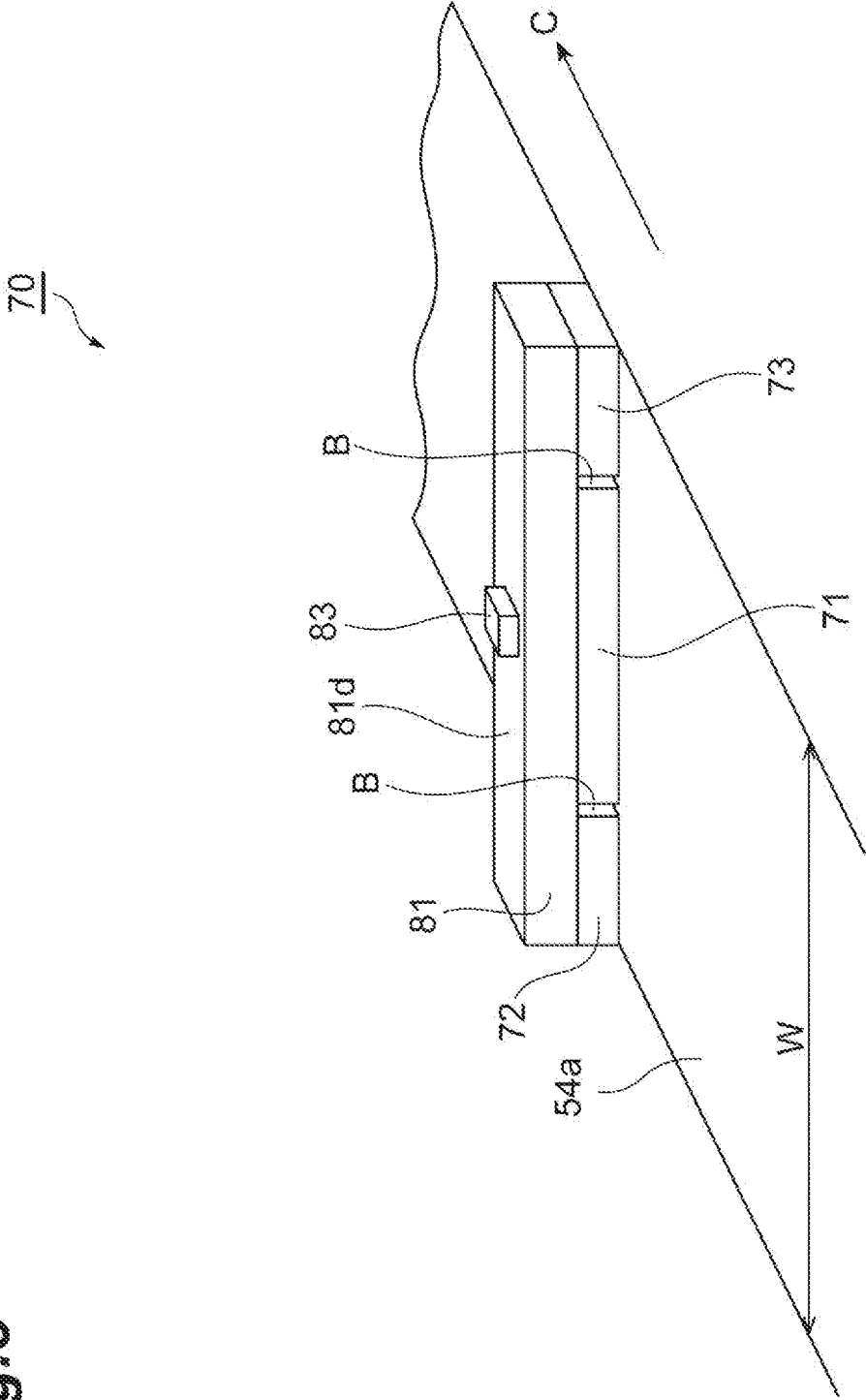


Fig.4

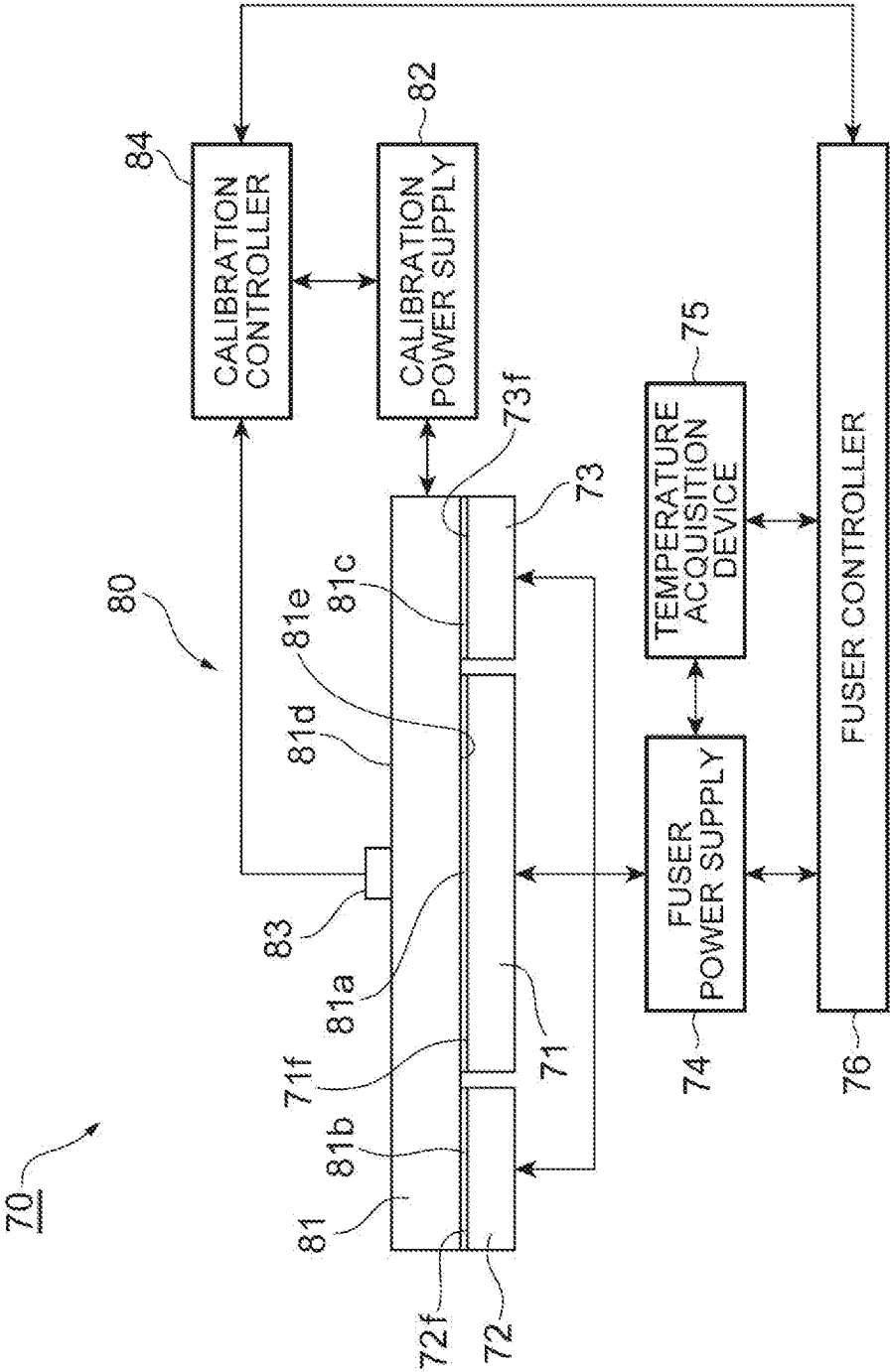


Fig.5

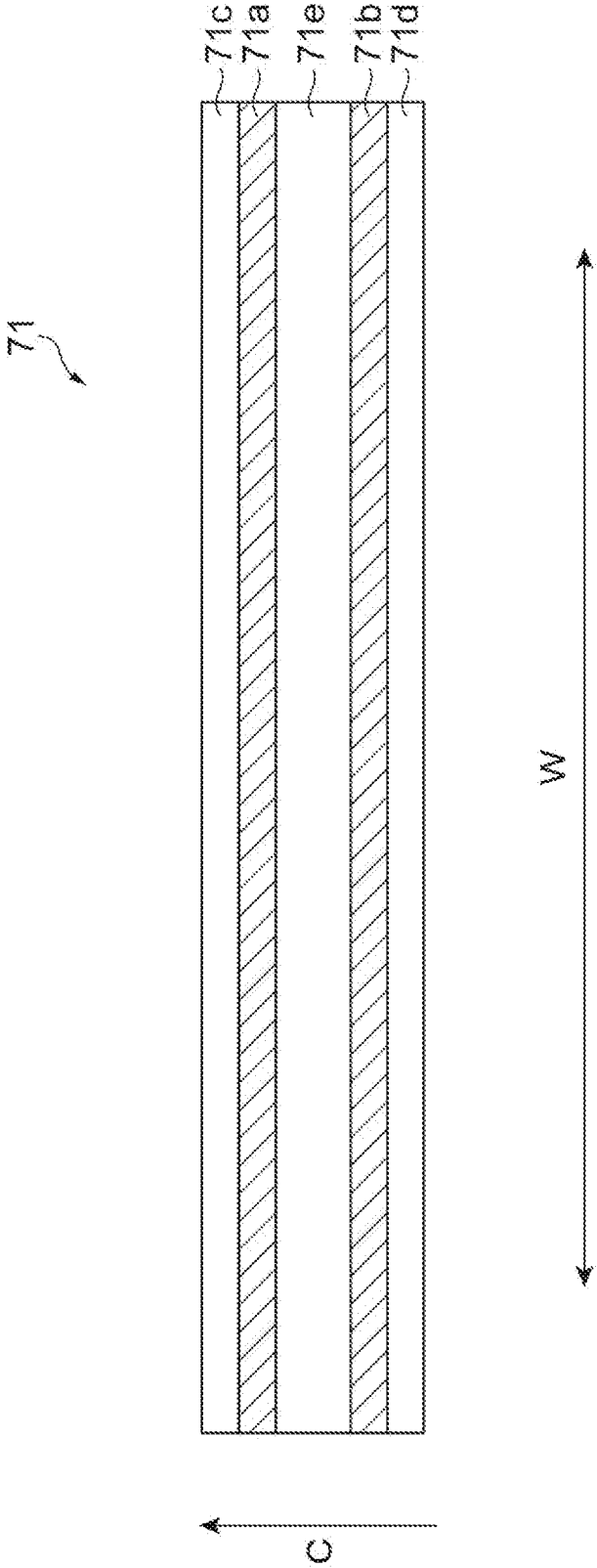


Fig.6

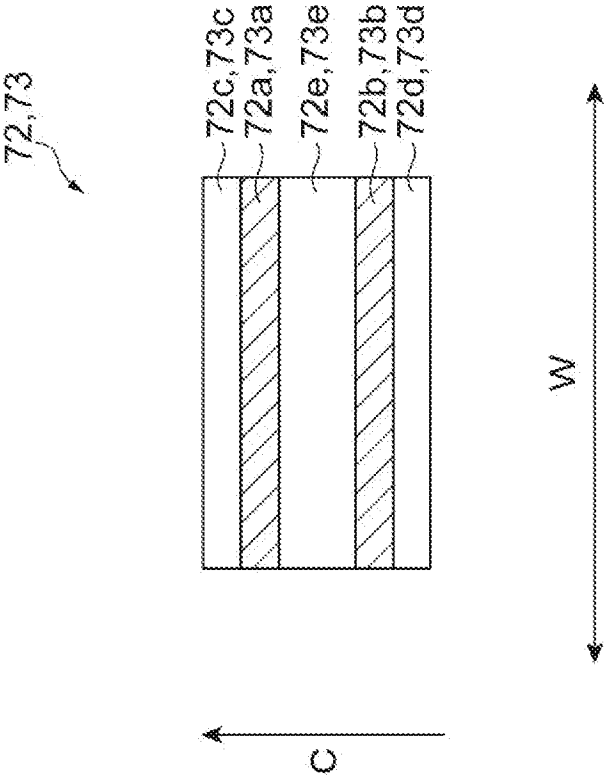


Fig.7

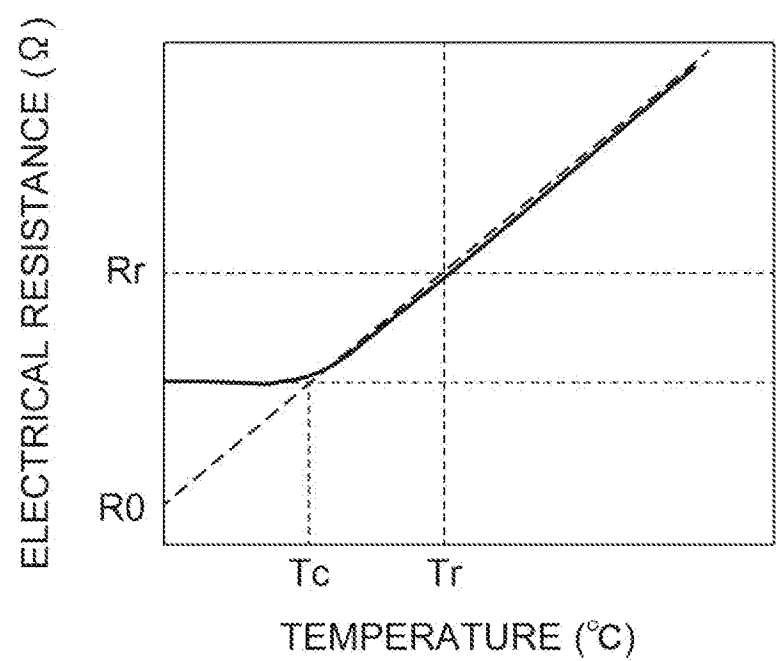


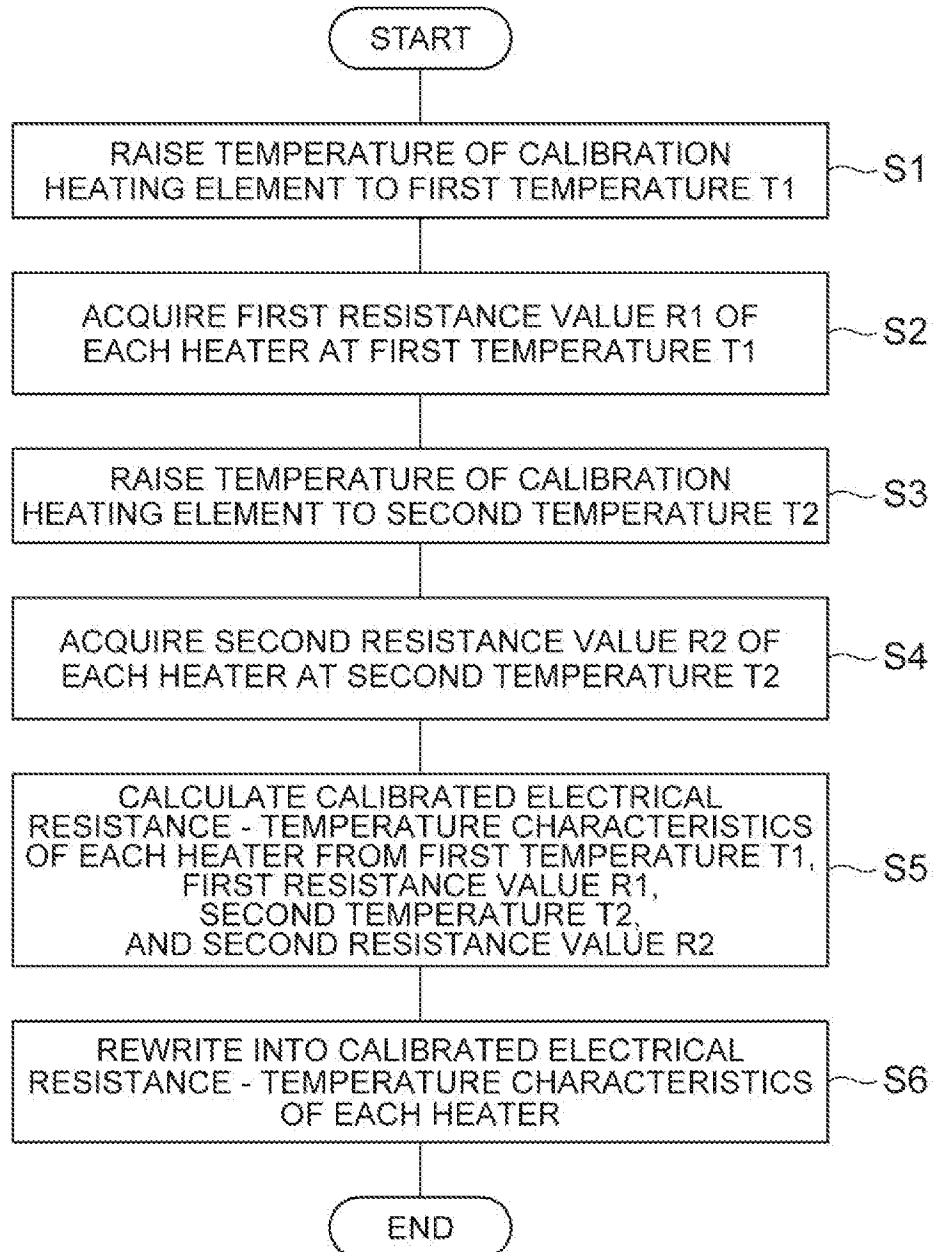
Fig.8

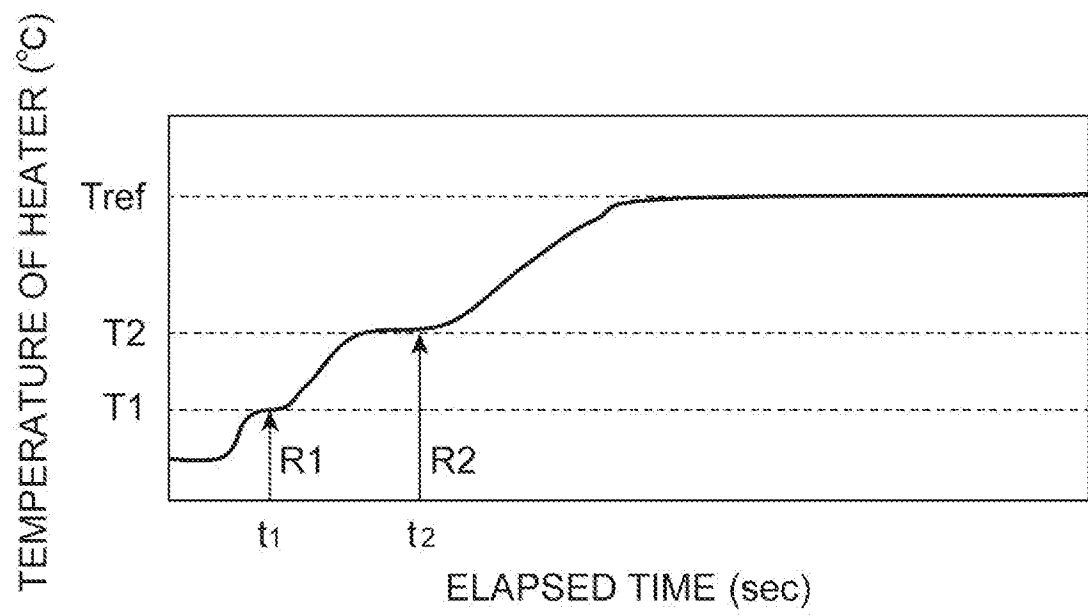
Fig.9

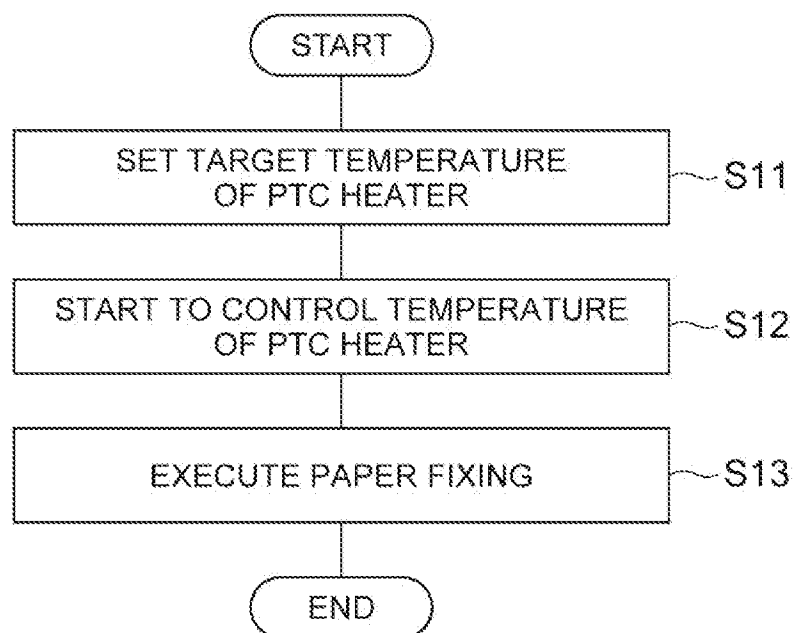
Fig.10

Fig.11

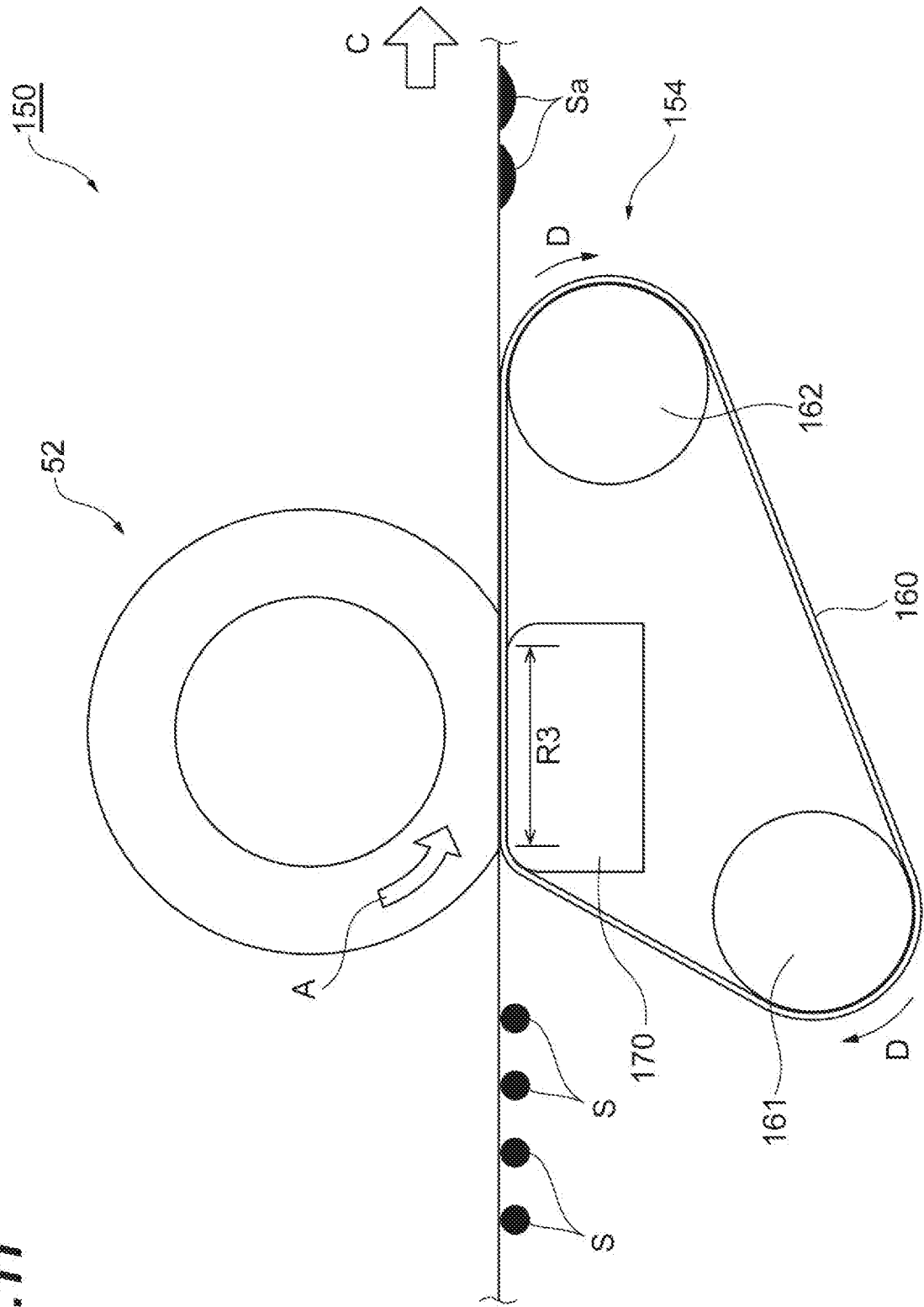


Fig. 12

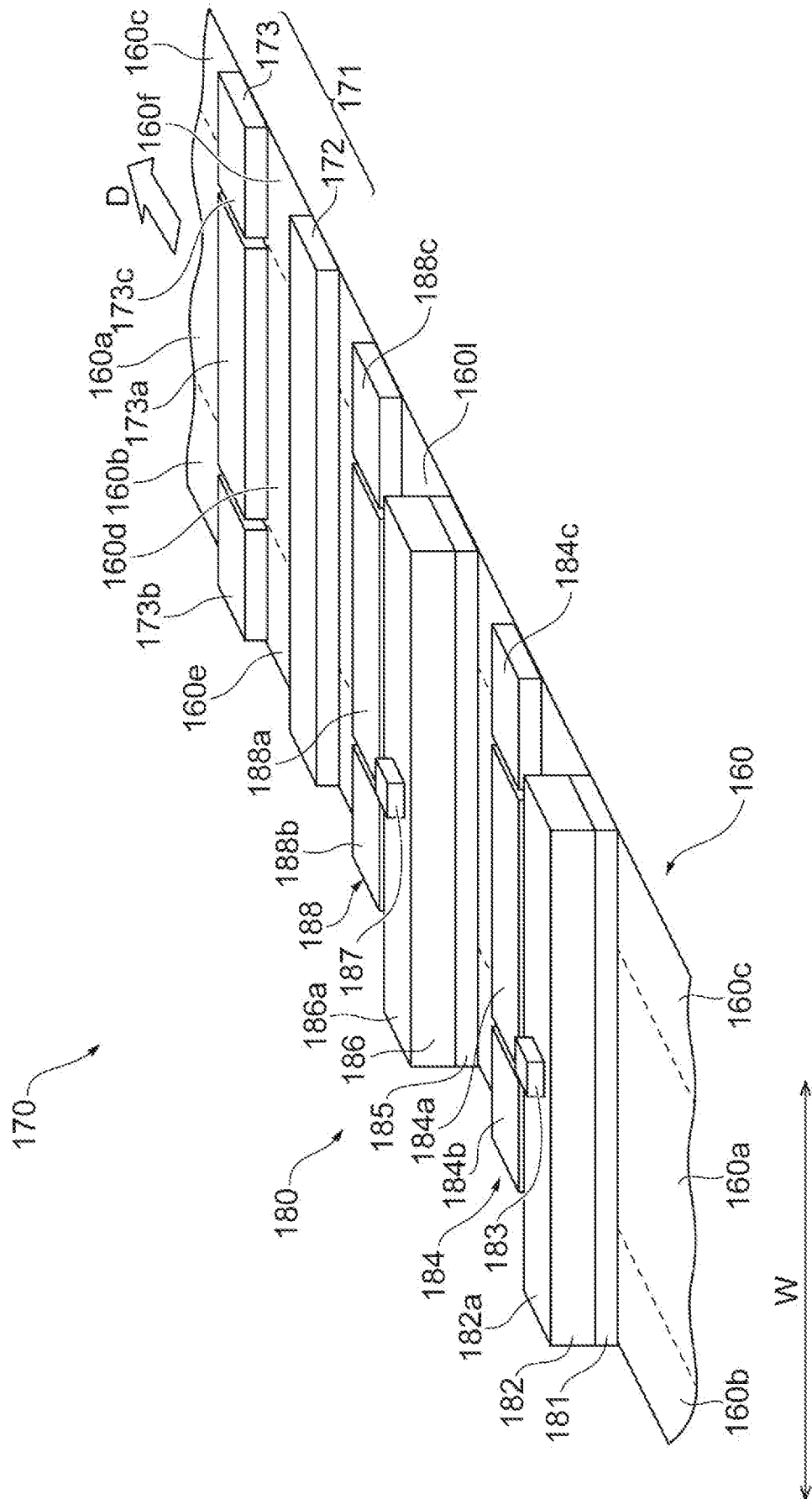


Fig.13

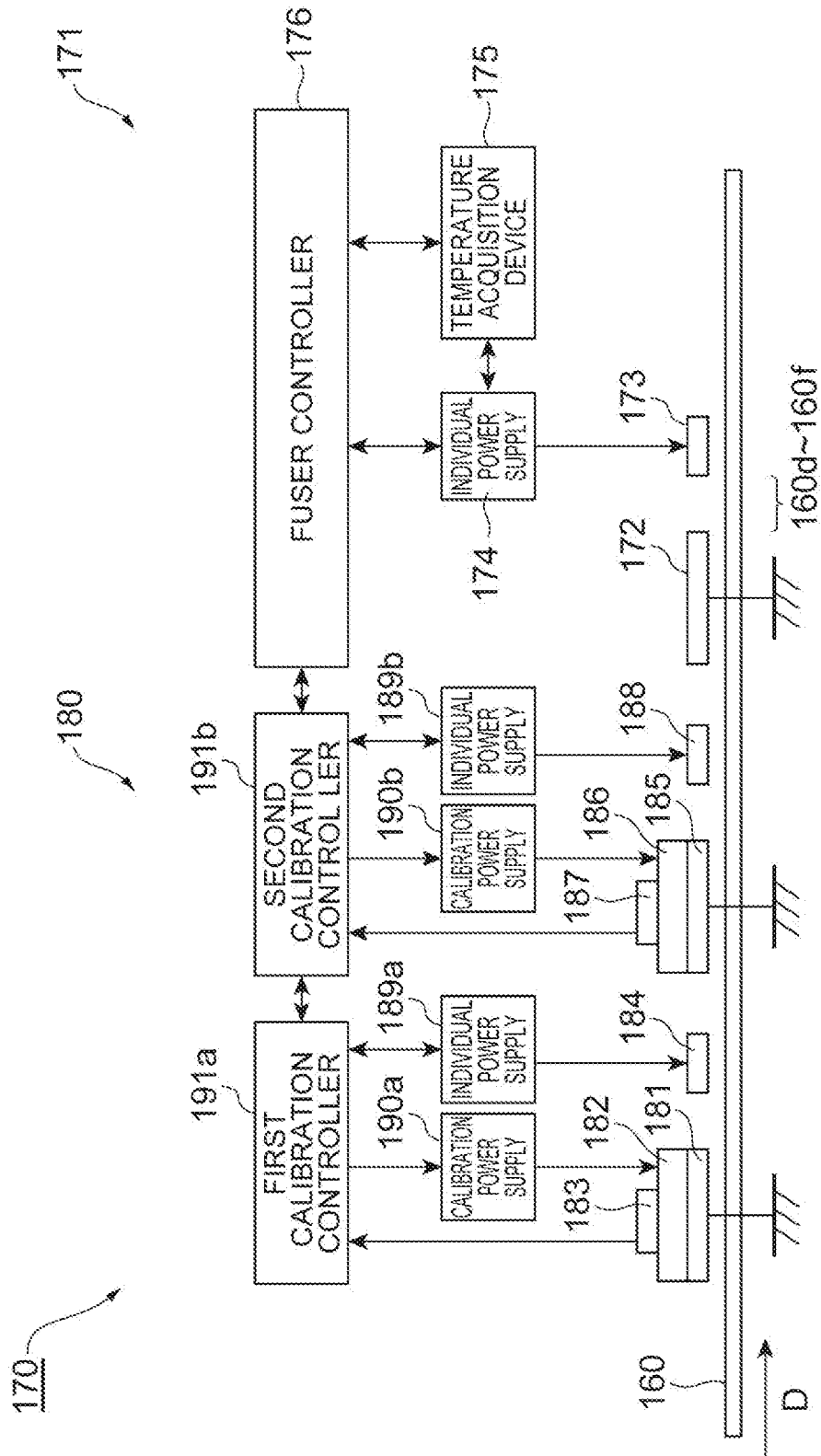
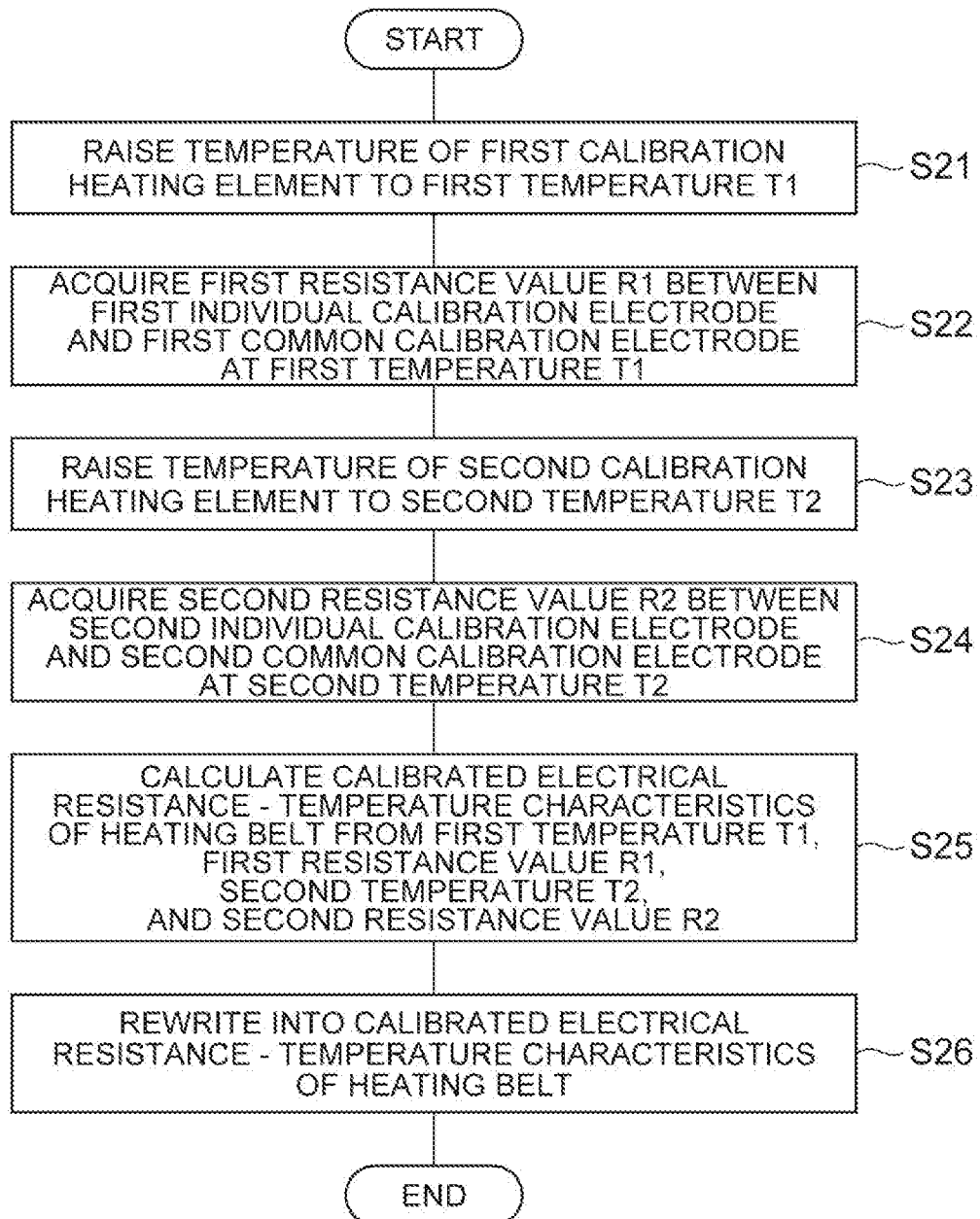


Fig.14

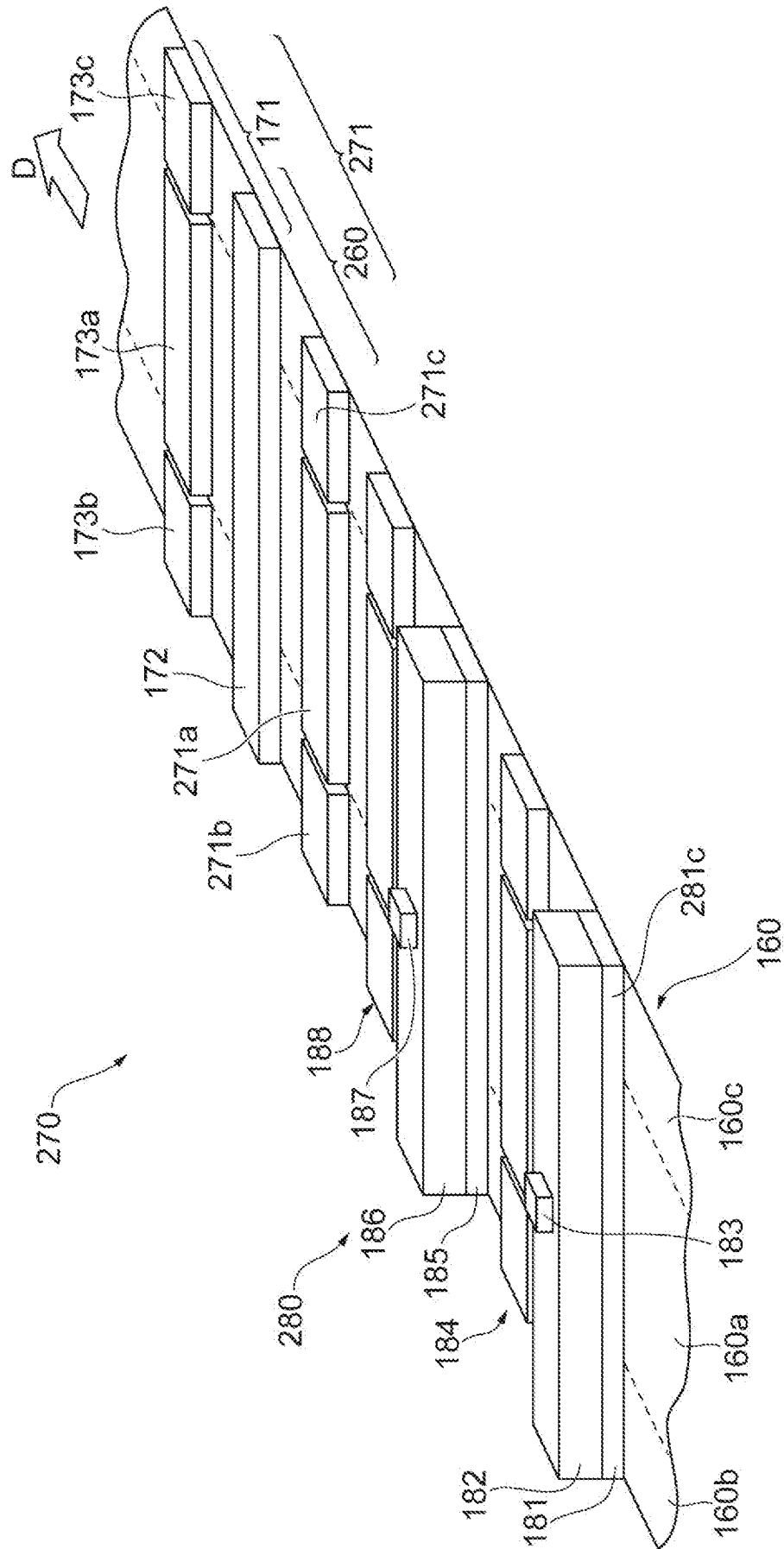


Fig. 15

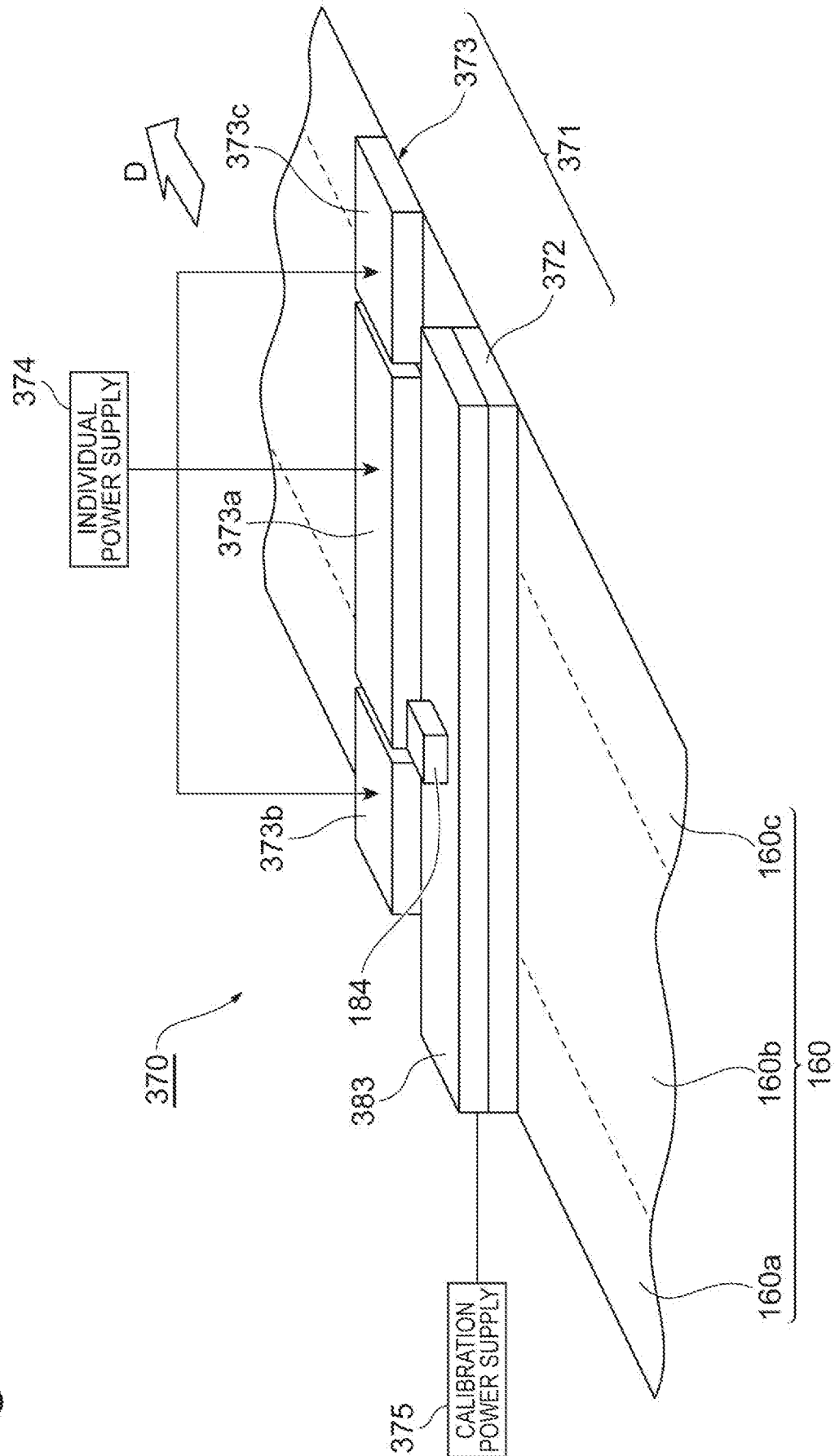


Fig. 16

Fig.17

	TEMPERATURE OF FUSING BELT BETWEEN ELECTRODES	CALIBRATION THERMOMETER	CALIBRATION POWER SUPPLY (APPLIED V)	INDIVIDUAL POWER SUPPLY (APPLIED V)	INDIVIDUAL POWER SUPPLY (MEASUREMENT I)
FIRST ROUND	FIRST TEMPERATURE T1 (CALIBRATION)	FIRST TEMPERATURE T1	TEMPERATURE RISING VOLTAGE V1	CALIBRATION VOLTAGE V	CALIBRATION CURRENT 1n
SECOND ROUND	SECOND TEMPERATURE T2 (CALIBRATION)	SECOND TEMPERATURE T2	TEMPERATURE RISING VOLTAGE V2	CALIBRATION VOLTAGE V	CALIBRATION CURRENT 2n
THIRD ROUND	FUSING TEMPERATURE T3	-	-	FUSING VOLTAGE Vn	FUSING CURRENT 3n

Fig. 18

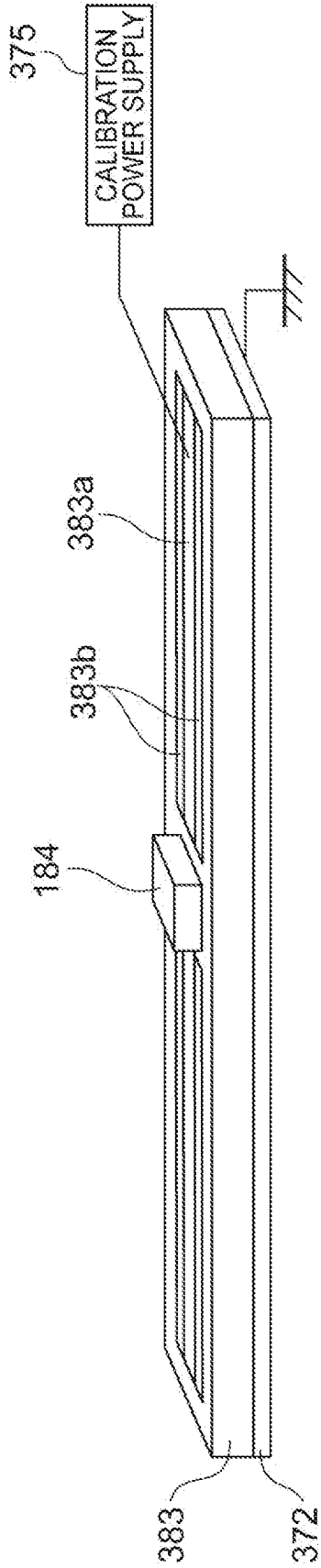


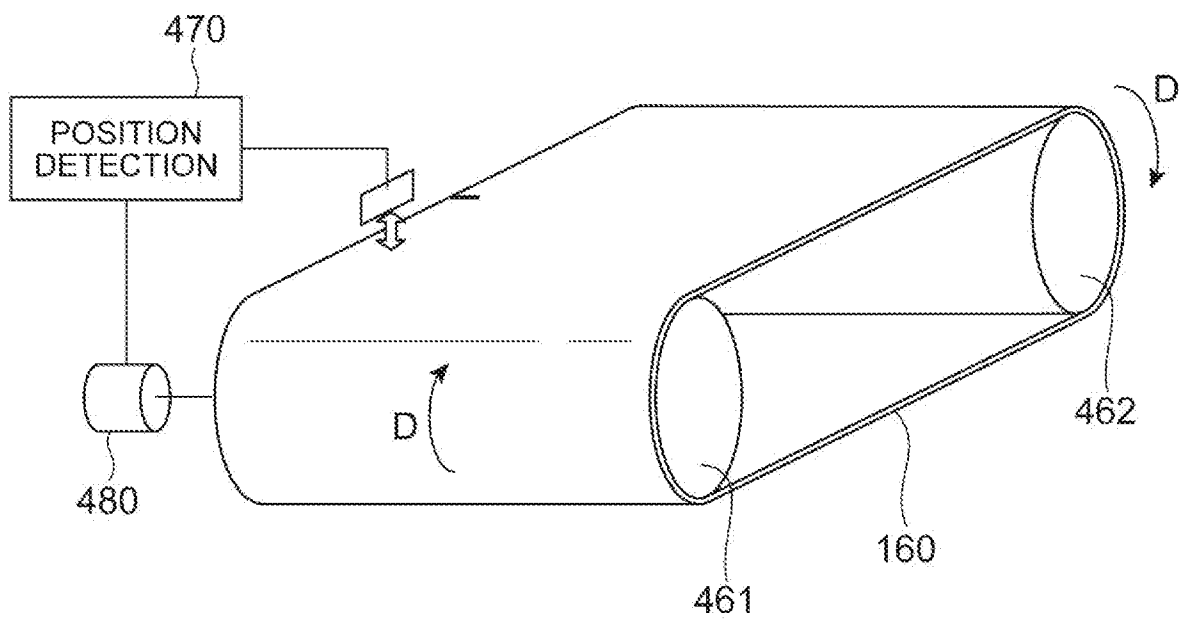
Fig.19

Fig.20

ABSOLUTE POSITION	X1	X2	Xnx
Y1	(R0-11, α -11)	(R0-21, α -21)	(R0-nx1, α -nx1)
Y2	(R0-12, α -12)	(R0-22, α -22)	(R0-nx2, α -nx2)
Yny	(R0-1ny, α -1ny)	(R0-2ny, α -2ny)	(R0-nxny, α -nxny)

Fig.21

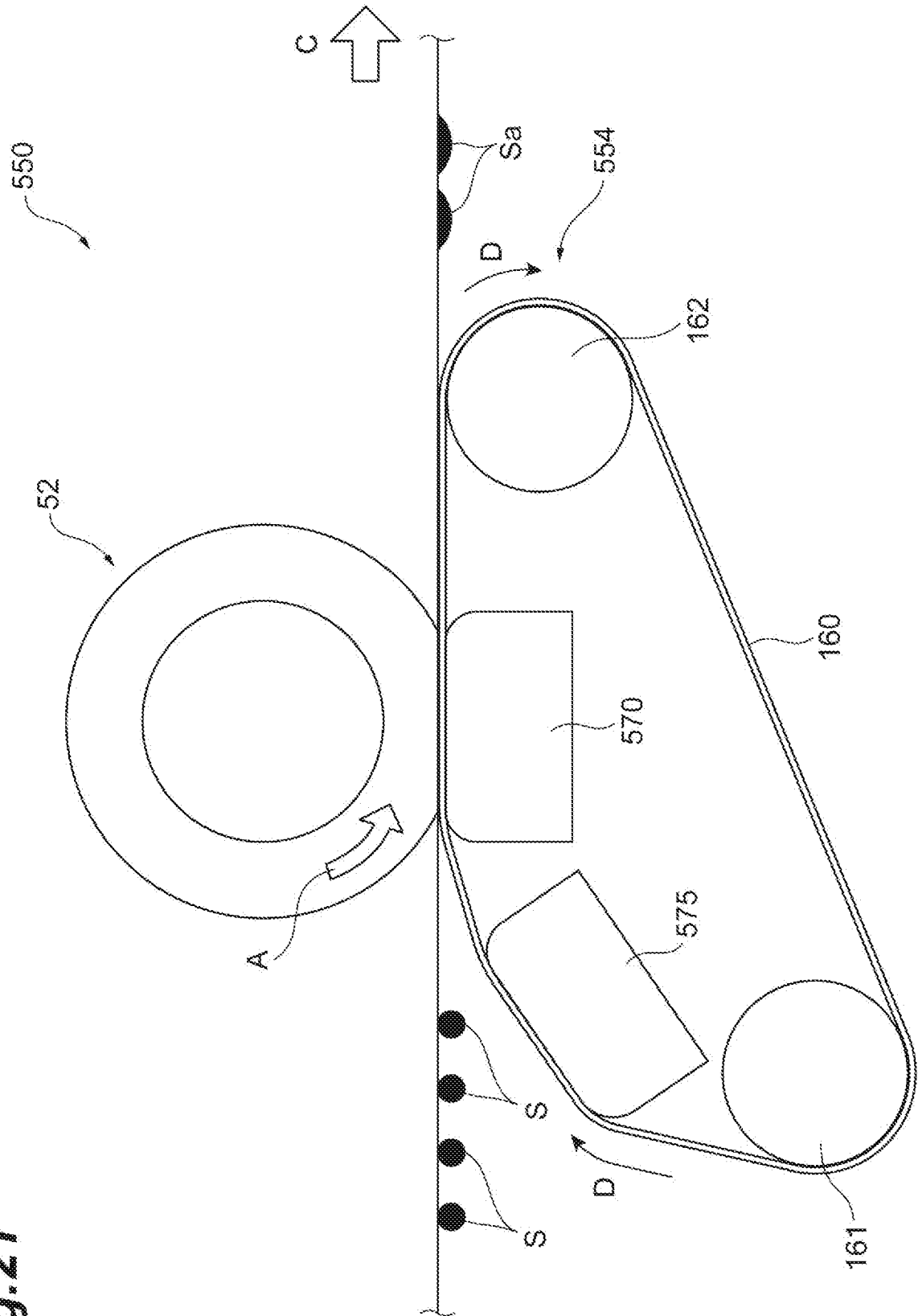
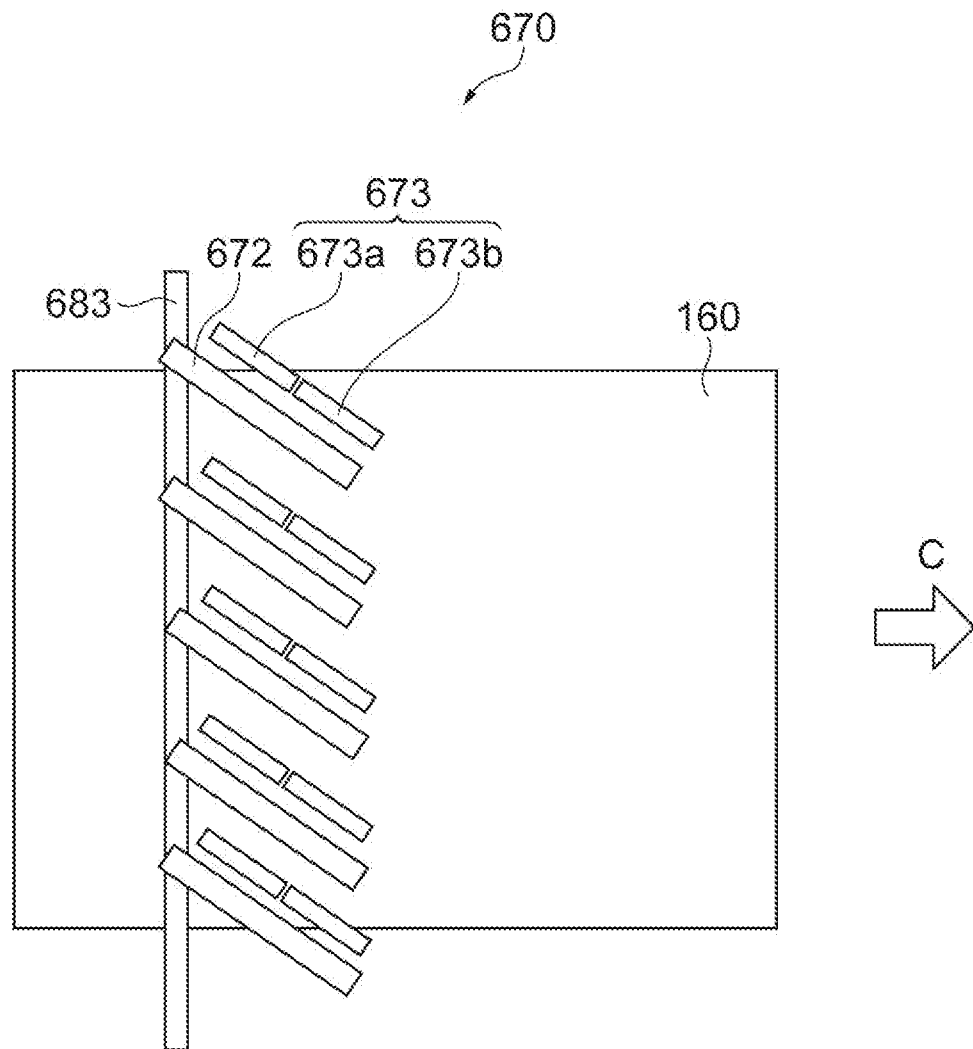


Fig.22



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2020/046606

A. CLASSIFICATION OF SUBJECT MATTER
B41M 7/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B41M 7/00, G03G 15/00, 15/20, 21/00, 21/20, B41J 29/00, 29/393

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSearch (RUPTO Internal), USPTO, PAJ, Espacenet, Information Retrieval System of FIPS, DEPATISnet, WIPO, EAPO

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6188854 B1 (COLEMAN TOMMY C, et al.) 13.02.2001, column 2 lines 5-41, column 4 lines 15-36, fig.1	1-15
A	US 5497218 A (XEROX CORP) 05.03.1996, abstract	1-15
A	EP 871088 A1 (XEROX CORP) 14.10.1998, abstract	1-15
A	WO 2019/216918 A1 (HEWLETT PACKARD DEVELOPMENT CO) 14.11.2019, abstract	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

01 March 2021 (01.03.2021)

Date of mailing of the international search report

11 March 2021 (11.03.2021)

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