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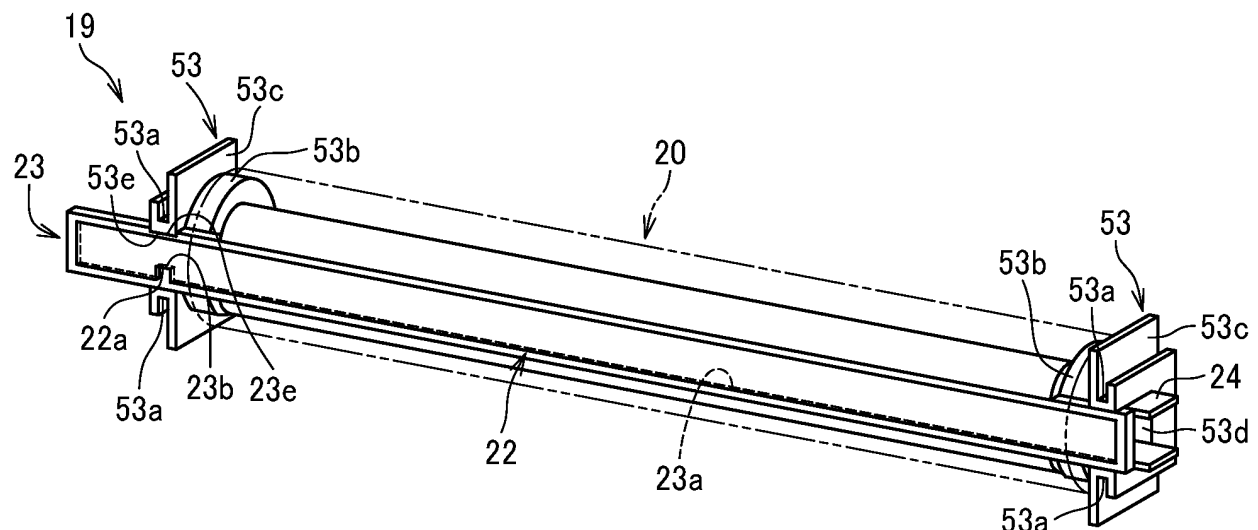
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(54) HEATING DEVICE, FIXING DEVICE, AND IMAGE FORMING APPARATUS

(57) A heating device (19) includes a subassembly (201) including a heater (22) and a heater holder (23) and a connector (40) having a U-shape in a cross section. The heater (22) includes a plate extending in a longitudinal direction. The heater holder includes a holding portion (23b) holding the heater (22) and a heater restrictor (23d) disposed at one end of the holding portion (23b) in a short-side direction orthogonal to the longitudinal direc-

tion to restrict a movement of the heater (22) in the short-side direction. The subassembly (201) is inserted into the connector (40) in the short-side direction, and the connector (40) sandwiches one end of the subassembly (201) in the longitudinal direction to supply power to the heater (22). The connector (40) has a taper (40b) on a tip (40a) of the connector (40) in the short-side direction.

FIG. 10A**EP 4 579 359 A1**

Description

BACKGROUND

Technical Field

[0001] The present disclosure relates to a heating device, a fixing device, and an image forming apparatus.

Related Art

[0002] A fixing device used in an image forming apparatus such as a copier and a printer is known in the art. One type of the fixing device includes a fixing belt that is a rotatable tube-shaped member and a heater having an elongated plate shape on which the inner circumferential surface of the fixing belt slides. The heater is held by a heater holder, and the heater holder is supported by a stay.

[0003] The heater, the heater holder, and the stay are assembled to form a subassembly. A pair of end holders hold both ends of the subassembly correctly assembled. Each of the end holders has a U-shaped opening to receive each of both ends of the subassembly. The end holder known in the art includes a bridging portion bridging both ends of the U-shaped opening to reinforce the end holder (Patent Document 1: Japanese Patent No. 5924915). The end holder has guide grooves. The fixing device includes a right side plate and a left side plate. Each of the right side plate and the left side plate has an insertion slot. Engaging edges of the insertion slot with the grooves assembles the end holder to the right side plate or the left side plate in the fixing device.

[0004] The heater holder has a fitting groove for fitting the heater. Although there is no problem if the subassembly is correctly assembled, correctly assembling the subassembly is not easy.

[0005] Since the heater has an elongated plate shape that is thin and easily bent, it is not easy to correctly fit the heater into the fitting groove of the heater holder. Even if the heater is correctly fitted into the fitting groove of the heater holder, setting the fixing belt on the heater may unexpectedly disengage the heater from the fitting groove, and this fitting failure cannot be visually confirmed in many cases.

[0006] Checking whether the subassembly is correctly assembled is difficult as described above. The subassembly including the heater that is not correctly in the fitting groove and has a part outside the fitting groove is likely to be assembled to the fixing device. In such a case, the pressing force of the pressure roller may concentrate on a part of the heater to cause cracking of the heater, or a fixing failure may occur due to a heat conduction failure of the heater with respect to the fixing belt during printing, or the heater may crack due to thermal stress.

SUMMARY

[0007] In order to solve the problems described above, an object of the present disclosure is to provide a heating device in which the heater, the heater holder, and the stay can be easily and correctly assembled. In order to achieve this object, there is provided a heating device according to claim 1. Advantageous embodiments are defined by the dependent claims.

[0008] The present disclosure described herein provides a heating device including a subassembly and a connector. The subassembly includes a heater and a heater holder. The heater includes a plate extending in a longitudinal direction. The heater holder includes a holding portion and a heater restrictor. The holding portion holds the heater. The heater restrictor is disposed at one end of the holding portion in a short-side direction orthogonal to the longitudinal direction to restrict a movement of the heater in the short-side direction.

[0009] The connector has a U-shape in a cross section of the connector. The subassembly is inserted into the connector in the short-side direction, and the connector sandwiches one end of the subassembly in the longitudinal direction to supply power to the heater. The connector has a taper on a tip of the connector in the short-side direction.

[0010] According to one aspect of the present disclosure, the heater, the heater holder, and the stay can be easily and correctly assembled.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] A more complete appreciation of embodiments of the present disclosure and many of the attendant advantages and features thereof can be readily obtained and understood from the following detailed description with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic diagram of a configuration of an image forming apparatus;

FIG. 2 is a schematic diagram of a configuration of a fixing device;

FIG. 3 is a perspective view of a heater according to a first example set on a heater holder;

FIG. 4 is a plan view of the heater of FIG. 3;

FIG. 5 is a diagram of a power supply circuit to supply power to the heater of FIG. 3;

FIG. 6 is a flowchart of a control operation of the heater of FIG. 3;

FIG. 7 is a plan view of a heater according to a second example;

FIG. 8 is a perspective view of a connector as a power supply component connected to a heater;

FIG. 9A is a perspective view of a fixing device;

FIG. 9B is an exploded perspective view of the fixing device of FIG. 9A;

FIG. 10A is a perspective view of a heating device;

FIG. 10B is an exploded perspective view of the

heating device of FIG. 10A;

FIG. 11A is a perspective view of one end of a heater holder, one end of a stay, and an end holder;

FIG. 11B is cross-sectional views of the heater holder, illustrating a cross section A taken along a line A in FIG. 11A, a cross section B taken along a line B in FIG. 11A, and a cross section C taken along a line C in FIG. 11A;

FIGS. 11C and 11D are diagrams illustrating problems regarding the end holder of FIG. 11A;

FIG. 11E is a cross-sectional view of the end holder of FIG. 11A;

FIG. 11F is a cross-sectional view of an end holder including a bridging portion;

FIGS. 12A to 12D are diagrams each illustrating the fixing device of FIG. 2 in which the heater, the heater holder, and the stay are in a correctly assembled state;

FIGS. 12E to 12G are diagrams each illustrating the fixing device of FIG. 2 in which the heater, the heater holder, and the stay are not in a correctly assembled state;

FIGS. 13A to 13C are diagrams illustrating the function of an end holder of the fixing device of FIG. 2;

FIG. 14A is a diagram illustrating a spring biasing a temperature detector and pushing up the back side of the heater of FIG. 10A;

FIG. 14B is a diagram illustrating a fixing belt set to the subassembly of the heater holder, the stay, and the heater pushed up by the temperature detector as illustrated in FIG. 14A;

FIG. 14C is a diagram illustrating end holders each having a taper and the subassembly of the heater holder, the stay, and the heater pushed up by the temperature detector as illustrated in FIG. 14A;

FIGS. 15A to 15D are diagrams illustrating the operation of the taper formed on the bridging portion of the end holder of FIG. 14C;

FIG. 16A is a diagram illustrating a connector set to a subassembly including a heater correctly assembled to a heater holder;

FIG. 16B is a diagram illustrating the connector of FIG. 16A set to the subassembly including the heater not correctly assembled to the heater holder;

FIG. 16C is a diagram illustrating a connector with a taper that starts to be set to the subassembly including the heater not correctly assembled to the heater holder;

FIG. 16D is a diagram illustrating the connector with the taper of FIG. 16C set to the subassembly;

FIG. 16E is a diagram illustrating a heater that is not correctly assembled to the heater holder in a short-side direction;

FIG. 16F is a diagram illustrating the heater of FIG. 16E that interferes with the end holder;

FIG. 16G is a diagram illustrating the end holder of FIG. 16F after the positional deviation of the heater of FIG. 16E is corrected and the subassembly including

the heater is inserted into the end holder;

FIG. 16H is a diagram illustrating a heater holder having tapers on both sides of a recess and the heater of FIG. 16E;

FIG. 17 is a schematic sectional view of a fixing device to illustrate a modification regarding the position of a thermistor;

FIG. 18 is a schematic sectional view of a fixing device different from the above fixing devices;

FIG. 19 is a schematic sectional view of a fixing device different from the above fixing devices;

FIG. 20 is a schematic sectional view of a fixing device different from the above fixing devices;

FIG. 21 is a schematic diagram illustrating a configuration of an image forming apparatus different from the image forming apparatus of FIG. 1;

FIG. 22 is a schematic sectional view of a fixing device different from the above fixing devices;

FIG. 23 is a plan view of a heater according to a third example;

FIG. 24 is a perspective view of a part of a heater and a heater holder;

FIG. 25 is a perspective view of a connector to be attached to a heater;

FIG. 26 is a schematic diagram illustrating an arrangement of thermistors and thermostats;

FIG. 27 is a schematic diagram illustrating a groove of an end holder;

FIG. 28 is a diagram illustrating a configuration of a fixing device different from the above fixing devices;

FIG. 29 is a perspective view of a heater, a first high thermal conductor, second high thermal conductors, and a heater holder;

FIG. 30 is a plan view of a heater to illustrate an arrangement of the first high thermal conductor and the second high thermal conductors of FIG. 29;

FIG. 31 is a diagram illustrating another arrangement of the first high thermal conductors and the second high thermal conductors;

FIG. 32 is a plan view of the heater to illustrate other examples of arrangements of the second high thermal conductors;

FIG. 33 is a diagram illustrating a configuration of a fixing device different from the above fixing devices;

FIG. 34 is a diagram illustrating the atomic crystal structure of graphene; and

FIG. 35 is a diagram illustrating the atomic crystal structure of graphite.

[0012] The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted. Also, identical or similar reference numerals designate identical or similar components throughout the several views.

DETAILED DESCRIPTION

[0013] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that have a similar function, operate in a similar manner, and achieve a similar result.

[0014] Referring now to the drawings, embodiments of the present disclosure are described below. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0015] Embodiments are described below with reference to the drawings. In the drawings, like reference signs are allocated to elements having a similar function or shape and redundant descriptions thereof are omitted below.

[0016] The following describes a configuration of an image forming apparatus. FIG. 1 is a schematic diagram of the configuration of the image forming apparatus. An image forming apparatus 100 illustrated in FIG. 1 includes four image forming units 1Y, 1M, 1C, and 1Bk detachably attached to an image forming apparatus body.

[0017] The image forming units 1Y, 1M, 1C, and 1Bk have the same configuration except for containing different color developers, i.e., yellow (Y), magenta (M), cyan (C), and black (Bk) toners, respectively, corresponding to decomposed color separation components of full-color images. Specifically, each of the image forming units 1Y, 1M, 1C, and 1Bk includes a photoconductor 2 that is drum-shaped and serves as an image bearer, a charging device 3 to charge a surface of the photoconductor 2, a developing device 4 to supply toner as a developer to the surface of the photoconductor 2 to form a toner image, and a cleaner 5 to clean the surface of the photoconductor 2.

[0018] The image forming apparatus 100 further includes an exposure device 6, a sheet feeder 7, a transfer device 8, a fixing device 9, and a sheet ejection device 10. The exposure device 6 exposes the surface of each of the photoconductors 2 and forms an electrostatic latent image on the surface of each of the photoconductors 2. The sheet feeder 7 supplies a sheet P serving as a recording medium to the transfer device 8. The transfer device 8 transfers the toner image formed on each of the photoconductors 2 onto the sheet P. The fixing device 9 fixes the toner image transferred onto the sheet P thereon. The sheet ejection device 10 ejects the sheet P to the outside of the image forming apparatus 100.

[0019] The transfer device 8 includes an intermediate transfer belt 11, four primary transfer rollers 12, and a secondary transfer roller 13. The intermediate transfer belt 11 is an endless belt serving as an intermediate transferor stretched taut across a plurality of rollers.

The four primary transfer rollers 12 serve as primary transferors that transfer yellow, magenta, cyan, and black toner images formed on the photoconductors 2 onto the intermediate transfer belt 11, respectively, thus forming a full-color toner image on the intermediate transfer belt 11.

The secondary transfer roller 13 serves as a secondary transferor that transfers the full-color toner image formed on the intermediate transfer belt 11 onto the sheet P. The four primary transfer rollers 12 are in contact with the respective photoconductors 2 via the intermediate transfer belt 11.

[0020] Thus, the intermediate transfer belt 11 contacts each of the photoconductors 2, forming a primary transfer nip therebetween. The secondary transfer roller 13 contacts, via the intermediate transfer belt 11, one of the plurality of rollers around which the intermediate transfer belt 11 is stretched. Thus, the secondary transfer nip is formed between the secondary transfer roller 13 and the intermediate transfer belt 11.

[0021] The image forming apparatus 100 includes a sheet conveyance path 14 through which the sheet P fed from the sheet feeder 7 is conveyed. A timing roller pair 15 is disposed at a position between the sheet feeder 7 and the secondary transfer nip defined by the secondary transfer roller 13 in the sheet conveyance path 14.

[0022] The following describes printing processes performed by the image forming apparatus 100 with reference to FIG. 1.

[0023] When the image forming apparatus 100 receives an instruction to start printing, a driver drives and rotates the photoconductor 2 clockwise in FIG. 1 in each of the image forming units 1Y, 1M, 1C, and 1Bk. The charging device 3 charges the surface of the photoconductor 2 uniformly at a high electric potential. Subsequently, the exposure device 6 exposes the surface of each of the photoconductors 2 based on image data created by a document reading device that reads an image on an original or print data instructed by a terminal, thus decreasing the electric potential of an exposed portion on the photoconductor 2 and forming an electrostatic latent image on the photoconductor 2. The developing device 4 supplies toner to the electrostatic latent image formed on the photoconductor 2, forming a toner image thereon.

[0024] The toner images formed on the photoconductors 2 reach the primary transfer nips defined by the primary transfer rollers 12 with the rotation of the photoconductors 2 and are transferred onto the intermediate transfer belt 11 driven and rotated counterclockwise in FIG. 1 successively such that the toner images are superimposed on the intermediate transfer belt 11, forming a full-color toner image thereon. The full-color toner image on the intermediate transfer belt 11 is conveyed to the secondary transfer nip defined by the secondary transfer roller 13 as the intermediate transfer belt 11 rotates. At the secondary transfer nip, the full-color toner image is transferred onto the sheet P conveyed to the secondary transfer nip.

[0025] The sheet P is supplied from the sheet feeder 7. The timing roller pair 15 temporarily halts the sheet P supplied from the sheet feeder 7. Then, the timing roller pair 15 conveys the sheet P to the secondary transfer nip at a time when the full color toner image formed on the intermediate transfer belt 11 reaches the secondary transfer nip.

[0026] Thus, the full-color toner image is transferred onto and borne on the sheet P. After the toner image is transferred from each of the photoconductors 2 onto the intermediate transfer belt 11, each of cleaning devices 5 removes residual toner on each of the photoconductors 2.

[0027] After the full color toner image is transferred onto the sheet P, the sheet P is conveyed to the fixing device 9 to fix the full color toner image onto the sheet P. Then, the sheet ejection device 10 ejects the sheet P onto the outside of the image forming apparatus 100, thus finishing a series of printing processes.

[0028] A description is given of the fixing device 9.

[0029] In the following description, the longitudinal direction of the heater is indicated by X as illustrated in FIG. 3. The longitudinal direction of the heater is along the surface of the base on which the resistive heat generators are provided.

[0030] The longitudinal direction of the heater is also in parallel with the rotational axis direction of the fixing belt or other parts in the fixing device or a direction in which the resistive heat generators are arranged that is referred to as an arrangement direction. The short-side direction of the heater (also referred to as the width direction of the heater) is orthogonal to the longitudinal direction and indicated by Y as illustrated in FIG. 3. The thickness direction of the heater (also referred to as a height direction) is orthogonal to the longitudinal direction and the short-side direction of the heater and is indicated by Z as illustrated in FIG. 3.

[0031] As illustrated in FIG. 2, the fixing device 9 according to the present embodiment includes an endless fixing belt 20, a pressure roller 21 as a pressure rotator that contacts an outer circumferential surface of the fixing belt 20 to form a fixing nip N, a heater 22 to heat the fixing belt 20, a heater holder 23 to hold the heater 22, a stay 24 as a support to support the heater holder 23, and thermistors 25 as temperature detectors to detect temperature of the fixing belt 20.

[0032] The fixing belt 20 includes a tubular base that is made of polyimide (PI) and has an outer diameter of 25 mm and a thickness in a range of 40 μm to 120 μm , for example. The fixing belt 20 further includes a release layer serving as an outermost surface layer. The release layer is made of fluororesin, such as tetrafluoroethylene-perfluoroalkylvinylether copolymer (PFA) or polytetrafluoroethylene (PTFE) and has a thickness in a range of from 5 to 50 μm to enhance the durability of the fixing belt 20 and facilitate separation of the sheet P and a foreign substance from the fixing belt 20.

[0033] An elastic layer made of rubber having a thick-

ness of from 50 to 500 μm may be interposed between the base layer and the release layer. The base of the fixing belt 20 may be made of heat-resistant resin such as polyetheretherketone (PEEK) or metal such as nickel (Ni) and steel use stainless (SUS), instead of polyimide. The inner circumferential surface of the fixing belt 20 may be coated with polyimide or PTFE as a slide layer.

[0034] The pressure roller 21 having, for example, an outer diameter of 25 mm, includes a solid iron core 21a, an elastic layer 21b formed on the surface of the core 21a, and a release layer 21c formed on the outside of the elastic layer 21b. The elastic layer 21b is made of silicone rubber and has a thickness of 3.5 mm, for example. Preferably, the release layer 21c is formed by a fluororesin layer having, for example, a thickness of approximately 40 μm on the surface of the elastic layer 21b to enhance releasability.

[0035] The pressure roller 21 is biased toward the fixing belt 20 by a biasing member and pressed against the heater 22 via the fixing belt 20. Thus, the fixing nip N is formed between the fixing belt 20 and the pressure roller 21. A driver drives and rotates the pressure roller 21 in a direction indicated by an arrow in FIG. 2, and the rotation of the pressure roller 21 rotates the fixing belt 20.

[0036] The heater 22 has a planar shape extending in the width direction of the fixing belt 20 and includes a planar base 30, resistive heat generators 31 disposed on the base 30, and an insulation layer 32 covering the resistive heat generators 31. In other words, the heater 22 includes a plate including the base 30, the resistive heat generators 31, and the insulation layer 32. The insulation layer 32 of the heater 22 contacts the inner circumferential surface of the fixing belt 20, and the heat generated by the resistive heat generators 31 is transmitted to the fixing belt 20 through the insulation layer 32.

[0037] Although the resistive heat generators 31 and the insulation layer 32 are disposed on the side of the base 30 facing the fixing belt 20 (that is, the fixing nip N) in the present embodiment, the resistive heat generators 31 and the insulation layer 32 may be disposed on the opposite side of the base 30, that is, the side facing the heater holder 23. In this case, since the heat of the resistive heat generator 31 is transmitted to the fixing belt 20 through the base 30, it is preferable that the base 30 be made of a material with high thermal conductivity such as aluminum nitride.

[0038] Making the base 30 with the material having high thermal conductivity enables the fixing belt 20 to be heated sufficiently even if the resistive heat generators 31 are disposed on the side of the base 30 opposite to the side facing the fixing belt 20. The heater 22 according to the present embodiment has various aspects that may be applied, which are described below.

[0039] A detailed description is now given of the construction of the heater holder 23 and the stay 24. The heater holder 23 and the stay 24 are disposed inside a loop formed by the fixing belt 20. The stay 24 is made of a metal channel member, and both side plates of the fixing

device 9 support both ends of the stay 24. Since the stay 24 supports the heater holder 23 and the heater 22 held by the heater holder 23, the heater 22 reliably receives a pressing force of the pressure roller 21 pressed against the fixing belt 20 and stably forms the fixing nip N.

[0040] Since the heater holder 23 is heated to a high temperature by heat from the heater 22, the heater holder 23 is preferably made of a heat resistant material. The heater holder 23 made of heat-resistant resin having low thermal conductivity, such as a liquid crystal polymer (LCP), reduces heat transfer from the heater 22 to the heater holder 23 and enables efficiently heating the fixing belt 20.

[0041] To reduce the contact area in which the heater holder 23 contacts the heater 22 and decrease the amount of heat transferred from the heater 22 to the heater holder 23, the heater holder 23 includes projections 23a in contact with the base 30 of the heater 22. The projection 23a of the heater holder 23 in the present embodiment contacts the back side of the base 30 not facing the resistive heat generator 31, which avoids contacting the projection 23a to a portion of the base 30 in which the temperature is likely to increase. Such a configuration further reduces the amount of heat transferred to the heater holder 23 and can effectively heat the fixing belt 20.

[0042] In addition, the heater holder 23 includes guides 26 to guide the fixing belt 20. The guides 26 include upstream guides upstream from the heater 22 (that is under the heater 22 in FIG. 2) and downstream guides downstream from the heater 22 (that is over the heater 22 in FIG. 2) in a rotation direction of the fixing belt 20.

[0043] As illustrated in FIG. 3, the upstream guides and the downstream guides of the guides 26 are disposed at intervals in the longitudinal direction of the heater 22 (in other words, in the width direction of the fixing belt 20). Each guide 26 is formed in a substantially fan shape and has an arc-shaped or convexly curved belt-facing surface 260 extending in a circumferential direction of the fixing belt 20 so as to face the inner circumferential surface of the fixing belt 20 (see FIG. 2). As illustrated in FIG. 3, a width β of each of the guides 26 arranged at both ends in the longitudinal direction of the heater 22 is larger than a width β of each of the other guides 26. Other than this, the guides 26 have the same length (the same circumferential length) L in the belt circumferential direction, the same width β , and the same height E.

[0044] When the fixing device 9 according to the present embodiment starts printing, the pressure roller 21 is driven to rotate, and the fixing belt 20 starts to be rotated. The belt-facing surface 260 of the guide 26 contacts and guides the inner circumferential surface of the fixing belt 20 to stably and smoothly rotate the fixing belt 20.

[0045] As power is supplied to the resistive heat generators 31 of the heater 22, the heater 22 heats the fixing belt 20. The sheet P bearing the unfixed toner image is conveyed through the fixing nip N between the fixing belt 20 having the temperature that has reached a predeter-

mined target temperature (which is referred to as a fixing temperature) and the pressure roller 21 as illustrated in FIG. 2, and applying heat and pressure to the unfixed toner image fixes the unfixed toner image onto the sheet P.

[0046] The following describes the heater 22 according to a first example.

[0047] FIG. 4 is a plan view of the heater according to the first example. As illustrated in FIG. 4, the heater 22 according to the first example includes multiple resistive heat generators 31 disposed at intervals in the longitudinal direction (that is the width direction of the fixing belt). In other words, the multiple resistive heat generators 31 configure a heat generation portion 35 including portions arranged in the width direction of the fixing belt 20.

[0048] The resistive heat generators 31 are electrically coupled in parallel to a pair of electrodes 34 disposed on both ends of the base 30 in the longitudinal direction of the base 30 via power supply lines 33. The power supply line 33 is made of a conductor having a resistance value smaller than that of the resistive heat generator 31.

[0049] A gap between neighboring resistive heat generators 31 is preferably 0.2 mm or more, more preferably 0.4 mm or more from the viewpoint of maintaining the insulation between the neighboring resistive heat generators 31. In addition, the gap between the resistive heat generators 31 adjacent to each other is preferably 5 mm or less, more preferably 1 mm or less from the viewpoint of reducing temperature unevenness along the longitudinal direction because too large gap between the heat generators 31 adjacent to each other easily causes a temperature drop in the gap.

[0050] The resistive heat generator 31 is made of a material having a positive temperature coefficient (PTC) of resistance that is a characteristic that the resistance value increases (the heater output decreases) as the temperature T increases.

[0051] When the small sheets each having a width smaller than the entire width of the heat generation portion 35 pass through the fixing device 9, the temperature of a region of the resistive heat generator 31 corresponding to a region of the fixing belt 20 that is not in contact with the small sheet increases because the small sheet does not absorb heat of the fixing belt 20 in the region that is not in contact with the small sheet, in other words, the region outside a small sheet passing region of the fixing belt 20 on which the small sheet passes. Since a constant voltage is applied to the resistive heat generators 31, the increase in resistance values of the resistive heat generators 31 caused by the temperature increase in the regions outside the width of the small sheets relatively reduces outputs (heat generation amounts) of the resistive heat generators 31 in the regions, thus restraining an increase in temperature in the regions that are end portions of the fixing belt outside the small sheets.

[0052] Electrically coupling the multiple resistive heat generators 31 in parallel can prevent temperature rises in non-sheet passing regions while maintaining the print

speed. The heat generator that configures the heat generation portion 35 may not be the resistive heat generator having the PTC characteristic. The resistive heat generators in the heater 22 may be arranged in a plurality of rows arranged in the short-side direction.

[0053] The resistive heat generators 31 are produced, for example, as below. Silver-palladium (AgPd) and glass powder are mixed to make a paste. The paste is coated to the base 30 by screen printing. Thereafter, the base 30 is subject to firing. Then, the resistive heat generators 31 are produced. The resistive heat generators 31 each have a resistance value of 80 Ω at room temperature, in the present embodiment.

[0054] The material of the resistive heat generators 31 may contain a resistance material, such as silver alloy (AgPt) or ruthenium oxide (RuO_2), other than silver-palladium (AgPd). Silver (Ag) or silver palladium (AgPd) may be used as a material of the power supply lines 33 and the electrodes 34. Screen-printing such a material forms the power supply lines 33 and the electrodes 34.

[0055] The material of the base 30 is preferably a nonmetallic material having excellent thermal resistance and insulating properties, such as glass, mica, or ceramic such as alumina or aluminum nitride. The base 30 according to the present embodiment uses an aluminum base having a shorter-side width of 8 mm, a longitudinal width of 270 mm, and a thickness of 1.0 mm.

[0056] The base 30 may be made by layering the insulation material on conductive material such as metal.

[0057] Low-cost aluminum or stainless steel is favorable as the metal material of the base 30. To enhance the thermal uniformity of the heater 22 and image quality, the base 30 may be made of a material having high thermal conductivity, such as copper, graphite, or graphene.

[0058] The insulation layer 32 may be, for example, a heat-resistant glass layer having a thickness of 75 μm . The insulation layer 32 covers the resistive heat generators 31 and the power supply lines 33 to insulate and protect the resistive heat generators 31 and the power supply lines 33 and maintain sliding performance with the fixing belt 20.

[0059] FIG. 5 is a diagram of a power supply circuit to supply power to the heater according to the first example.

[0060] As illustrated in FIG. 5, an alternating-current (AC) power supply 400 is electrically connected to the electrodes 34 of the heater 22 to configure the power supply circuit in the first example that supplies power to the resistive heat generators 31. The power supply circuit includes a triac 401 that controls the amount of supplied power.

[0061] A controller 402 controls the amount of power supplied to the resistive heat generators 31 via the triac 401 based on temperatures detected by the thermistors 25 as temperature detectors. The controller 402 includes a microcomputer including, for example, a central processing unit (CPU), a read-only memory (ROM), a random-access memory (RAM), and an input and output (I/O) interface.

[0062] In the present embodiment, one of the pair of thermistors 25 as temperature detectors is disposed in the central region of the heater 22 in the longitudinal direction, which is in the smallest span within which sheets are conveyed, and the other one of the pair of thermistors 25 is disposed in one end portion of the heater 22 in the longitudinal direction. A thermostat 27 as a power cut-off device is disposed at one end of the heater 22 in the longitudinal direction and cuts off the power supply to the resistive heat generators 31 when the temperature of the resistive heat generator 31 becomes a predetermined temperature or higher. The thermistors 25 and the thermostat 27 are in contact with a back side of the base 30 (that is a side opposite to a side on which the resistive heat generators 31 are disposed) to detect the temperatures of the resistive heat generators 31.

[0063] The control operation of the heater according to the present embodiment is described below with reference to the flowchart of FIG. 6.

[0064] In step S1 in FIG. 6, to start the printing processes, the controller 402 controls the AC power supply 400 to start supplying power to each of the resistive heat generators 31 of the heater 22. As a result, each resistive heat generator 31 starts to generate heat, and the heat heats the fixing belt 20.

[0065] In step S2 in FIG. 6, the thermistor 25 disposed in the central region of the heater 22 in the longitudinal direction of the heater 22 (that is a central thermistor) detects a temperature T4 of the resistive heat generator 31 positioned in the central region of the heater 22. Based on the temperature T4 obtained from the central thermistor 25, the controller 402 controls the amount of power supplied to each resistive heat generator 31 by the triac 401 so that the temperature of each resistive heat generator 31 reaches a predetermined temperature (step S3 in FIG. 6).

[0066] At the same time, in step S4 in FIG. 6, the thermistor 25 disposed on one end of the heater 22 in the longitudinal direction (that is an end thermistor) also detects a temperature T8 of the resistive heat generator 31. In step S5 in FIG. 6, the controller 402 determines whether the temperature T8 detected by the thermistor 25 at one end of the heater 22 is equal to or higher than a predetermined temperature T_N ($T_8 \geq T_N$). If the temperature T8 is lower than the predetermined temperature T_N , the controller 402 determines that the temperature is abnormally low due to breakage or disconnection and controls the power supply 400 to cut off the power supplied to the heater 22 (step S6 in FIG. 6). In addition, if the temperature T8 is lower than the predetermined temperature T_N , the controller 402 controls an operation panel of the image forming apparatus to display an error message (step S7 in FIG. 6). On the other hand, if the detected temperature T8 is equal to or higher than the predetermined temperature T_N , the controller 402 determines that the temperature is not abnormally low and starts the printing process (step S8 in FIG. 6).

[0067] Further, if breakage or disconnection of the

resistive heat generator 31 causes out-of-control in the temperature control based on the detection by the thermistor 25 at the central region, the other resistive heat generators 31 including the resistive heat generator 31 at one end in the longitudinal direction may have an abnormally high temperature. In this case, in response to reaching the temperature of the resistive heat generator 31 to a predetermined temperature or higher, the thermostat 27 operates to cut off the power supply to the resistive heat generator 31, thereby preventing the resistive heat generator 31 from reaching an abnormally high temperature.

[0068] The fixing device 9 according to the present embodiment includes the thin fixing belt 20, the thin fixing belt 20 has a small thermal capacity. As a result, the surface temperature of the fixing belt 20 is easily affected by the heat generation amount distribution of the heater 22. Since the fixing device 9 according to the present embodiment has the heat generation portion 35 including portions arranged in the width direction of the fixing belt 20, the temperature of the fixing belt 20 tends to be low at a position corresponding to a gap between the portions of the heat generation portion 35.

[0069] The following describes the heater 22 according to a second example with reference to FIG. 7.

[0070] Differences from the above-described first example are described below, and descriptions of other parts similar to the above-described first example are omitted below as appropriate. The heater according to the second example may be referred to as a series type heater for convenience in the present specification.

[0071] FIG. 7 is a plan view of the heater according to the second example. As illustrated in FIG. 7, the heater 22 according to the second example includes a base 55 having a planar shape extending in a direction indicated by an arrow X in FIG. 7. The base 55 is disposed so that a longitudinal direction X of the base 55 is in parallel with the longitudinal direction of the fixing belt 20 or the axial direction of the pressure roller 21. On the surface of the base 55, two resistive heat generators 56 extend in the longitudinal direction X of the base 55 and are arranged side by side in a short-side direction Y of the base 55.

[0072] As illustrated in FIG. 7, a pair of electrodes 58 are disposed on one end of the base 55 in the longitudinal direction X. The pair of electrodes 58 are coupled to ends of the two resistive heat generators 56 via a pair of power supply lines 59. The other ends of the resistive heat generators 56, which are not coupled to the pair of electrodes 58, are coupled to each other via another power supply line 59.

[0073] An insulation layer 57 covers the resistive heat generators 56 and power supply lines 59 to insulate the resistive heat generators 56 and power supply lines 59 from other parts.

On the other hand, electrodes 58 are not covered with the insulation layer 57 and are exposed so that a connector as a power supply terminal to be described later can be coupled.

[0074] The base 55 is made of a material having excellent heat resistance and insulating properties, such as polyimide, glass, mica, or ceramic such as alumina or aluminum nitride. Alternatively, the base 55 may include a metal plate made of metal (that is a conductive material) such as steel use stainless (SUS), iron, or aluminum and an insulation layer formed on the metal plate.

[0075] In particular, the base 55 made of a high thermal conductive material such as aluminum, copper, silver, graphite, or graphene enhances the thermal uniformity of the heater 22 and image quality.

[0076] The insulation layer 57 is made of a material having excellent heat resistance and insulating properties, such as polyimide, glass, mica, or ceramic such as alumina or aluminum nitride.

[0077] The resistive heat generator 56 is, for example, produced as below. Silver-palladium (AgPd) and glass powder are mixed to make a paste. The paste is screen-printed on the surface of the base 55. Thereafter, the base 55 is subject to firing. Thus, the resistive heat generator 56 is produced. The material of the resistive heat generator 56 may contain a resistance material, such as silver alloy (e.g., AgPt) or ruthenium oxide (RuO₂). The electrodes 58 and the power supply lines 59 are formed by screen-printing silver (Ag) or silver-palladium (AgPd).

[0078] FIG. 8 is a perspective view of a connector 40 as a power supply member coupled to the heater 22. As illustrated in FIG. 8, the connector 40 includes a housing 41 made of resin and having a U-shape in a cross section, multiple contact terminals 42 disposed in the housing 41, and a harness 43 including wires each coupled to each contact terminal 42 to supply power. Each contact terminal 42 is configured by an elastically deformable member such as a flat spring.

[0079] As illustrated in FIG. 8, the connector 40 is attached to the heater 22 and the heater holder 23 such that the connector 40 sandwiches the heater 22 and the heater holder 23 together. Thus, the connector 40 holds the heater 22 and the heater holder 23 together.

[0080] In the above-described state, contact portions 42a disposed at ends of the contact terminals 42 in the connector 40 elastically contact and press against the electrodes 58 corresponding to the contact terminals 42 to electrically couple to the electrodes 58 and contact terminals 42, respectively. As a result, power can be supplied from a power supply disposed in the image forming apparatus to the heater 22 (that is, the resistive heat generators 56) via the connector 40.

[0081] The following describes a device frame 80 of the fixing device 9.

[0082] FIG. 9A is a perspective view of the fixing device 9, and FIG. 9B is an exploded perspective view of the fixing device 9. As illustrated in FIGS. 9A and 9B, the fixing device 9 includes the device frame 80 that includes a first device frame 65 and a second device frame 66. The first device frame 65 includes a pair of side walls 68 and a front wall 67. The second device frame 66 includes a rear

wall 69. The side walls 68 are disposed at one lateral end and another lateral end of the fixing belt 20, respectively, in the width direction of the fixing belt 20. The side walls 68 support both lateral ends of each of the pressure roller 21 and a heating device 19, respectively.

[0083] Each of the side walls 68 includes a plurality of engaging projections 68a. As the engaging projections 68a engage engaging holes 69a penetrating through the rear wall 69, the first device frame 65 is coupled to the second device frame 66. Each of the side walls 68 includes an insertion slot 68b through which a rotation shaft of the pressure roller 21 is inserted. The insertion slot 68b opens toward the rear wall 69 and closes at a portion opposite the rear wall 69, and the portion of the insertion slot 68b opposite the rear wall 69 serves as a contact portion.

[0084] A pair of bearings 70 are disposed at the ends of the contact portions to support the rotation shaft of the pressure roller 21. As both sides of the rotation shaft of the pressure roller 21 are attached to the corresponding bearings 70, the side walls 68 rotatably support the pressure roller 21.

[0085] A driving force transmission gear 71 serving as a driving force transmitter is disposed at one end of the rotation shaft of the pressure roller 21 in an axial direction thereof. When the side walls 68 support the pressure roller 21, the driving force transmission gear 71 is exposed outside the side wall 68. Accordingly, when the fixing device 9 is installed in the body of the image forming apparatus 100, the driving force transmission gear 71 is coupled to a gear disposed inside the body of the image forming apparatus 100 so that the driving force transmission gear 71 transmits the driving force from the driver to the pressure roller 21.

[0086] The rear wall 69 has a hole 69b as a positioner to position the body of the fixing device with respect to the body of the image forming apparatus. The hole 69b is at one end of the rear wall 69 in the longitudinal direction of the rear wall 69. When the body of the fixing device 9 is installed in the body of the image forming apparatus 100, a projection 101 serving as a positioner disposed in the body of the image forming apparatus 100 is inserted into the hole 69b of the fixing device 9. Accordingly, the projection 101 engages the hole 69b, positioning the body of the fixing device 9 with respect to the body of the image forming apparatus 100 in the longitudinal direction of the fixing device 9, that is, the width direction or the rotation axis direction of the fixing belt 20.

[0087] A pair of end holders 53 is disposed at both ends of the heating device 19 in a longitudinal direction of the heating device 19 to support the fixing belt 20 and other parts. Each of the end holders 53 is a device frame of the heating device 19 and a part of the device frame 80 of the fixing device 9. The end holders 53 support the fixing belt 20 adopting a free belt method in which the fixing belt 20 is not applied with tension in a circumferential direction of the fixing belt 20 while the fixing belt 20 does not rotate. Each of the end holders 53 has guide grooves 53a. As the

edges of the insertion slot 68b of the side wall 68 enter the guide grooves 53a, the end holder 53 is attached to the side wall 68.

[0088] A pair of springs 73 serving as a pair of biasing members is interposed between each of the end holders 53 and the rear wall 69. As the springs 73 bias the end holders 53 toward the pressure roller 21, respectively, the fixing belt 20 is pressed against the pressure roller 21 to form the fixing nip N between the fixing belt 20 and the pressure roller 21.

[0089] The following describes the heating device.

[0090] FIG. 10A is a perspective view of the heating device 19. FIG. 10B is an exploded perspective view of the heating device 19. As illustrated in FIGS. 10A and 10B, the heater holder 23 has a rectangular recess 23b disposed on the belt-side face of the heater holder 23 that faces the fixing belt 20 and the fixing nip N. The recess 23b holds and accommodates the heater 22 and serves as a holding portion of the heater holder 23. The connector 40 as illustrated in FIG. 8 sandwiches the heater holder 23 and the heater 22 accommodated in the recess 23b, thus holding the heater 22.

[0091] As illustrated in FIGS. 10A, 10B, 11A and 11B, each of the pair of end holders 53 includes a belt support 53b, a belt restrictor 53c, and a stay support 53d. The belt support 53b is C-shaped and inserted into the loop formed by the fixing belt 20, thus contacting the inner circumferential surface of the fixing belt 20 to support the fixing belt 20. The belt restrictor 53c has a flange shape and contacts an edge face of the fixing belt 20 to restrict motion (e.g., slide) of the fixing belt 20 in the width direction of the fixing belt 20. The stay support 53d is inserted with a lateral end of each of the heater holder 23 and the stay 24 in the longitudinal direction thereof, thus supporting the heater holder 23 and the stay 24. The stay 24 has a staircase portion 24a that abuts against an inner end portion of the stay support 53d to position the stay 24 in the longitudinal direction.

[0092] The following describes problems regarding the end holder.

[0093] Japanese Unexamined Patent Application Publication No. 2020-052347 discloses an example of the fixing device. The fixing device of this document includes the heating device including a pair of frames adjacent to both ends of the fixing belt in the longitudinal direction (the rotation axis direction) of the fixing belt. Both ends of the frame of the heating device in the short-side direction of the heater are fitted to a frame of the fixing device to insert the heating device into the frame of the fixing device in the thickness direction of the heater.

[0094] The frame of the heating device is a device frame of the heating device and is also a part of the device frame of the fixing device. The pair of frames includes end holders. The end holder is inserted into the loop of the fixing belt to support the inner circumferential surface of the fixing belt.

[0095] The end holder 53 has guide grooves 53a. The guide groove 53a is formed by a guide groove forming

portion 53f and the belt restrictor 53c. The edges of the insertion slot of the frame are inserted into the guide grooves 53a to assemble the end holder 53 to the frame of the fixing device.

[0096] FIGS. 11C and 11D are diagrams illustrating the problems regarding the shape of the end holder 53. With reference to FIGS. 11C and 11D, the problems caused by the shape of the end holder 53 are described below.

[0097] The end holder 53 is often made of resin and often has a substantially C-shape (a substantially U-shape) when viewed from the rotation axis direction of the fixing belt (see the left drawing of FIG. 11C). In the above-described structure, contraction during molding or a pressing force received from the pressure roller may deform the end holder 53 so that the tips of the C-shape (the U-shape), in other words, edges of the opening of the C-shape (the U-shape) are closed (see the right drawing of FIG. 11C).

[0098] In the fixing device, the heater is positioned to the heater holder, the heater holder is positioned by the stay supporting the heater holder, the stay is positioned by the end holders 53, and the end holder 53 is positioned by the frame (see the left drawing of FIG. 11D). Due to the rotation of the pressure roller, the heater receives a force directed downstream in the rotation direction of the pressure roller. As a result, the end holder 53 is pushed against the downstream side of the frame in the rotation direction of the pressure roller.

[0099] If the end holder 53 is deformed, the pushed end holder 53 displaces the heater from a predetermined position (see the right drawing of FIG. 11D). The heater displaced from the predetermined position does not sufficiently transmit the heat to the fixing belt, which may cause a fixing failure. In addition, the temperature of a part of the heater displaced from the predetermined position may excessively rise, and such an excessive temperature rise generates thermal stress that may damage the heater.

[0100] With reference to FIGS. 11E and 11F, a bridging portion 53h disposed in the end holder 53 is described. To solve the above-described problem, the tips of the C-shape of the end holder 53 as illustrated in FIG. 11E are connected by the bridging portion 53h to form a substantially square shape as illustrated in FIG. 11F. As a result, the deformation of the end holder 53 can be prevented.

[0101] The bridging portion 53h increases the rigidity of the end holder 53, and the end holder 53 is hardly deformed. As a result, the bridging portion 53h prevents the positional deviation of the heater 22 and enables maintaining a predetermined contact state or heat transfer state with the fixing belt.

[0102] The bridging portion 53h is in direct or indirect contact with the end of the heater holder 23 and the end of the stay 24. The end of the heater 22 outside the heat generation portion 35 (see FIG. 4) is inside the opening formed by the bridging portion 53h.

[0103] FIGS. 12A to 12D are diagrams each illustrating the fixing device in which the heater 22, the heater holder

23, and the stay 24 are in a correctly assembled state. In FIGS. 12A to 12D, the fixing belt 20 is omitted. The "correctly assembled state" means that the heater 22, the heater holder 23, and the stay 24 are correctly assembled without being displaced from each other. As illustrated in FIG. 12D, a gap is formed between the heater 22 and the bridging portion 53h. In the correctly assembled state, since the heater 22 is correctly accommodated in the recess 23b of the heater holder 23, the pressure of the pressure roller 21 can be uniformly exerted in the longitudinal direction of the heater 22.

[0104] FIGS. 12D to 12F are diagrams each illustrating the fixing device in which the heater 22, the heater holder 23 and the stay 24 are not in the correctly assembled state. In FIGS. 12D to 12F, the fixing belt 20 is omitted. As illustrated in FIGS. 12D to 12F, since the end of the heater 22 is separated from the recess 23b of the heater holder 23, which is not in the correctly assembled state, the end of the heater 22 is subjected to bending stress due to the pressure of the pressure roller 21, and the heater 22 may be broken.

[0105] The following describes an end holder in the fixing device according to the present embodiment with reference to FIGS. 13A to 13C.

[0106] In FIG. 13A, the heater 22, the heater holder 23, the stay 24, and the end holder 53 have the following relation.

$$A < B < A + C.$$

where A is a height from the stay 24 to a heater restrictor 23c of the heater holder 23 in the correctly assembled state of the heater 22, the heater holder 23, and the stay 24, B is an opening length from the stay support 53d to the bridging portion 53h in the end holder 53, and C is a thickness of the heater 22. Setting the opening length B of the end holder 53 to satisfy the above relation, $A < B < A + C$, enables easily assembling the heater 22, the heater holder 23, and the stay 24 to the correctly assembled state.

[0107] When the heater 22 is not in the correctly assembled state with respect to the recess 23b of the heater holder 23, that is, when one end of the heater 22 separates from the bottom of the recess 23b and rides on the heater restrictor 23c of the heater holder 23 as illustrated in FIG. 13A, the one end of the heater 22 riding on the heater restrictor 23c of the heater holder 23 abuts on (interferes with) the bridging portion 53h as illustrated in FIG. 13B, and a worker cannot set the end holder 53 to the subassembly 201 of the heater 22, the heater holder 23, and the stay 24 even if the worker moves the end holder 53 in a direction indicated by a white arrow in FIG. 12B and tries to set the end holder 53 to the one end of the subassembly 201 in the longitudinal direction. As a result, the worker can reliably notice that the heater 22 is not in the correctly assembled state and can reinsert the heater 22 into the recess 23b of the heater holder 23.

[0108] In contrast, under a relation in which the open-

ing length B is larger than $A + C$, ($A + C < B$), the one end of the heater 22 in the longitudinal direction that rides on the heater restrictor 23c passes through the inside of the bridging portion 53h without difficulty as illustrated in FIGS. 12B and 12C. As a result, the worker is less likely to notice the heater 22 wrongly assembled and may assemble the heater 22 that is wrongly assembled to the fixing device.

[0109] The following describes how a biasing force to bias a temperature sensor such as a thermistor or a thermostat affects the displacement of the heater.

[0110] FIG. 14A is a diagram illustrating a spring 25a biasing a thermistor 25 as a temperature detector and pushing up the back side of the heater 22. The thermistor 25 is often disposed at a position shifted from the center of the heater 22 toward one end of the heater 22 in the longitudinal direction. When the spring 25a pushes the thermistor 25 at the position shifted from the center of the heater 22 in the longitudinal direction, one end of the heater 22 tends to separate from the recess 23b of the heater holder 23. The biasing force to bias a thermostat 27 as the temperature sensor similarly affects the displacement of the heater.

[0111] Moving the fixing belt 20 in a direction indicated by the arrow in FIG. 14B to set the fixing belt 20 to the subassembly 201 of the heater holder 23, the stay 24, and the heater 22 having the one end separated from the recess 23b may cause the fixing belt 20 to push and displace the heater 22 to the right side in FIG. 14B. As a result, the above-described one end of the heater 22 rides on the heater restrictor 23c of the heater holder 23. To prevent one end of the heater 22 from riding on the heater restrictor 23c, end holders 53 have tapers 53g1 and 53g2 formed on the inner sides of the bridging portions 53h as illustrated in FIG. 14C in addition to setting the above-described relation that is $A < B < A + C$.

[0112] Each of the tapers 53g1 and 53g2 is designed to have a length such that an end of the heater 22 riding on the heater restrictor 23c of the heater holder 23 reliably abuts against either the taper 53g1 or the taper 53g2. Since the thermistor 25 as the temperature sensor is disposed at the position shifted from the center of the heater 22 toward one end of the heater 22 in the longitudinal direction, the end holder 53 set to one end of the heater 22 is closer to the thermistor 25 than the end holder 53 set to the other end of the heater 22. Accordingly, the length of the taper 53g1 of the end holder 53 set to the one end of the heater 22 is preferably longer than the length of the taper 53g2 of the end holder 53 set to the other end of the heater 22.

[0113] The angle of each of the tapers 53g1 and 53g2 is, for example, 45° . In the following description, each of the tapers 53g1 and 53g2 is referred to as a taper 53g to describe common features of the tapers 53g1 and 53g2. The angle of the taper 53g may be greater or less than 45° but is preferably in a range from 30° to 60° . FIGS. 15A to 15D are diagrams illustrating the operation of the taper 53g.

[0114] With reference to FIGS. 15A to 15D, the operation of the taper 53g formed on the bridging portion 53h of the end holder is described below.

[0115] As illustrated in FIGS. 15A and 15B, moving the end holder 53 in a direction indicated by an arrow in FIG. 15A to assemble the end holder 53 to the subassembly 201 of the heater 22, the heater holder 23, and the stay 24 causes the taper 53g of the bridging portion 53h of the end holder 53 to contact the one end of the heater 22 riding on the heater restrictor 23 c.

[0116] As a result, a pressing force F in a direction perpendicular to the taper 53g acts on the one end of the heater 22. The pressing force F can be divided into a component force Fx in the longitudinal direction of the heater 22 and a component force Fy in a direction perpendicular to the longitudinal direction of the heater 22.

[0117] The component force Fx acts on the one end of the heater 22 and moves the heater 22 riding on the heater restrictor 23c toward the left side in FIG. 15B. As a result, the one end of the heater 22 reaches the edge of the recess 23b of the heater holder 23 as illustrated in FIG. 15C. Subsequently, the component force Fy correctly sets (fits) the heater 22 in the recess 23b of the heater holder 23 as illustrated in FIG. 15D.

[0118] In order to optimize the magnitudes of the component forces Fx and Fy, the angle of the taper 53g is preferably in the range from 30° to 60° .

[0119] The connector 40 set to the heater 22 and the heater holder 23 is described below.

[0120] FIG. 16A is a diagram illustrating the connector 40 set to the heater 22 that is correctly assembled to the heater holder 23. In other words, the heater 22 is in the correctly assembled state with respect to the heater holder 23. In FIG. 16A, the heater holder 23 has heater restrictors 23d outside both ends of the recess 23b in the short-side direction to restrict the movement of the heater 22 in the short-side direction. A part of the subassembly 201, which includes the heater 22 and the heater holder 23, is inserted into the connector 40 in the short-side direction, and the connector 40 sandwiches one end of the subassembly 201 in the longitudinal direction to supply power.

[0121] The heater 22, the heater holder 23, and the connector 40 are designed to satisfy the following relationship.

$$A < B < A + C.$$

where A is the height from the heater restrictor 23d of the heater holder 23 to the back side of the heater holder 23 in the thickness direction orthogonal to the longitudinal direction and the short-side direction, B is an opening length between tips of the U-shape of the connector 40, and C is the thickness of the heater in the thickness direction.

[0122] In FIG. 16A, the heater 22 is correctly fitted into the recess 23b of the heater holder 23 (in the correctly assembled state), and therefore, the connector 40 can be

smoothly inserted from the direction indicated by the arrow in FIG. 16A that is the short-side direction of the heater 22. On the other hand, FIG. 16B is a diagram illustrating the connector 40 moved to set the heater holder 23 and the heater 22 that is not correctly set to the heater holder 23, that is, not in the correctly assembled state. Since the heater 22 is not correctly fitted into the recess 23b of the heater holder 23 (a wrongly assembled state), a part of the heater 22 that is the one end of the heater 22 in the longitudinal direction rides on the surface of the heater holder 23.

[0123] As a result, moving the connector 40 in the direction indicated by the arrow in FIG. 16B (the short-side direction of the heater 22) to set the connector 40 to the heater 22 and the heater holder 23 causes a tip 40a of the connector 40 to contact the one end of the heater 22 riding on the surface of the heater holder 23 (the one end in the longitudinal direction). The worker can notice that the heater 22 is not correctly assembled to the heater holder 23. In other words, the worker can notice the heater 22 is not in the correctly assembled state.

[0124] The worker correctly reinserts the heater 22 into the recess 23b of the heater holder 23 and then moves the connector 40 in the direction indicated by the arrow in FIG. 16A to set the connector 40 to the heater 22 and the heater holder 23 as illustrated in FIG. 16A. The above-described configuration can prevent the heater 22 from being wrongly assembled to the heater holder 23.

[0125] When another component is interposed between the heater 22 and the heater holder 23, for example, when a thermal equalization plate is interposed between the heater 22 and the heater holder 23, the above-described height A is from the surface of the heater 22 in the correctly assembly state including the thermal equalization plate to the back side of the heater holder 23.

[0126] In order to correctly and easily assemble the heater 22 that is not correctly fitted to the recess 23b of the heater holder 23, the connector 40 may have a taper 40b formed on the tip 40a of the connector 40 as illustrated in FIGS. 16C and 16D. The taper 40b is designed to have a length such that the one end of the heater 22 riding on the heater restrictor 23d of the heater holder 23 reliably abuts against the taper 40b.

[0127] The angle of the taper 40b is, for example, 45°. The angle of the taper 40b may be greater or less than 45° but is preferably in a range from 30° to 60°.

[0128] Moving the connector 40 to the one end of the subassembly 201 of the heater 22 and the heater holder 23 in the longitudinal direction as illustrated in FIG. 16C causes the taper 40b of the connector 40 to abut on the end of the heater 22 in the short-side direction riding on the heater restrictor 23d. As a result, the above-described one end of the heater 22 in the short-side direction reaches the edge of the recess 23b of the heater holder 23 as illustrated in FIG. 16C. Subsequently, the heater 22 is correctly set (fitted) in the recess 23b of the heater holder 23 as illustrated in FIG. 16D, so that the

heater 22 riding on the heater holder 23 is corrected. The details of the operation of the taper 40b are the same as those in FIG. 15 and thus omitted.

[0129] A configuration to correct the heater wrongly assembled to the heater holder in the short-side direction is described below.

[0130] FIGS. 16E and 16F are diagrams illustrating the heater 22 that is not correctly assembled to the heater holder 23 in the short-side direction. In the wrongly assembled state of FIG. 16E, the heater 22 is inclined with respect to the short-side direction and rides on the heater restrictor 23d of the heater holder 23.

[0131] When the end holder 53 is moved toward one end of the subassembly 201 of the heater 22, the heater holder 23, and the stay 24 in the longitudinal direction that are in the wrongly assembled state as illustrated in FIG. 16F, the end of the heater 22 in the short-side direction abuts (interferes) on the bridging portion 53h of the heater holder 23, and the end holder 53 cannot be set the subassembly 201 because the height A + C is larger than the opening length B of the end holder 53. As a result, the worker can reliably notice that the heater 22 is not in the correctly assembled state and can reinsert the heater 22 into the recess 23b of the heater holder 23 as illustrated in FIG. 16F.

[0132] When the height of A + C slightly exceeds the opening length B, the heater 22 can be fitted into the recess 23b without reinserting the heater 22 into the recess 23b. For example, as illustrated in FIG. 16H, forming a taper 23a on the side of the recess 23b in the short-side direction enables the heater to easily fit to the heater holder 23.

[0133] The following describes a modification regarding the position of the thermistor.

[0134] In the fixing device described above, the position of the thermistor in a direction intersecting the arrangement direction may be designed as follows. For example, as illustrated in FIG. 17, the position of the thermistor 25 in the direction intersecting the arrangement direction is upstream from the center position NA of the fixing nip N in the rotation direction of the fixing belt 20 in the present modification. In other words, the thermistor 25 in the present modification is disposed close to an entrance portion of the fixing nip N. Since the sheet P easily takes the heat from the heater at the entrance portion of the fixing nip N, the thermistor 25 that detects the temperature of this portion enables the fixing device 9 to enhance the fixing property and effectively prevent the occurrence of fixing offset.

[0135] In addition to the above-described fixing devices, the following describes the fixing devices as illustrated in FIGS. 18 to 20 in which the present disclosure can be applied.

[0136] The configurations of fixing devices illustrated in FIGS. 18 to 20 are briefly described below.

[0137] First, the fixing device 9 illustrated in FIG. 18 includes a pressurization roller 44 opposite the pressure roller 21 with respect to the fixing belt 20. The pressur-

ization roller 44 is an opposed rotator that rotates and is opposite the fixing belt 20 as the rotator. The fixing belt 20 is sandwiched by the pressurization roller 44 and the heater 22 and heated by the heater 22. On the other hand, a nip formation pad 45 is disposed inside the loop formed by the fixing belt 20 and disposed opposite the pressure roller 21. The nip formation pad 45 is supported by the stay 24. The nip formation pad 45 sandwiches the fixing belt 20 together with the pressure roller 21, thereby forming the fixing nip N.

[0138] The fixing device 9 illustrated in FIG. 19 is described below. The fixing device in FIG. 19 omits the above-described pressurization roller 44 and includes the heater 22 formed to be arc having a curvature of the fixing belt 20 to keep a circumferential contact length between the fixing belt 20 and the heater 22. Other parts of the fixing device 9 illustrated in FIG. 19 are the same as the fixing device 9 illustrated in FIG. 13.

[0139] Finally, the fixing device 9 illustrated in FIG. 20 is described. The fixing device 9 includes a heating assembly 92, a fixing roller 93 that is a fixing rotator, and a pressure assembly 94 that is a facing member. The heating assembly 92 includes the heaters 22, the heater holder 23, the stay 24, and a heating belt 120 as an example of a rotator, as described in the above-described embodiment. The fixing roller 93 is an opposed rotator that rotates and faces the heating belt 120 as the rotator. The fixing roller 93 includes a core 93a, an elastic layer 93b, and a release layer 93c. The core 93a is a solid core made of iron. The elastic layer 93b coats the circumferential surface of the core 93a. The release layer 93c coats an outer circumferential surface of the elastic layer 93b. The pressure assembly 94 is opposite to the heating assembly 92 with respect to the fixing roller 93. The pressure assembly 94 includes a nip formation pad 95 and a stay 96 inside the loop of a pressure belt 97, and the pressure belt 97 is rotatably arranged to wrap around the nip formation pad 95 and the stay 96. The sheet P passes through the fixing nip N2 between the pressure belt 97 and the fixing roller 93 to be heated and pressed to fix the image onto the sheet P.

[0140] The following describes a configuration of an image forming apparatus according to a modification.

[0141] The image forming apparatus according to the present embodiments of the present disclosure is applicable not only to the color image forming apparatus illustrated in FIG. 1 but also to a monochrome image forming apparatus, a copier, a printer, a facsimile machine, or a multifunction peripheral including at least two functions of the copier, printer, and facsimile machine.

[0142] For example, as illustrated in FIG. 21, an image forming apparatus 100 according to the modification of the present embodiment includes an image forming device 50 including a photoconductor drum, a sheet conveyor including a timing roller pair 15, a sheet feeder 7, a fixing device 9, a sheet ejection device 10, and a reading device 51. The sheet feeder 7 includes multiple sheet feeding trays, and the sheet feeding trays store sheets of

different sizes.

[0143] The reading device 51 reads an image of a document J. The reading device 51 generates image data from the read image. The sheet feeder 7 stores the multiple sheets P and feeds the sheet P to the conveyance path. The timing roller pair 15 conveys the sheet P on the conveyance path to the image forming device 50.

[0144] The image forming device 50 forms a toner image on the sheet P. Specifically, the image forming device 50 includes the photoconductor drum, a charging roller, the exposure device, the developing device, a supply device, a transfer roller, the cleaning device, and a discharging device. The toner image is, for example, an image of the document Q. The fixing device 9 heats and presses the toner image to fix the toner image on the sheet P. Conveyance rollers convey the sheet P on which the toner image has been fixed to the sheet ejection device 10. The sheet ejection device 10 ejects the sheet P to the outside of the image forming apparatus 100.

[0145] Additional modifications of the fixing device are described below.

[0146] Descriptions of the configurations common to the fixing devices of the above-described embodiments and modifications may be omitted as appropriate.

[0147] As illustrated in FIG. 22, the fixing device 9 includes the fixing belt 20, the pressure roller 21, the heater 22, the heater holder 23, the stay 24, and the thermistor 25.

[0148] The fixing nip N is formed between the fixing belt 20 and the pressure roller 21. The nip width of the fixing nip N is 10 mm, and the linear velocity of the fixing device 9 is 240 mm / s.

[0149] The fixing belt 20 includes the polyimide base and the release layer and does not include the elastic layer. The release layer is made of a heat-resistant film material made of, for example, fluororesin. The outer loop diameter of the fixing belt 20 is about 24 mm.

[0150] The pressure roller 21 includes the core 21a, the elastic layer 21b, and the release layer 21c. The pressure roller 21 has an outer diameter of 24 to 30 mm, and the elastic layer 21b has a thickness of 3 to 4 mm.

[0151] The heater 22 includes the base, a thermal insulation layer, a conductor layer including the resistive heat generator, and the insulation layer and is formed to have a thickness of 1 mm as a whole. A width Y of the heater 22 in the short-side direction of the heater 22 (that is also the direction intersecting the arrangement direction) is 13 mm.

[0152] FIG. 23 is a plan view of a heater according to a third example. Like the heater of the first example, the heater of the fourth example includes multiple resistive heat generators 31 arranged in the longitudinal direction of the heater. In the following description, an area between neighboring resistive heat generators 31 in the arrangement direction is referred to as a separation area B. As illustrated in FIG. 23, the conductor layer of the

heater 22 includes multiple resistive heat generators 31, power supply lines 33, and electrodes 34A to 34C. As illustrated in the enlarged view of FIG. 23, the separation area B is formed between neighboring resistive heat generators of the multiple resistive heat generators 31 arranged in the arrangement direction. The enlarged view of FIG. 23 illustrates two separation areas B, but the separation area B is formed between the neighboring resistive heat generators of all the multiple resistive heat generators 31. The resistive heat generators 31 configure three heat generation portions 35A to 35C. When a current flows between the electrodes 34A and 34B, the heat generation portions 35A and 35C generate heat. When a current flows between the electrodes 34A and 34C, the heat generation portion 35B generates heat. When the fixing device 9 fixes the toner image onto the small sheet, the heat generation portion 35B generates heat. When the fixing device 9 fixes the toner image onto the large sheet, all the heat generation portions 35A to 35C generate heat.

[0153] As illustrated in FIG. 24, the heater holder 23 holds the heater 22 in the recess 23b of the heater holder 23. The recess 23b is formed on the side of the heater holder 23 facing the heater 22. The recess 23b has a bottom surface 23b1 and walls 23b2 and 23b3. The bottom surface 23b1 is substantially parallel to the base 30 and the surface recessed from the side of the heater holder 23 toward the stay 24. The walls 23b2 are both side surfaces of the recess 23b in the arrangement direction. The recess 23b may have one wall 23b2. The walls 23b3 are both side surfaces of the recess 23b in the direction intersecting the arrangement direction. The heater holder 23 has guides 26. The heater holder 23 is made of LCP.

[0154] As illustrated in FIG. 25, the connector 40 includes a housing made of resin such as LCP and a plurality of contact terminals fixed to the housing.

[0155] The connector 40 is attached to the heater 22 and the heater holder 23 such that a front side of the heater 22 and the heater holder 23 and a back side of the heater 22 and the heater holder 23 are sandwiched by the connector 40. In this state, the contact terminals contact and press against the electrodes of the heater 22, and the heat generation portions 35 are electrically coupled to the power supply in the image forming apparatus via the connector 40. The above-described configuration enables the power supply to supply power to the heat generation portions 35.

[0156] Note that at least part of each of the electrodes 34 is not coated by the insulation layer and therefore exposed to connect the connector 40.

[0157] The end holder 53 contacts the inner circumferential surface of the fixing belt 20 at each of both ends of the fixing belt 20 in the arrangement direction to hold the fixing belt 20. The end holders 53 are fixed to the housing of the fixing device 9. The end holder 53 is inserted into each of both ends of the stay 24 (see a direction indicated by the arrow from the end holder 53 in FIG. 25).

[0158] To attach to the heater 22 and the heater holder 23, the connector 40 is moved in the direction intersecting the arrangement direction (see a direction indicated by the arrow from the connector 40 in FIG. 25). The connector 40 and the heater holder 23 may have a convex portion and a recessed portion to attach the connector 40 to the heater holder 23. The convex portion disposed on one of the connector 40 and the heater holder 23 is engaged with the recessed portion disposed on the other one of the connector 40 and the heater holder 23 and relatively move in the recessed portion to attach the connector 40 to the heater holder 23. The connector 40 is attached to one end of the heater 22 and one end of the heater holder 23 in the arrangement direction. These ends of the heater 22 and the heater holder 23 are farther from a portion in which the pressure roller 21 receives a driving force from a drive motor than the other end of the heater 22 and the other end of the heater holder 23, respectively.

[0159] As illustrated in FIG. 26, one thermistor 25 faces a center portion of the inner circumferential surface of the fixing belt 20 in the arrangement direction, and another thermistor 25 faces an end portion of the inner circumferential surface of the fixing belt 20 in the arrangement direction. The heater 22 is controlled based on the temperature of the center portion of the fixing belt 20 and the temperature of the end portion of the fixing belt 20 in the arrangement direction that are detected by the thermistors 25. Any one of the thermistors 25 is disposed corresponding to the separation area between the neighboring resistive heat generators of the heater 22.

[0160] As illustrated in FIG. 26, one thermostat 27 faces the center portion of the inner circumferential surface of the fixing belt 20 in the arrangement direction, and another thermostat 27 faces the end portion of the inner circumferential surface of the fixing belt 20 in the arrangement direction. Each of the thermostats 27 shuts off a current to the heater 22 in response to a detection of a temperature of the fixing belt 20 higher than a predetermined threshold value.

[0161] The end holders 53 are disposed at both ends of the fixing belt 20 in the arrangement direction and hold both ends of the fixing belt 20, respectively. The end holder 53 is made of LCP.

[0162] As illustrated in FIG. 27, the end holder 53 has the guide groove 53a. The guide groove 53a extends in a direction in which the fixing belt 20 moves toward and away from the pressure roller 21. An engaging portion of the housing of the fixing device 9 is engaged with the guide groove 53a. The relative movement of the engaging portion in the guide groove 53a enables the fixing belt 20 to move toward and away from the pressure roller 21.

[0163] The following describes other types of fixing devices each including high thermal conductors.

[0164] For convenience of explanation, reference numerals different from the reference numerals in the above description are given.

[0165] A fixing device 160 illustrated in FIG. 28 includes a heater holder 164, a first high thermal conductor 89, and second high thermal conductors 90 between the heater holder 164 and the first high thermal conductor 89. The second high thermal conductor 90 is disposed at a position different from the position of the first high thermal conductor 89 in the left-to-right direction in FIG. 28 that is a direction in which the heater holder 164, a stay 165, and the first high thermal conductor 89 are layered. Specifically, the second high thermal conductor 90 is disposed so as to overlap the first high thermal conductor 89.

[0166] The fixing device in the present embodiment includes a temperature sensor 167 (that is, a thermistor), which is the same as the fixing device in the above-described embodiments. FIG. 28 illustrates a cross section in which the temperature sensor 167 is not disposed.

[0167] The second high thermal conductor 90 is made of a material having thermal conductivity higher than the thermal conductivity of a base 155, for example, graphene or graphite. The second high thermal conductor 90 in the present embodiment is made of a graphite sheet having a thickness of 1 mm. Alternatively, the second high thermal conductor 90 may be a plate made of aluminum, copper, or silver.

[0168] As illustrated in FIG. 29, multiple second high thermal conductors 90 are arranged on a recess 164b of the heater holder 164 at intervals in the longitudinal direction.

[0169] The recess 164b of the heater holder 164 has a plurality of holes in which the second high thermal conductors 90 are disposed. Clearances are formed between the heater holder 164 and both sides of the second high thermal conductor 90 in the longitudinal direction. The clearance prevents heat transfer from the second high thermal conductor 90 to the heater holder 164, and a heater 163 efficiently heats a fixing belt 161.

[0170] The heater illustrated in FIG. 30 includes multiple resistive heat generators arranged in the longitudinal direction of the heater. As illustrated in FIG. 30, each of the second high thermal conductor 90 (see the hatched portions) is disposed at a position corresponding to a gap B1 in the longitudinal direction indicated by the arrow X and faces at least a part of the neighboring resistive heat generators 156 in the longitudinal direction. In particular, each of the second high thermal conductors 90 in the present embodiment faces the entire gap B1. Although FIG. 30 (and FIG. 32) illustrates the first high thermal conductor 89 disposed over the entirety in the longitudinal direction of the region where all the resistive heat generators 156 are disposed, the arrangement range of the first high thermal conductor 89 is not limited thereto.

[0171] The fixing device according to the present embodiment includes the second high thermal conductor 90 disposed at the position corresponding to the separation area B1 in the longitudinal direction and the position at which at least a part of the neighboring resistive heat generators 156 faces the second high thermal conductor 90 in addition to the first high thermal conductor 89. The

above-described structure further enhances the heat transfer efficiency in the gap B1 in the longitudinal direction and more efficiently reduces the temperature unevenness of the heater 163 in the longitudinal direction. As illustrated in FIG. 31, the first high thermal conductors 89 and the second high thermal conductors 90 may be disposed opposite the entire gap B1 between the resistive heat generators 156. The above-described structure enhances the heat transfer efficiency of the part of the heater 163 corresponding to the gap B1 to be higher than the heat transfer efficiency of the other part of the heater 163.

In FIG. 31, for the sake of convenience, the resistive heat generators 156, the first high thermal conductors 89, and the second high thermal conductors 90 are shifted in the vertical direction of FIG. 31 but are disposed at substantially the same position in the direction intersecting the longitudinal direction indicated by the arrow Y. However, the present disclosure is not limited to the above. The first high thermal conductor 89 and the second high thermal conductor 90 may be disposed opposite a part of the resistive heat generators 156 in the direction intersecting the longitudinal direction or may be disposed so as to cover the entire resistive heat generators 156 in the direction intersecting the longitudinal direction.

[0172] A graphene sheet is described below.

[0173] Both the first high thermal conductor 89 and the second high thermal conductor 90 may be made of the graphene sheet. The first high thermal conductor 89 and the second high thermal conductor 90 made of the graphene sheet have high thermal conductivity in a predetermined direction along the plane of the graphene, that is, not in the thickness direction but in the longitudinal direction. Accordingly, the above-described structure can effectively reduce the temperature unevenness of the fixing belt 161 in the longitudinal direction and the temperature unevenness of the heater 163 in the longitudinal direction.

[0174] Graphene is a flaky powder. Graphene has a planar hexagonal lattice structure of carbon atoms, as illustrated in FIG. 34. The graphene sheet is typically a single layer. The graphene sheet may contain impurities in a single layer of carbon or may have a fullerene structure. The fullerene structures are generally recognized as compounds including an even number of carbon atoms, which form a cage-like fused ring polycyclic system with five and six membered rings, including, for example, C60, C70, and C80 fullerenes or other closed cage structures having three-coordinate carbon atoms.

[0175] Graphene sheets are artificially made by, for example, a chemical vapor deposition (CVD) method.

[0176] The graphene sheet is commercially available. The size and thickness of the graphene sheet or the number of layers of the graphite sheet are measured by, for example, a transmission electron microscope (TEM).

[0177] Graphite obtained by multilayering graphene has a large thermal conduction anisotropy. As illustrated

in FIG. 35, graphite has a crystal structure in which layers of condensed six membered ring planes of carbon atoms spread in a planar shape are stacked. Among carbon atoms in this crystal structure, adjacent carbon atoms in the layer are coupled by a covalent bond, and carbon atoms between layers are coupled by a van der Waals bond. The covalent bond has a larger bonding force than a van der Waals bond. Therefore, there is a large anisotropy between the bond between carbon atoms in a layer and the bond between carbon atoms in different layers. That is, the first high thermal conductor 89 and the second high thermal conductor 90 that are made of graphite each have the heat transfer efficiency in the longitudinal direction larger than the heat transfer efficiency in the thickness direction of the first high thermal conductor 89 and the second high thermal conductor 90 (that is, the stacking direction of these members), reducing the heat transferred to the heater holder 164.

[0178] Accordingly, the above-described structure can efficiently decrease the temperature unevenness of the heater 163 in the longitudinal direction and can minimize the heat transferred to the heater holder 164. Since the first high thermal conductor 89 and the second high thermal conductor 90 that are made of graphite are not oxidized at about 700 degrees or lower, the first high thermal conductor 89 and the second high thermal conductor 90 each have an excellent heat resistance.

[0179] The physical properties and dimensions of the graphite sheet may be appropriately changed according to the function required for the first high thermal conductor 89 or the second high thermal conductor 90. For example, the anisotropy of the thermal conduction can be increased by using high-purity graphite or single-crystal graphite or by increasing the thickness of the graphite sheet. Using a thin graphite sheet can reduce the thermal capacity of the fixing device so that the fixing device can perform high-speed printing. The width of the first high thermal conductor 89 or the width of the second high thermal conductor 90 in the direction intersecting the longitudinal direction may be increased in response to a large width of the nip N or a large width of the heater 163.

[0180] From the viewpoint of increasing mechanical strength, the number of layers of the graphite sheet is preferably 11 or more. The graphite sheet may partially include a single layer portion and a multilayer portion.

[0181] As long as the second high thermal conductor 90 faces a part of the neighboring resistive heat generators 156 and at least a part of the gap B1 between the neighboring resistive heat generators 156 in the longitudinal direction, the configuration of the second high thermal conductor 90 is not limited to the configuration illustrated in FIG. 30. For example, as illustrated in FIG. 32, a second high thermal conductor 90A is longer than the base 155 in the direction intersecting the longitudinal direction indicated by the arrow Y (the short-side direction), and both ends of the second high thermal conductor 90A in the direction intersecting the longitudinal direction are outside the base 155 in FIG. 32. A second high

thermal conductor 90B faces a range in which the resistive heat generators 156 are disposed in the direction intersecting the longitudinal direction. A second high thermal conductor 90C faces a part of the gap B1 and a part of neighboring resistive heat generators 156.

[0182] The fixing device according to an embodiment illustrated in FIG. 33 has a gap between the first high thermal conductor 89 and the heater holder 164 in the thickness direction that is the lateral direction in FIG. 33. In other words, the fixing device has a gap 164c serving as a thermal insulation layer in a part of a region of the recess 164b (see FIG. 29) of the heater holder 164 in which the heater 163, the first high thermal conductor 89, and the second high thermal conductor 90 are disposed. The gap 164c is in the part of the region of the recess 164b in the longitudinal direction, and the second high thermal conductor 90 is not in the part. Therefore, FIG. 33 does not include the second high thermal conductor 90. The gap 164c has a depth deeper than the depth of the recess 164b of the heater holder 164. Thus, the area of contact between the heater holder 164 and the first high thermal conductor 89 can be kept to a minimum, so that the heat transfer from the first high thermal conductor 89 to the heater holder 164 is reduced, thus allowing the fixing belt 161 to be effectively heated by the heater 163. In the cross section of the fixing device taken along the direction orthogonal to the longitudinal direction at a position in which the second high thermal conductor 90 is set, the second high thermal conductor 90 is in contact with the heater holder 164 as illustrated in FIG. 28 of the above-described embodiment.

[0183] The gap 164c in the present embodiment is in an entire area in which the resistive heat generators 156 are disposed in the direction intersecting the longitudinal direction that is the vertical direction in FIG. 33. The above-described configuration efficiently prevents heat transfer from the first high thermal conductor 89 to the heater holder 164, and the heater 163 efficiently heats the fixing belt 161. The fixing device may include a thermal insulation layer made of thermal insulator having a lower thermal conductivity than the thermal conductivity of the heater holder 164 instead of a space like the gap 164c serving as the thermal insulation layer.

[0184] In the present embodiment, the second high thermal conductor 90 is a member different from the first high thermal conductor 89, but the present embodiment is not limited to this. For example, the first high thermal conductor 89 may have a thicker portion than the other portion so that the thicker portion faces the gap B1 and functions as the second high thermal conductor 90.

[0185] As described above, a heating device in the present embodiment includes the fixing belt 20 as a tube, the heater 22, and the end holder 53. The fixing belt 20 is rotatable and has a rotational axis direction. The heater 22 includes heat generators 31 or 56 to heat the fixing belt 20. The end holder 53 holds the heater and an end of the fixing belt in the rotational axis direction. The end holder 53 includes the bridging portion 53h forming an opening

through which the heater 22 passes. The heater 22 has a protrusion 22p that is at least one end of both ends of the heater 22 in the rotational axis direction. The protrusion 22p protrudes from the bridging portion 53h toward the outside.

[0186] The above-described structure prevents a mark from becoming difficult to be visually recognized.

[0187] As described above, the heating device in the present embodiment includes the protrusion 22p protruding outward from the bridging portion 53h, and a mark 22m to identify the characteristic value of the heater 22 is on the protrusion 22p.

[0188] The above-described structure can enhance the visibility of the mark. In addition, the working efficiency at the time of assembly is enhanced.

[0189] The width of the protrusion 22p protruding in the longitudinal direction of the heater 22 is larger than the width of the heater 22 in the direction orthogonal to the rotational axis direction of the fixing belt 20.

[0190] The above-described structure can prevent the size of the heater in the short-side direction of the heater from increasing.

[0191] As described above, the heating device 200 in the present embodiment includes the connector 40 coupled to the electrodes 58 of the heater 22. The heater 22 has the protrusion 22p as one end protruding from the end holder and the protrusion as the other end protruding from the end holder. The connector 40 is disposed on the other end.

[0192] The above-described structure can prevent the size of the heater in the longitudinal direction of the heater from increasing and reduce the temperature difference between both ends of the heater 22 in the longitudinal direction.

[0193] As described above, the end holder 53 is made of resin.

[0194] The end holder 53 made of resin prevents the heat generated by the heater from transferring to the outside of the heater.

[0195] As described above, the fixing device 9 in the present embodiment includes the pressure roller 21 including the core 21a, and the protrusion 22p extends outward from the core 21a.

[0196] The above-described structure can enhance the visibility of the mark and reduce the size of the heater in the short-side direction of the heater.

[0197] As described above, the bridging portion 53h in the present embodiment has a facing portion 53t facing the pressure roller 21, and the facing portion 53t is thinner than the other portion of the bridging portion 53h.

[0198] The above-described structure can avoid the interference with the core of the pressure roller and reduce the size of the fixing device.

[0199] As described above, the fixing device 9 in the present embodiment includes the heater holder 23 that holds the heater 22 and the stay 24 that supports the heater holder 23, and the end holder 53 and the stay 24 are in contact with each other.

[0200] The above-described structure can prevent deformation due to a load.

[0201] As described above, the fixing device 9 in the present embodiment includes the heating device 200 and the side wall 68 that holds the end holder 53 so as to be relatively movable, and the bridging portion 53h is positioned so as to overlap the frame 80 in the direction orthogonal to the rotational axis direction.

[0202] The above-described structure can prevent the deformation of the fitting portion of the side plate and enhance the positional accuracy.

[0203] As described above, the fixing device 9 in the present embodiment includes the heating device 200 and the side plate such as the frame 80 that holds the end holder 53 so as to be relatively movable, and the width of the bridging portion 53h is larger than the thickness of the side plate such as the frame 80. The above-described structure can prevent the deformation of the end holder 53.

[0204] As described above, the fixing device 9 in the present embodiment includes the heating device 200 and the side plate such as the frame 80 that holds the end holder 53 so as to be relatively movable, and the width of the bridging portion 53h is larger than the thickness of the heater 22. The above-described structure can prevent the deformation of the end holder 53.

[0205] The following describes modifications of the image forming apparatus to which the present disclosure can be applied.

[0206] The image forming apparatus according to the present embodiments of the present disclosure is applicable not only to the color image forming apparatus illustrated in FIG. 1 but also to a monochrome image forming apparatus, a copier, a printer, a facsimile machine, or a multifunction peripheral including at least two functions of the copier, printer, and facsimile machine. The heating device 19 according to the present disclosure may be applied to, for example, a dryer for an inkjet type image forming apparatus. The heating device 19 according to the present disclosure may be applied to a laminating device.

[0207] The above-described embodiments are illustrative and do not limit this disclosure.

It is therefore to be understood that within the scope of the appended claims, numerous additional modifications and variations are possible to this disclosure otherwise than as specifically described herein.

Claims

1. A heating device (19) comprising:

a subassembly (201) including:

a heater (22) including a plate extending in a longitudinal direction; and
a heater holder (23) including:

a holding portion (23b) holding the heater (22); and
 a heater restrictor (23d) disposed at one end of the holding portion (23b) in a short-side direction orthogonal to the longitudinal direction to

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restrict a movement of the heater (22) in the short-side direction; and a connector (40) having a U-shape in a cross section of the connector (40),

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the connector (40), into which the subassembly (201) is inserted in the short-side direction, to sandwich one end of the subassembly (201) in the longitudinal direction to supply power to the heater (22), and
 the connector (40) having a taper (40b) on a tip (40a) of the connector (40) in the short-side direction.

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2. The heating device (19) according to claim 1, wherein the heater holder (23), the connector (40), and the heater (22) satisfy the following relationship,

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$$A < B < A + C$$

where A is a height from a back side of the heater holder (23) to the heater restrictor (23d) in a thickness direction orthogonal to the longitudinal direction and the short-side direction;
 B is an opening length between tips of the U-shape of the connector (40) in the thickness direction; and
 C is a thickness of the heater (22) in the thickness direction.

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3. The heating device (19) according to claim 1 or 2, wherein an angle of the taper (40b) is from 30° to 60°.
4. A fixing device (9) comprising the heating device (19) according to any one of claims 1 to 3.
5. An image forming apparatus comprising the fixing device (9) according to claim 4.

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FIG. 1

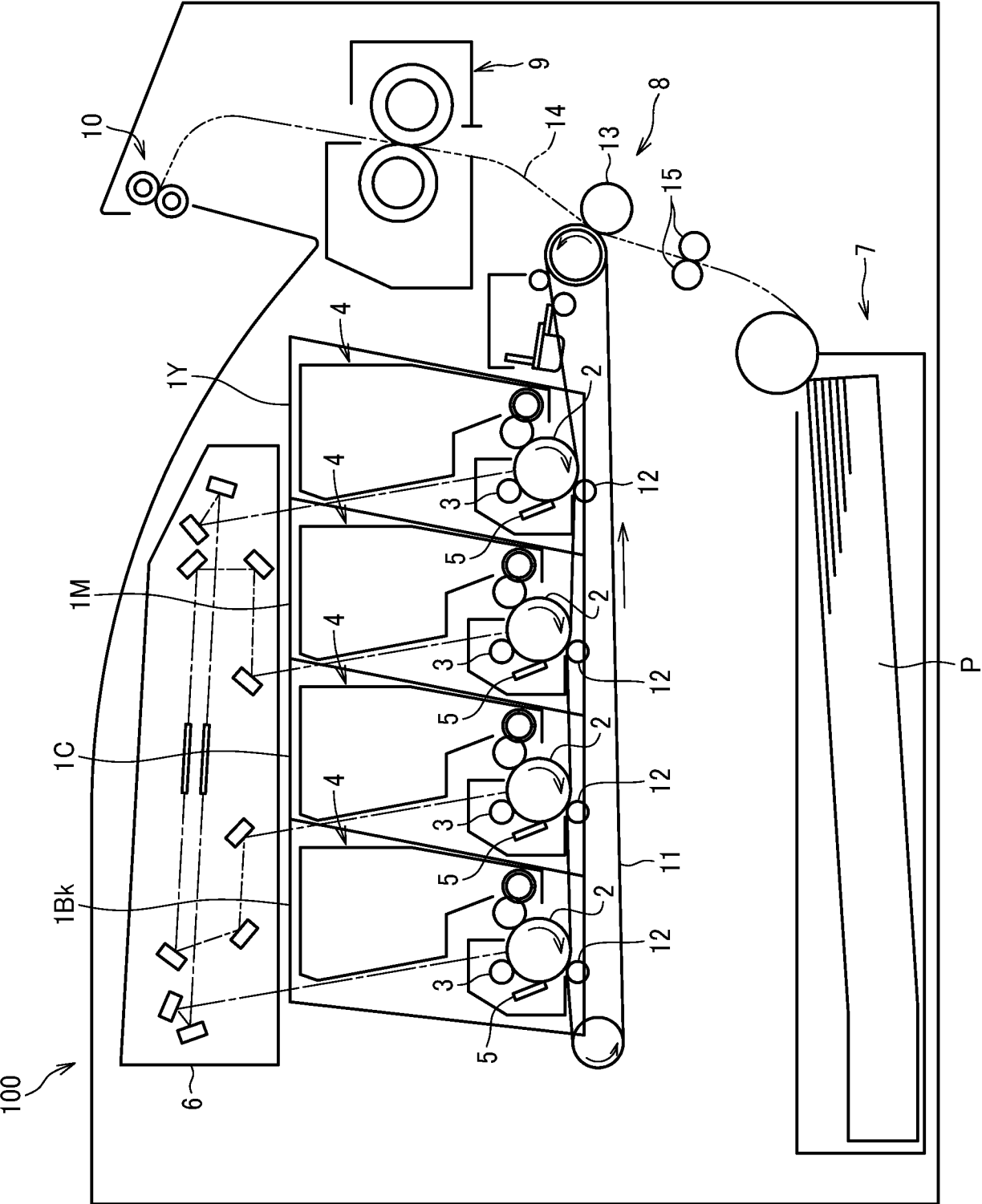


FIG. 2

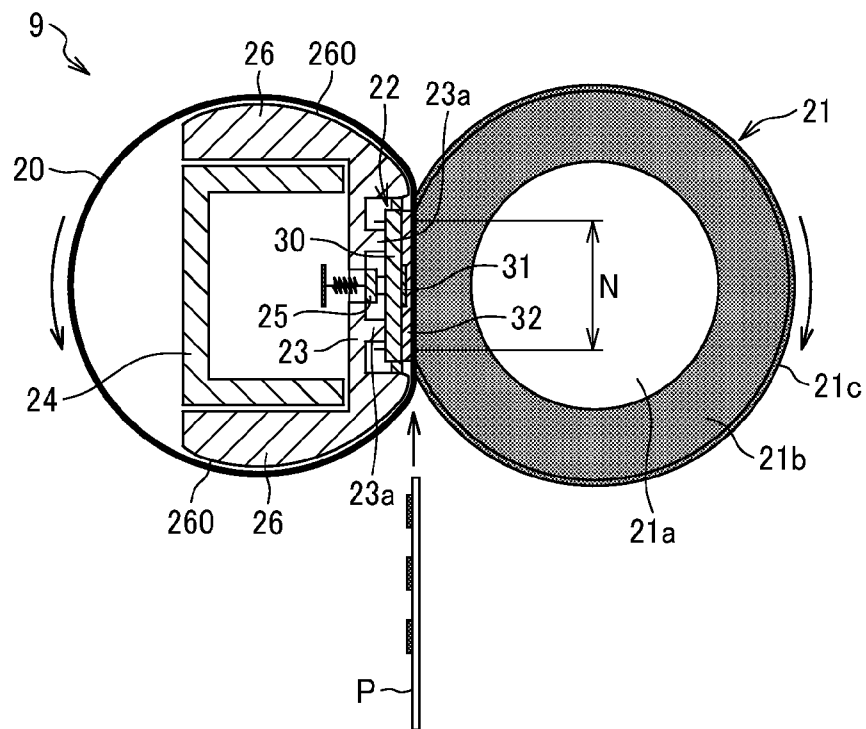


FIG. 3

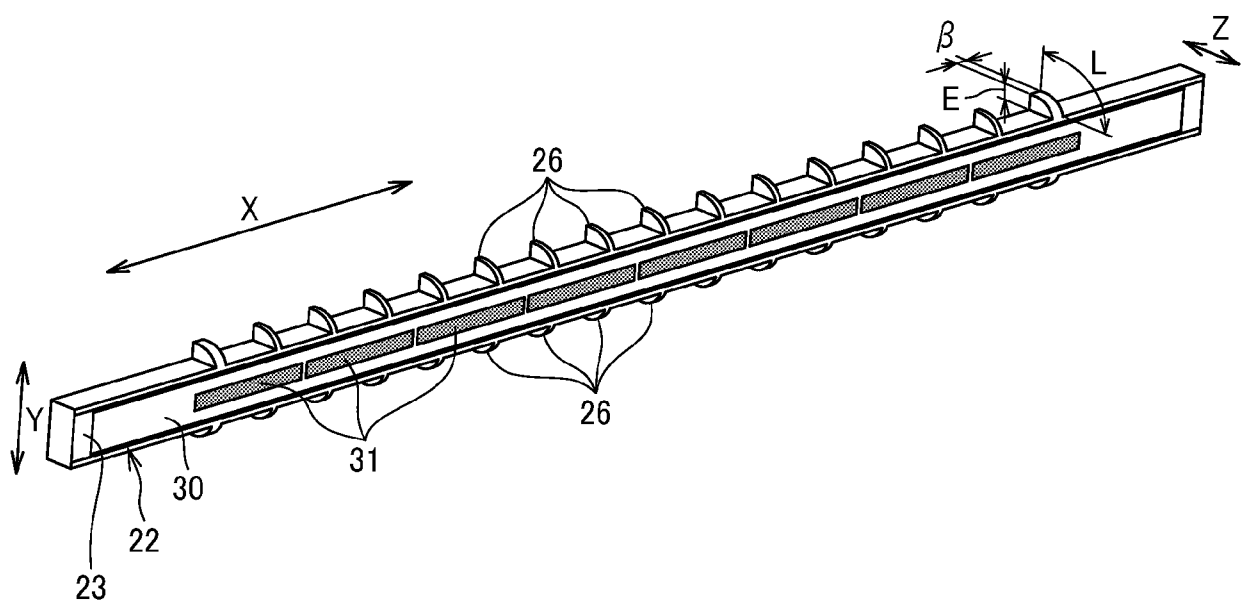


FIG. 4

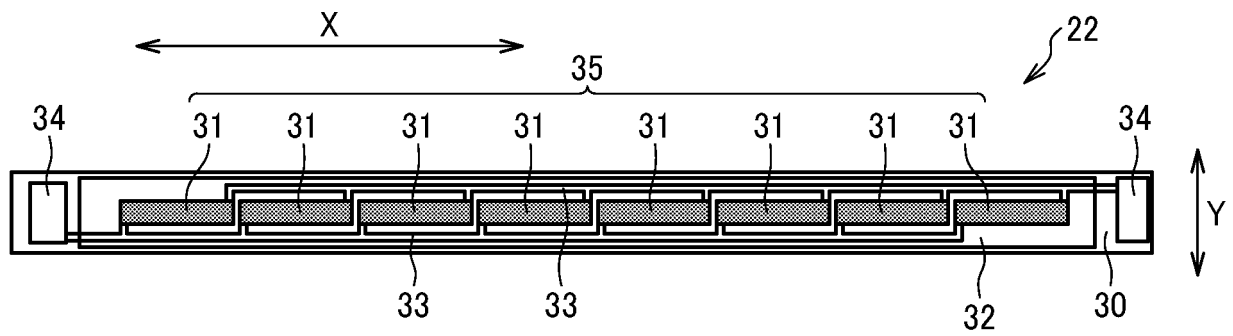


FIG. 5

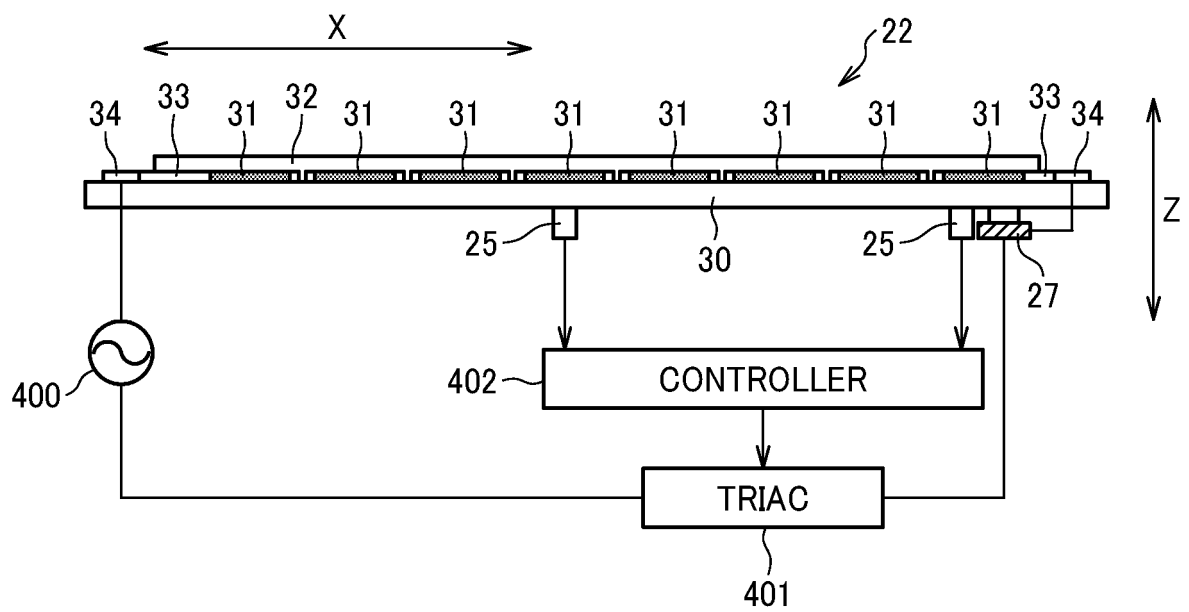


FIG. 6

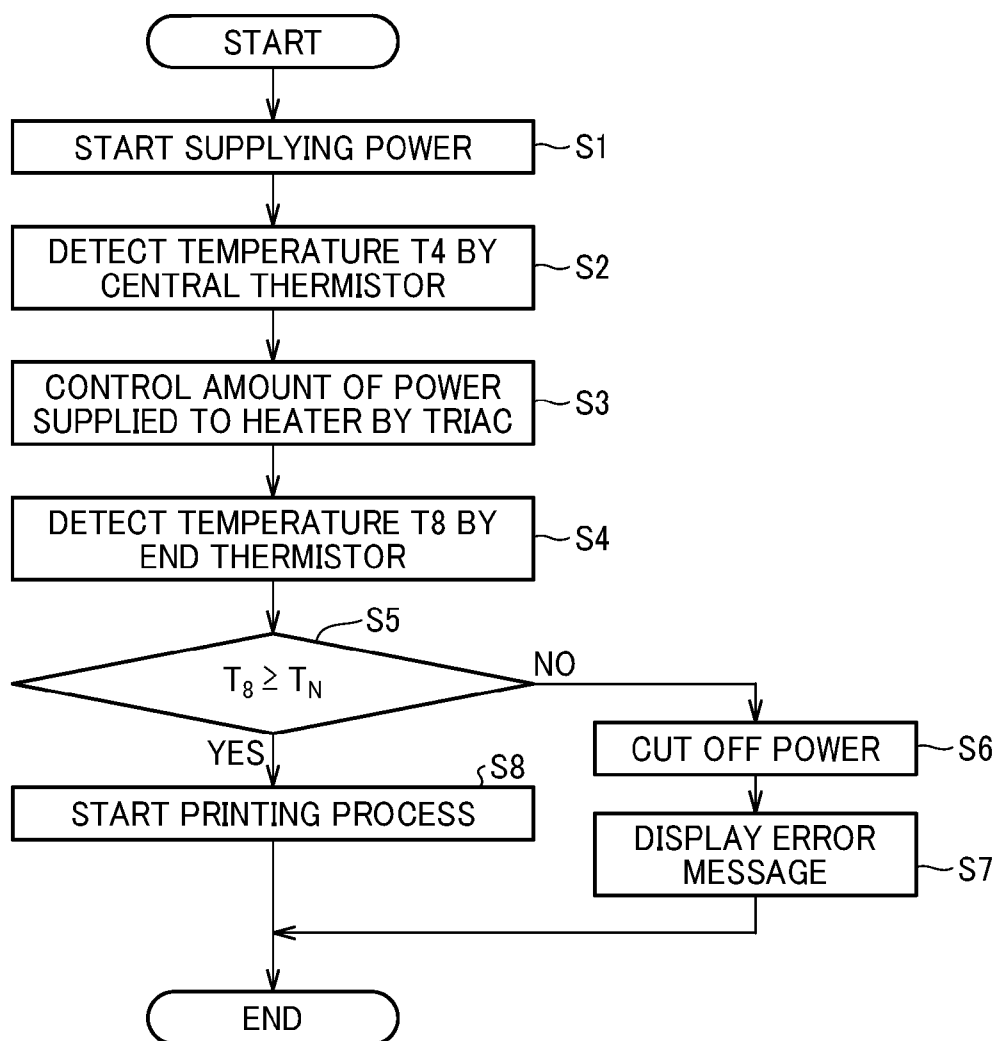


FIG. 7

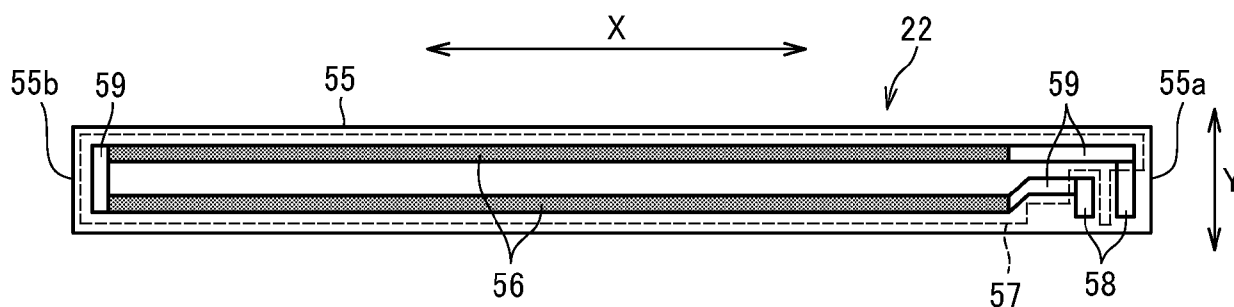


FIG. 8

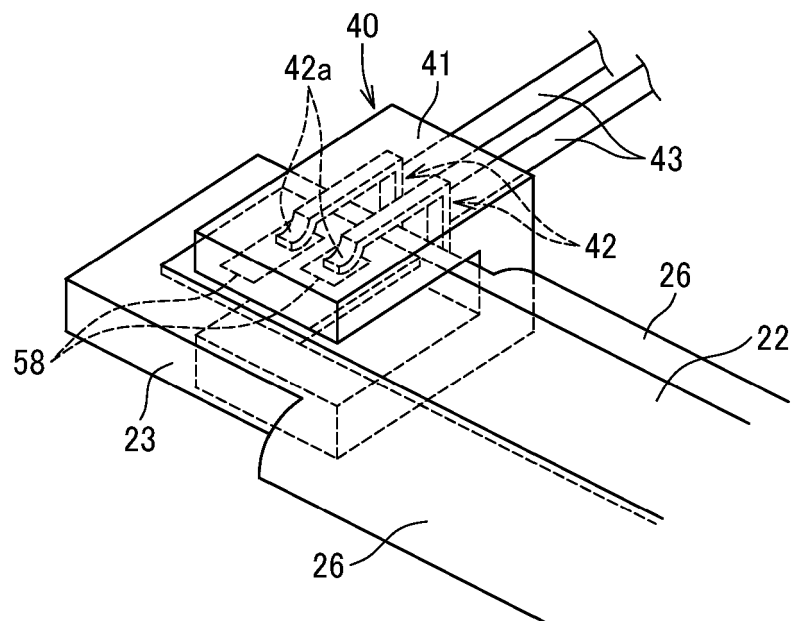


FIG. 9A

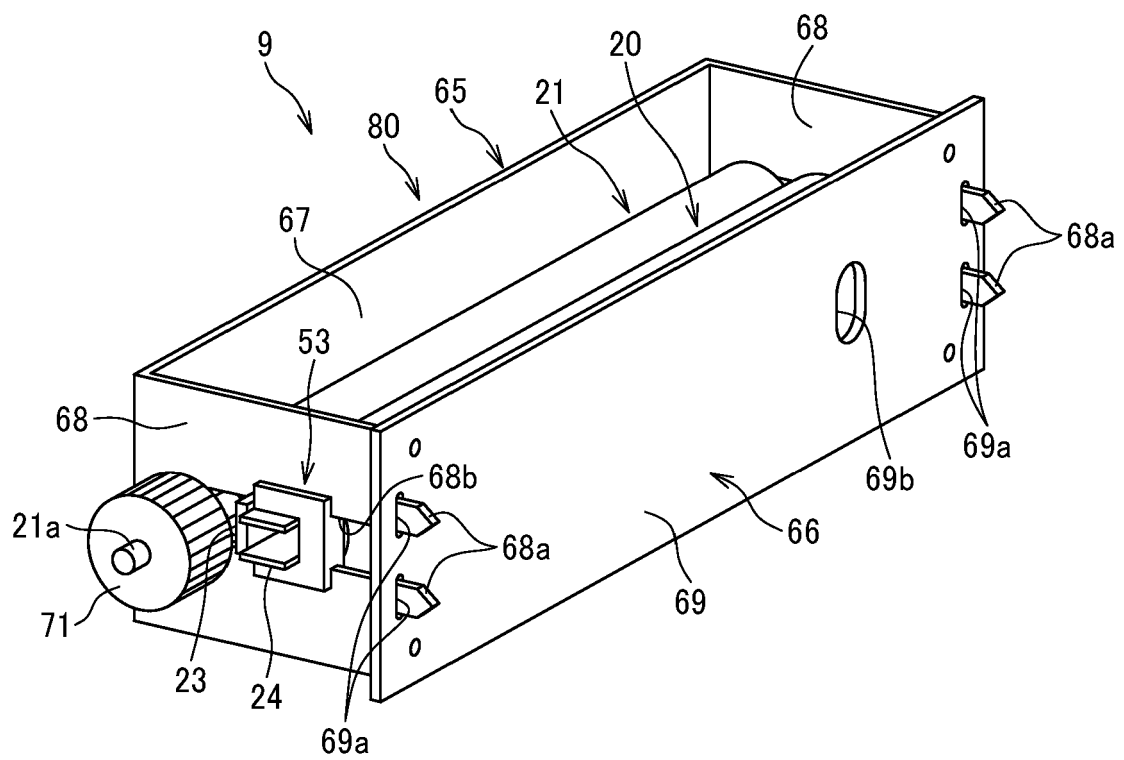


FIG. 9B

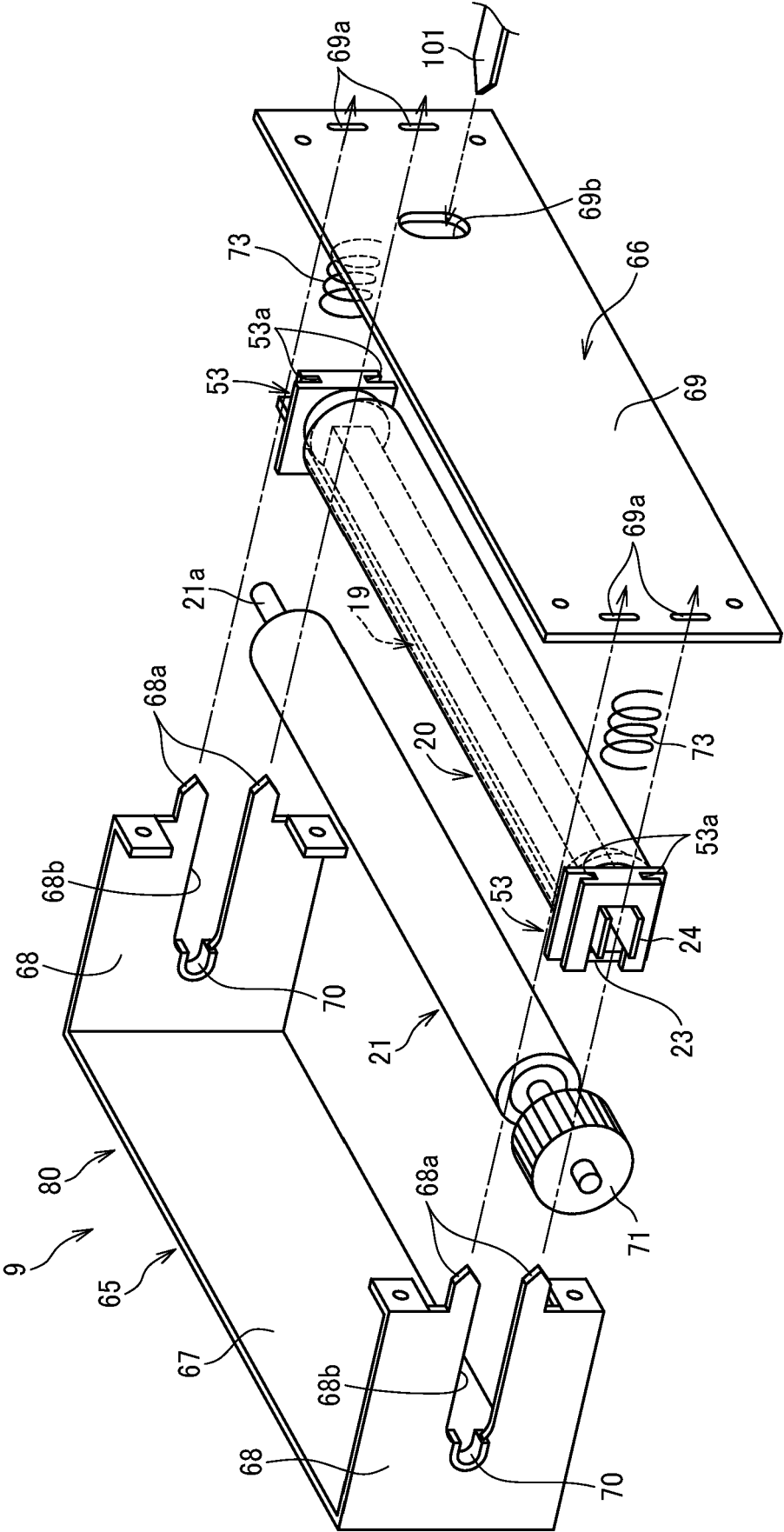


FIG. 11A

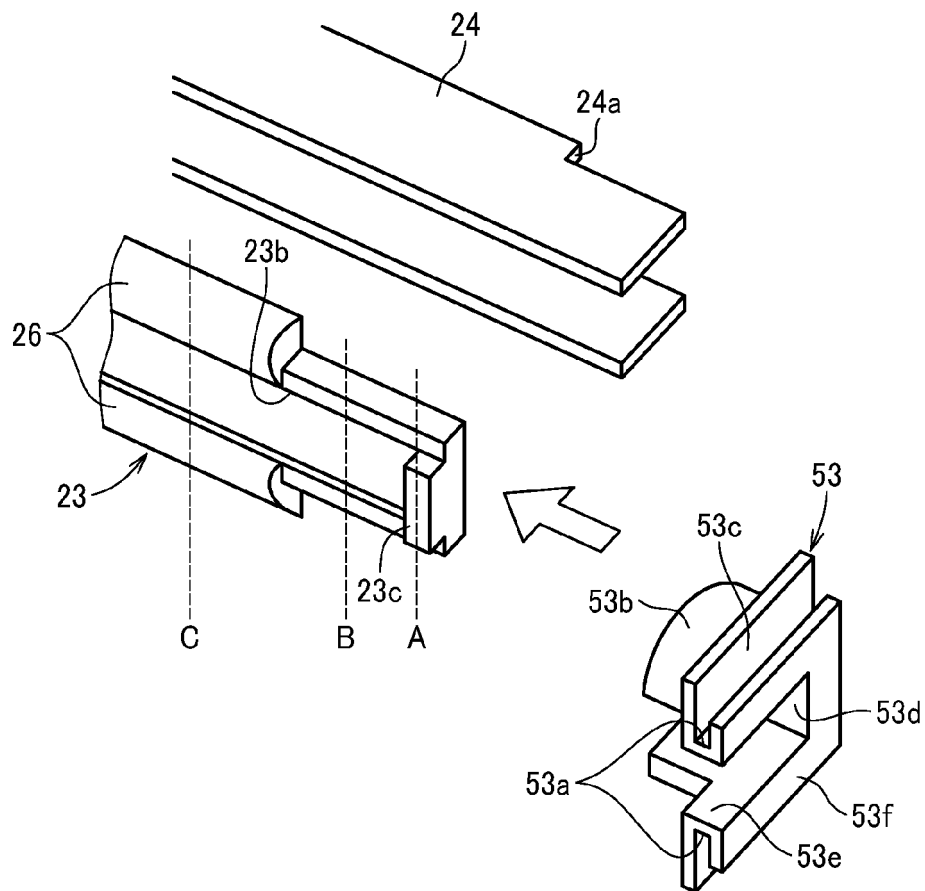


FIG. 11B

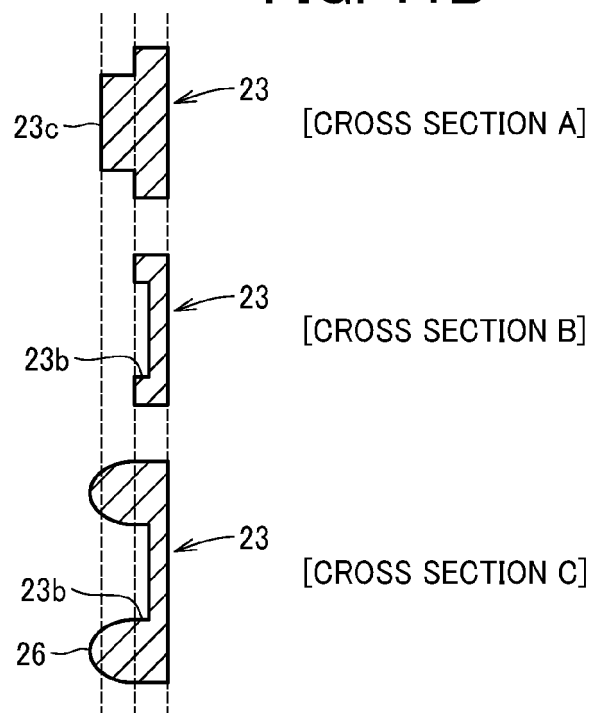


FIG. 11C

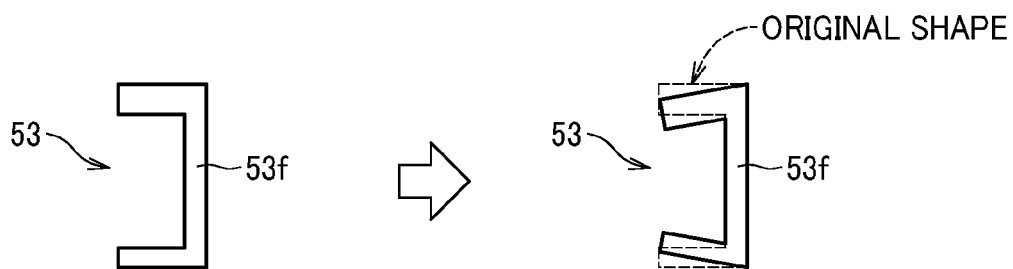


FIG. 11D

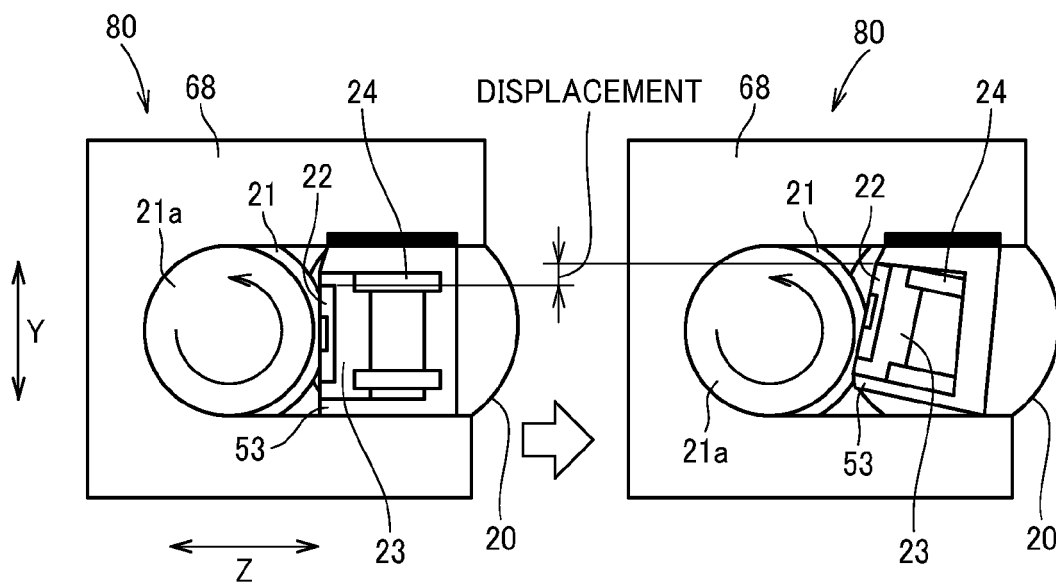


FIG. 11E

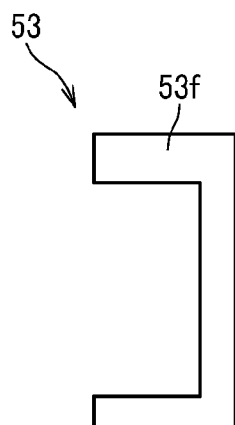


FIG. 11F

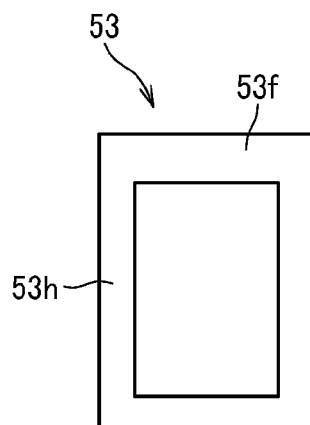


FIG. 12A

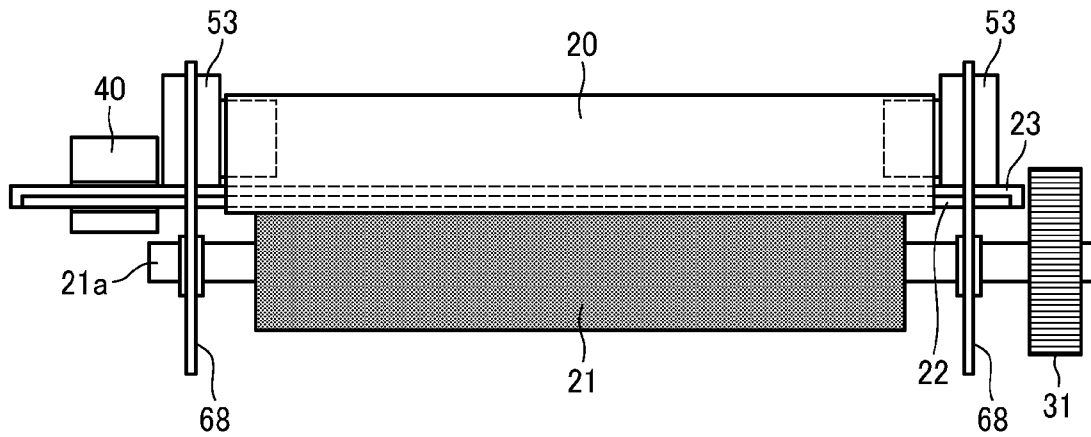


FIG. 12B

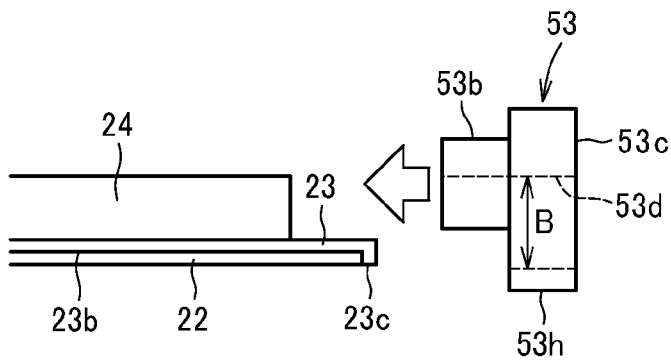


FIG. 12C

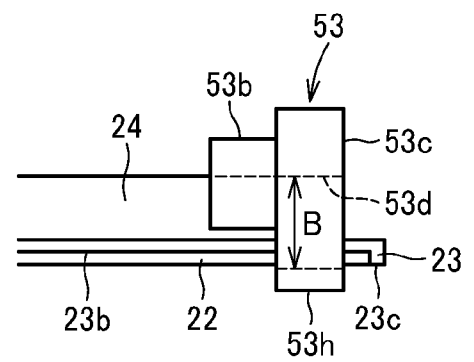


FIG. 12D

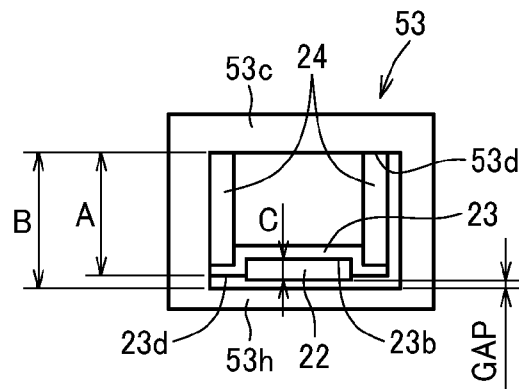


FIG. 12E

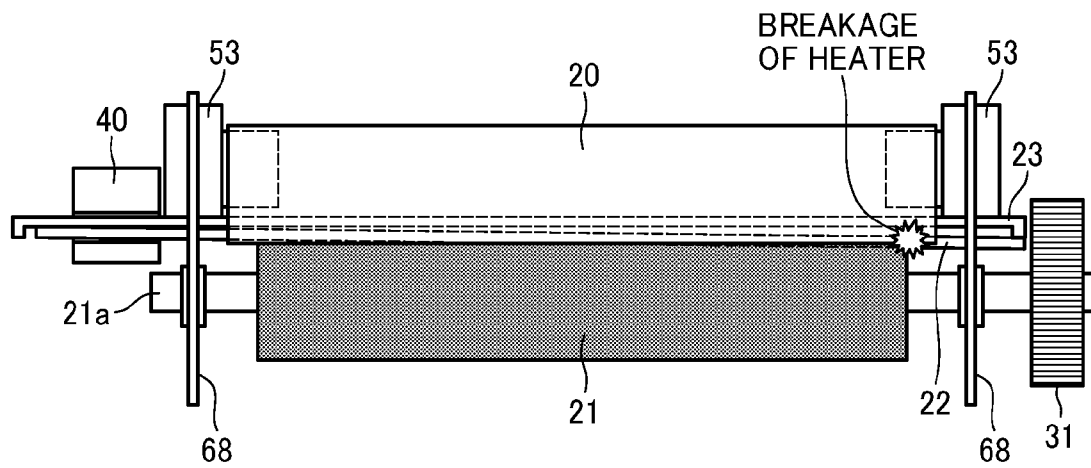


FIG. 12F

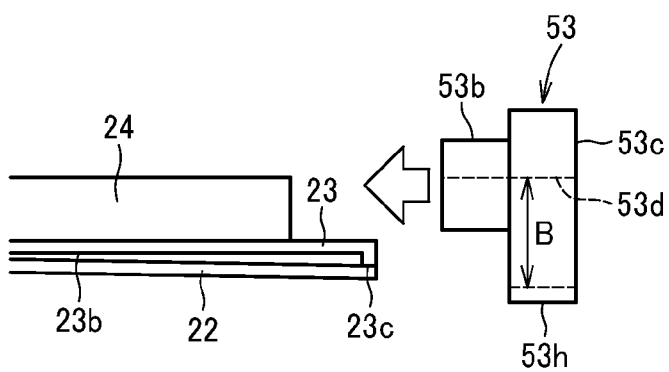


FIG. 12G

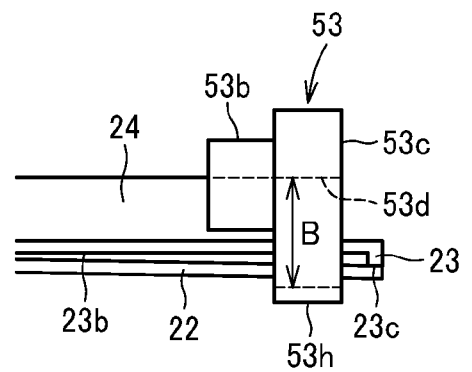


FIG. 13A

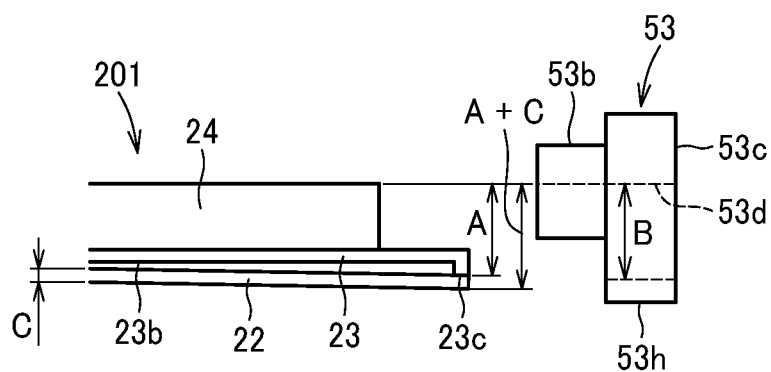


FIG. 13B

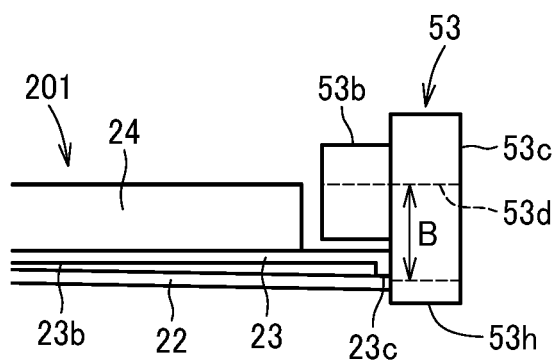
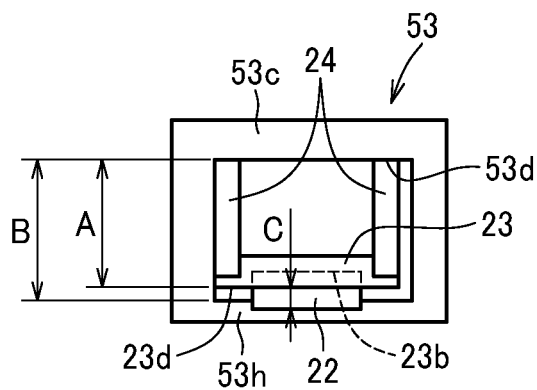


FIG. 13C



$$A < B < A + C$$

FIG. 14A

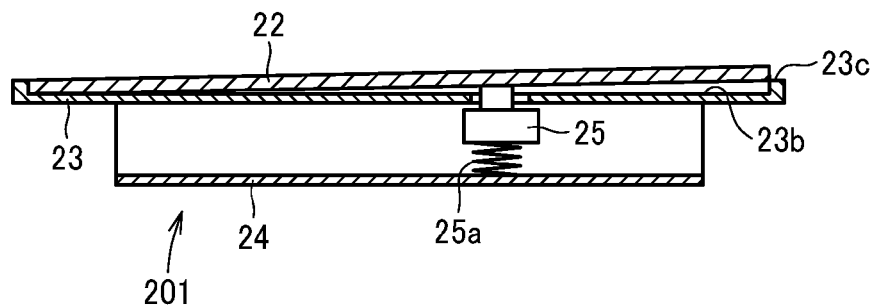


FIG. 14B

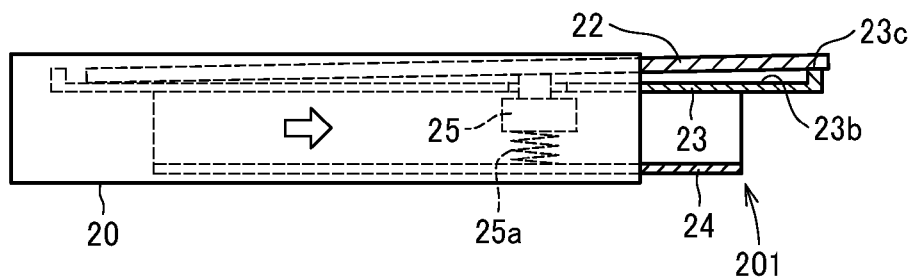


FIG. 14C

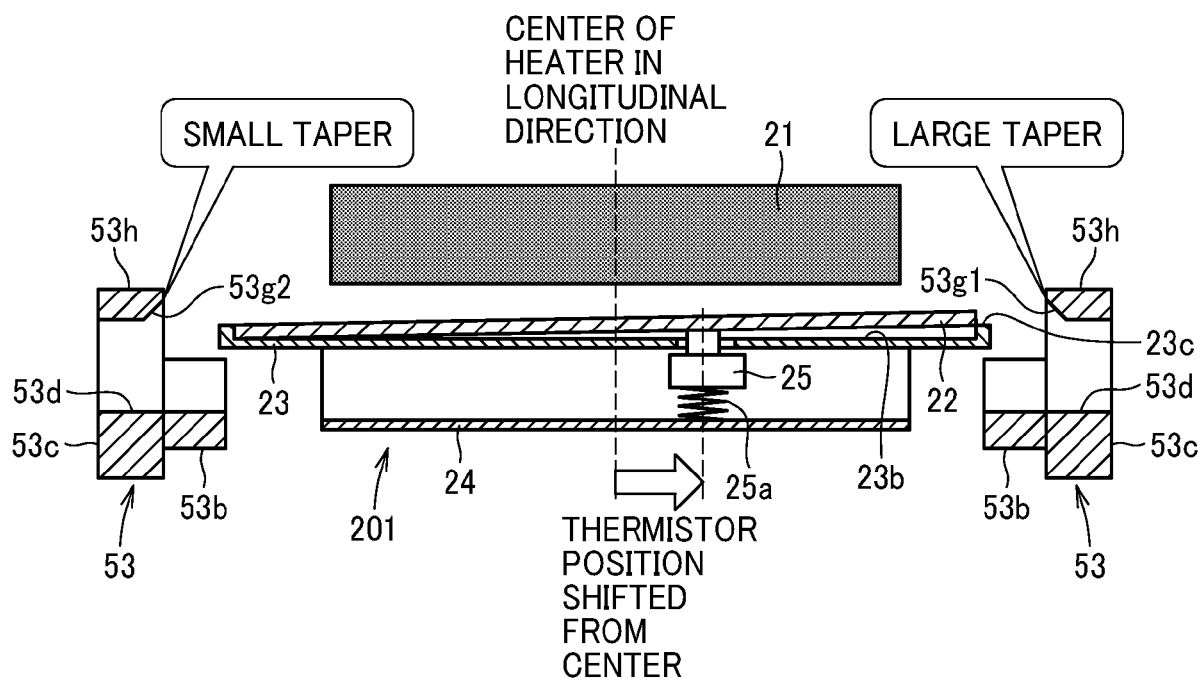


FIG. 15A

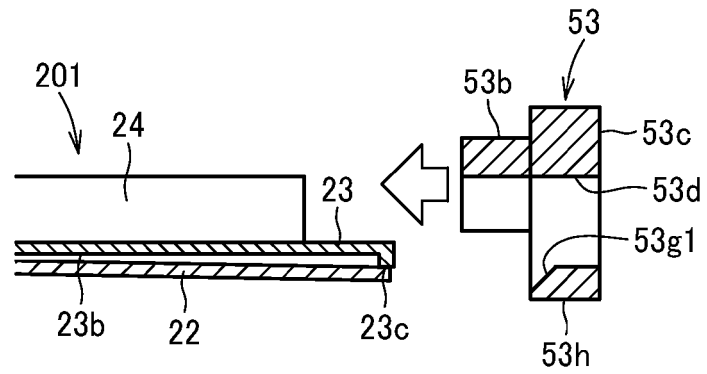


FIG. 15B

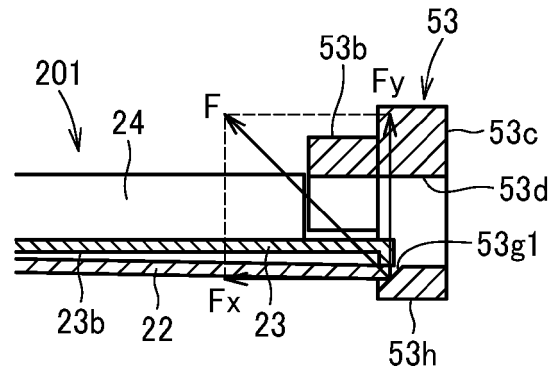


FIG. 15C

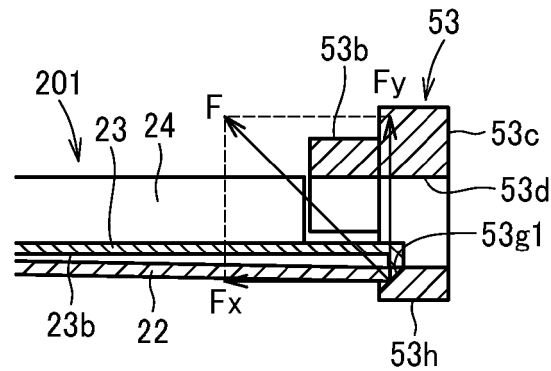


FIG. 15D

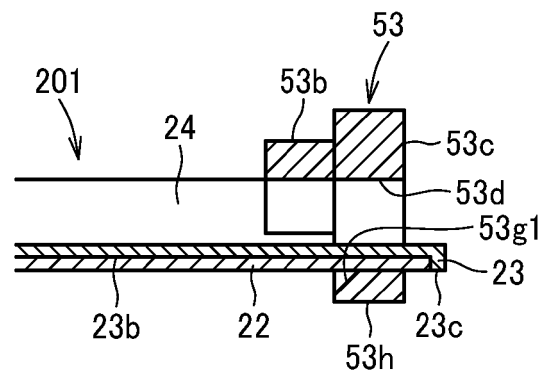


FIG. 16A

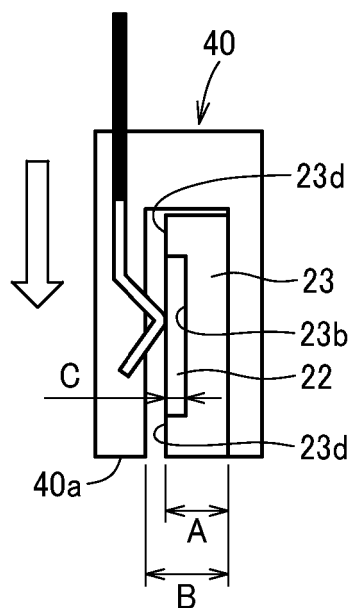


FIG. 16B

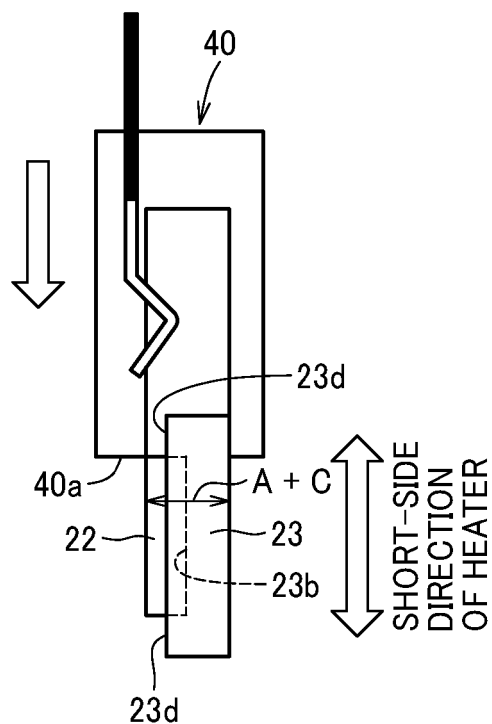


FIG. 16C

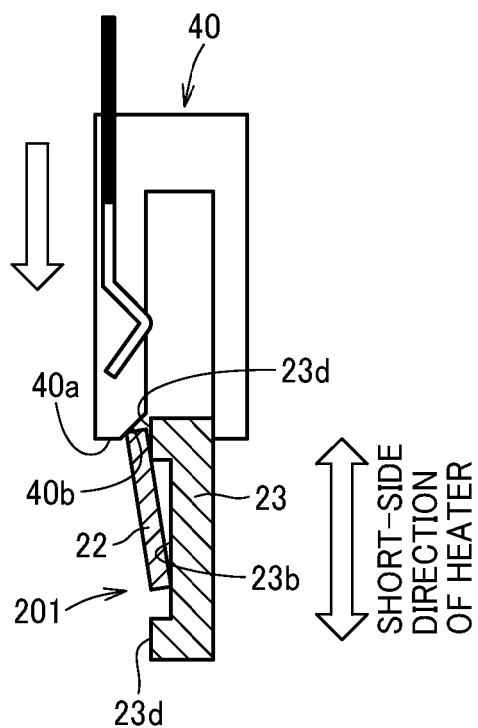


FIG. 16D

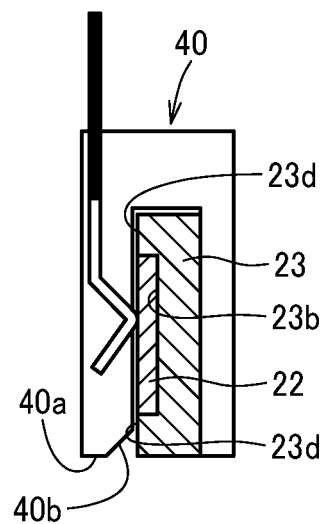


FIG. 16E

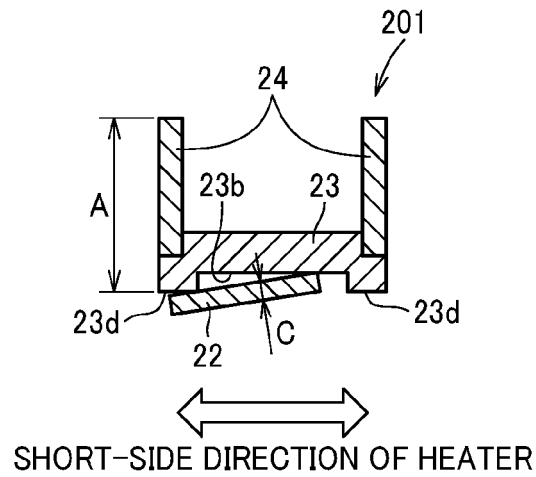


FIG. 16F

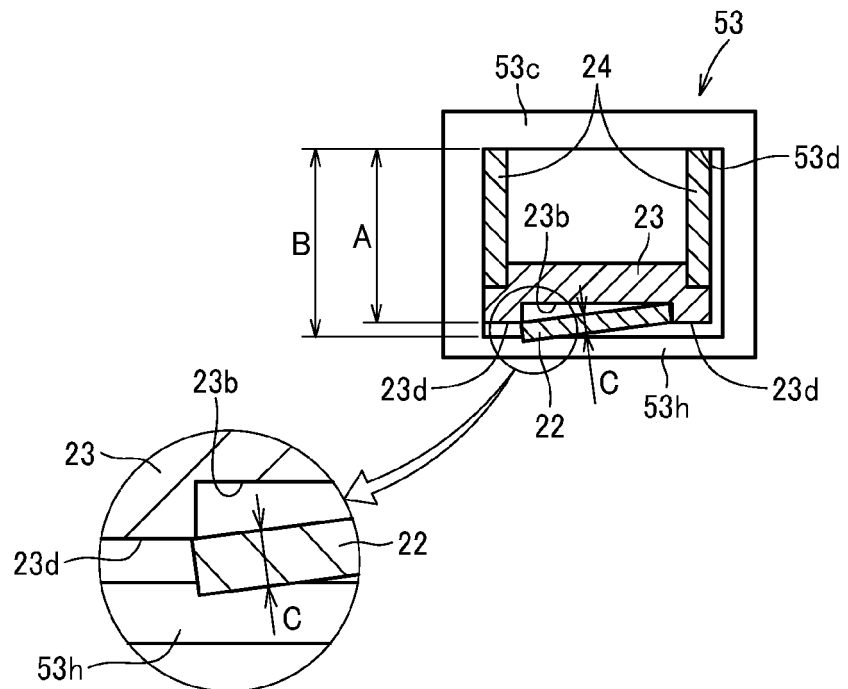


FIG. 16G

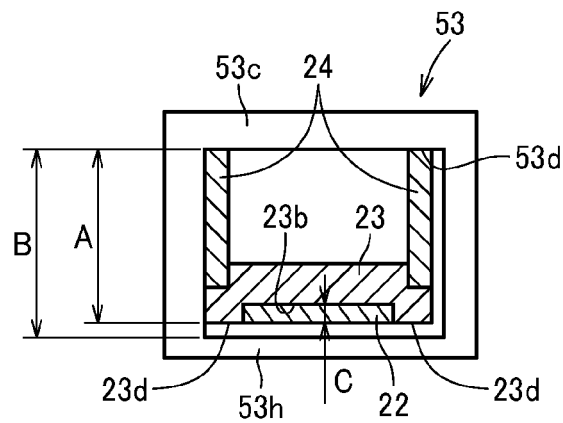


FIG. 16H

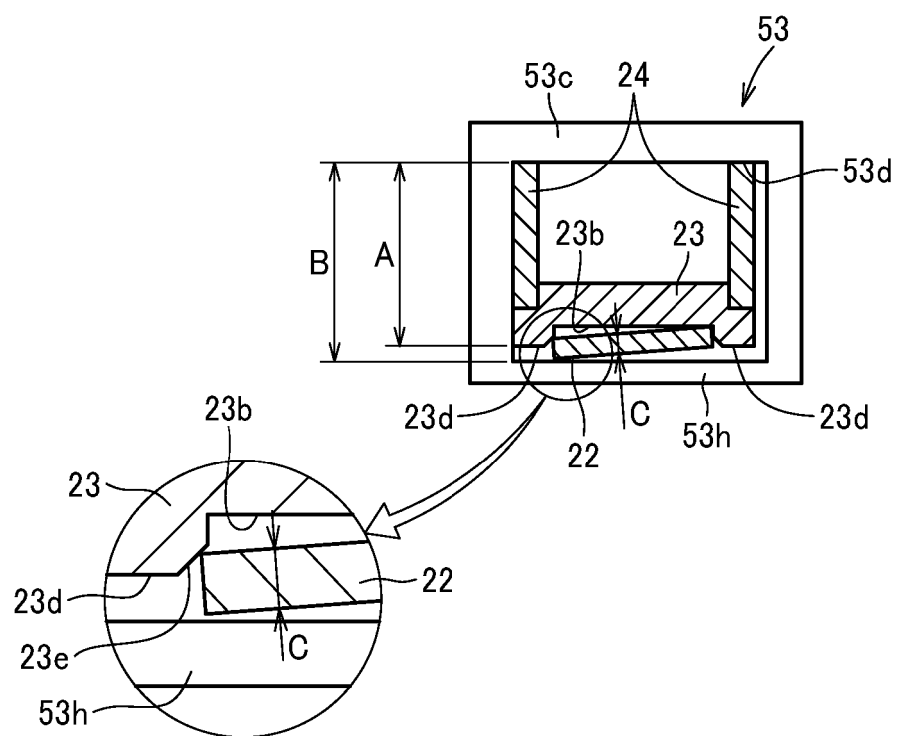


FIG. 17

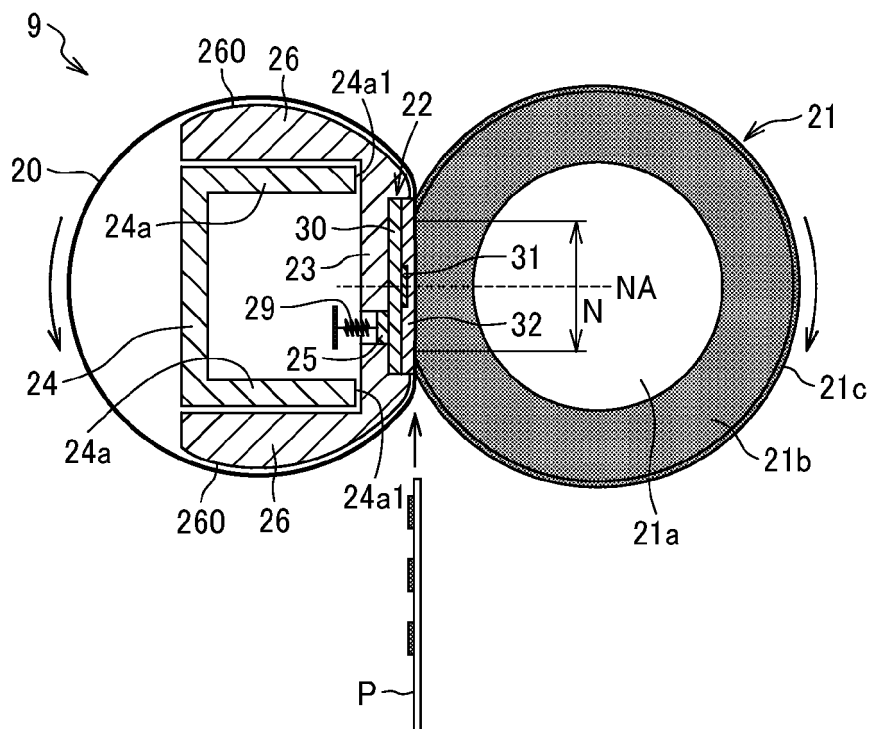


FIG. 18

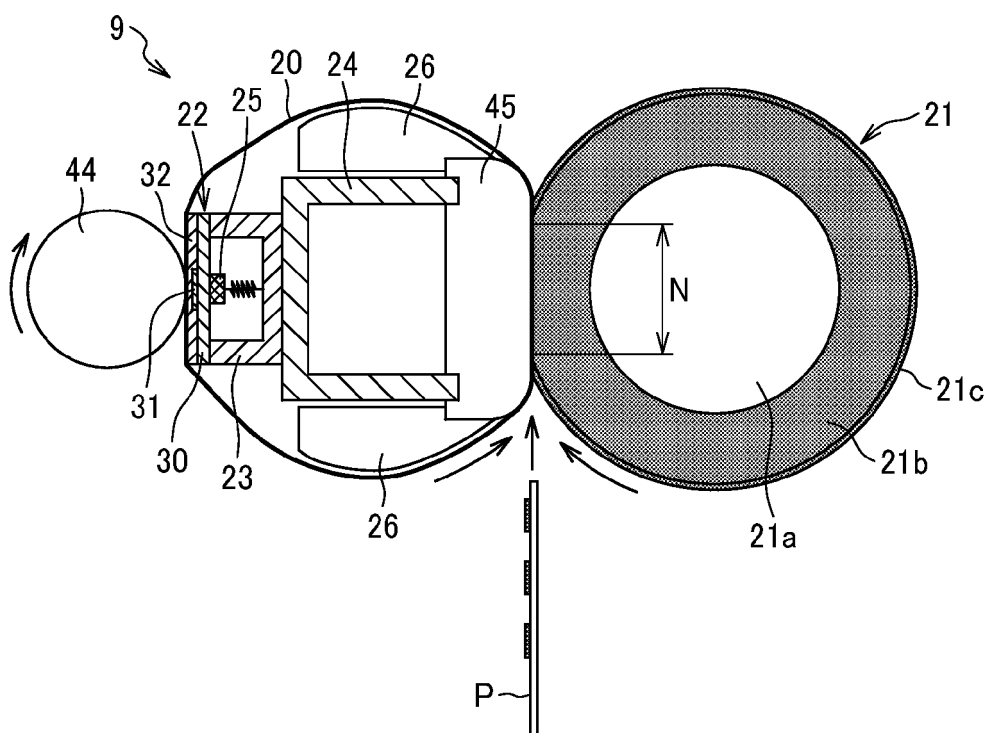


FIG. 19

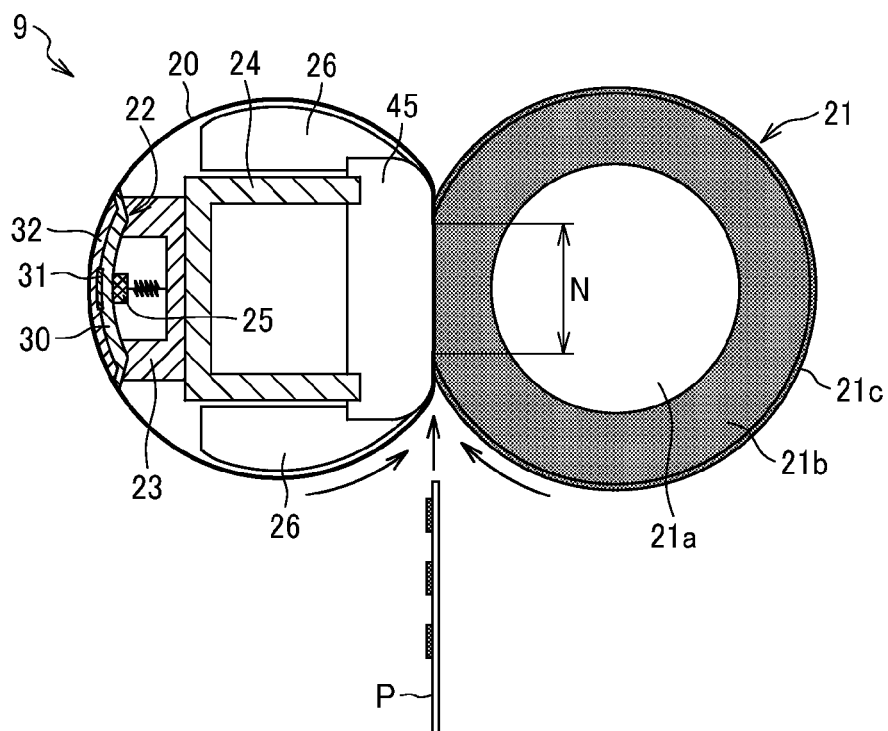


FIG. 20

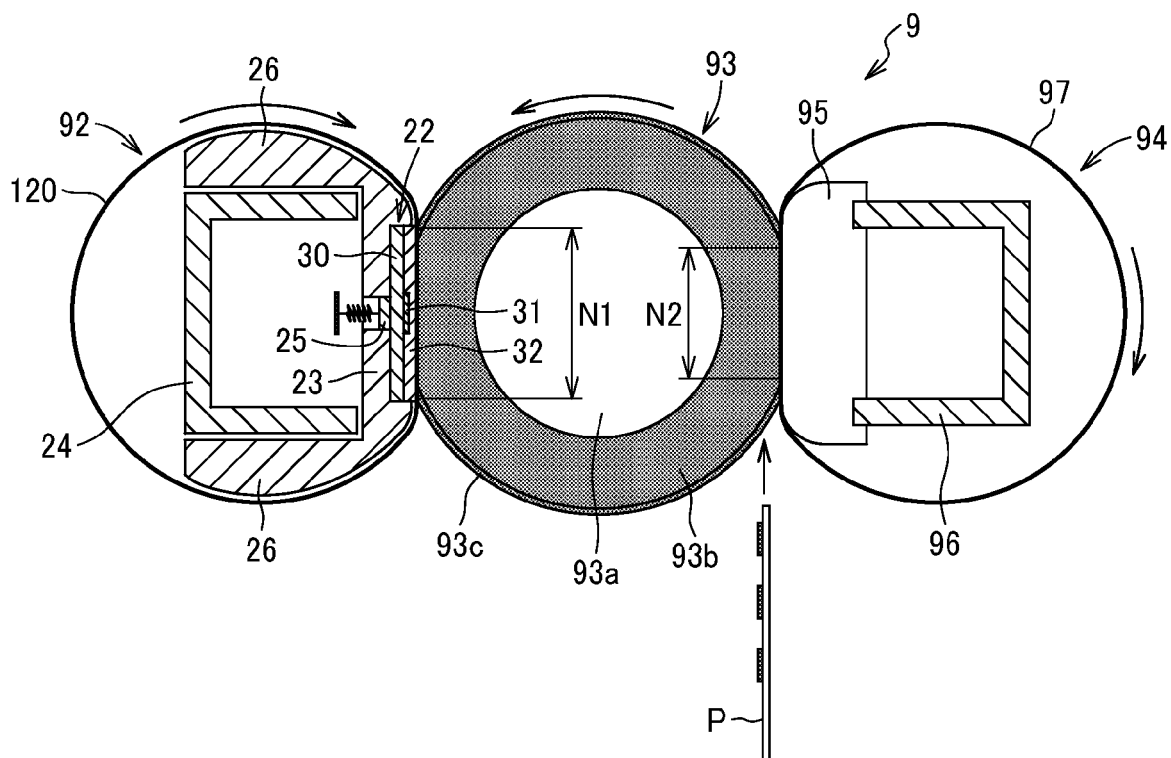


FIG. 21

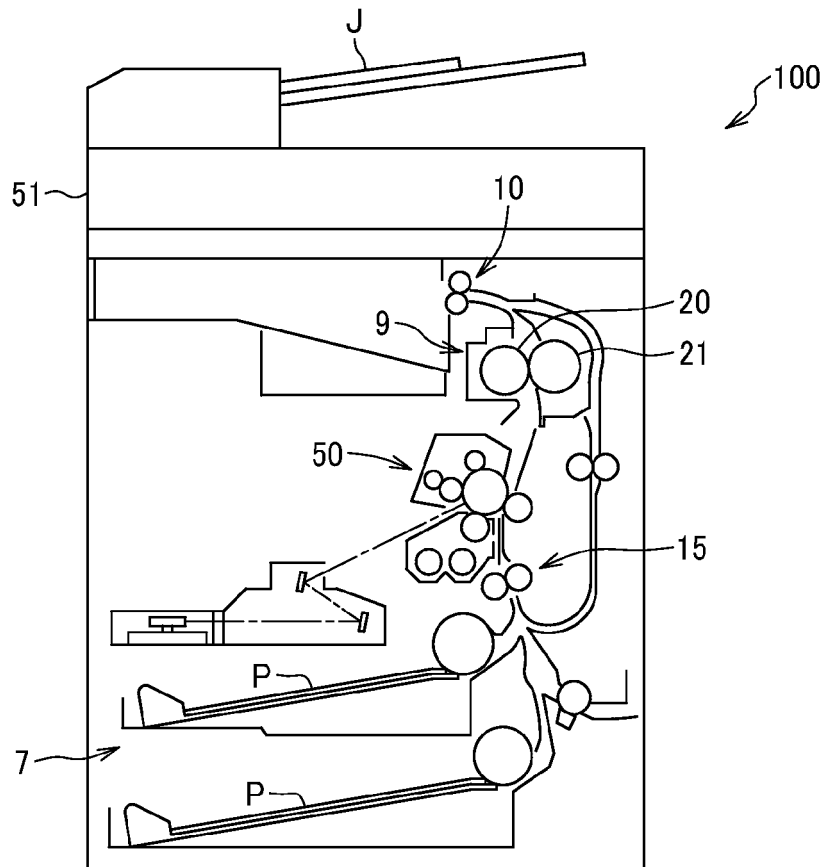


FIG. 22

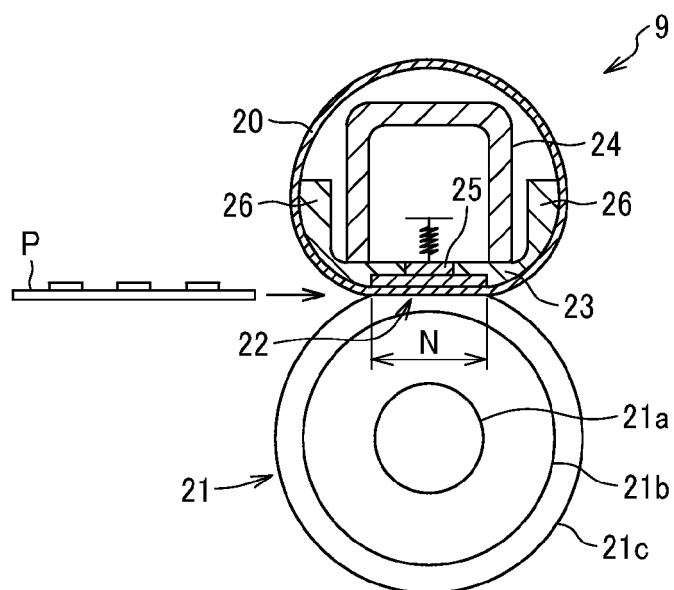


FIG. 23

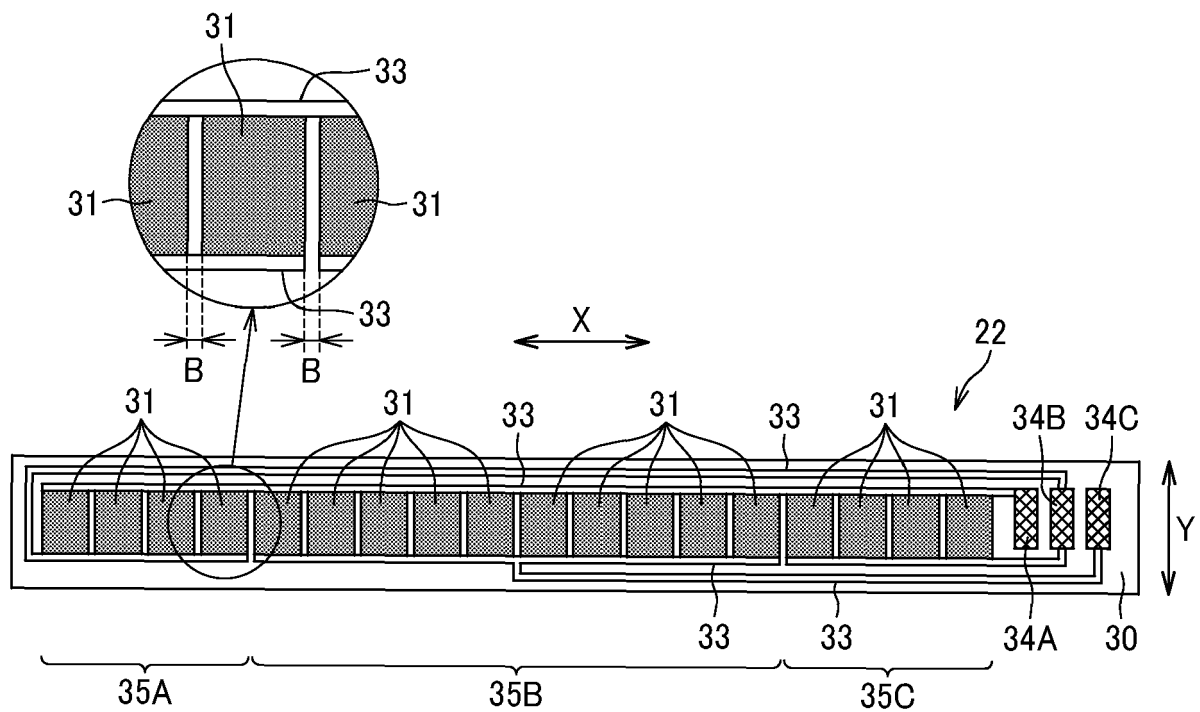


FIG. 24

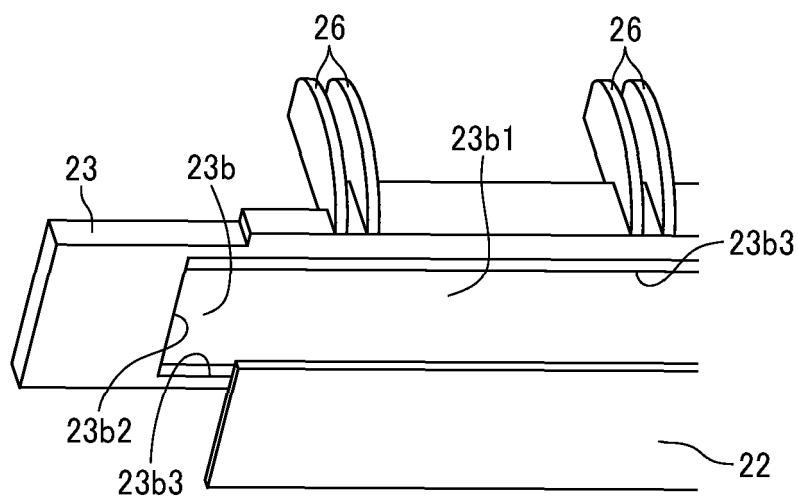


FIG. 25

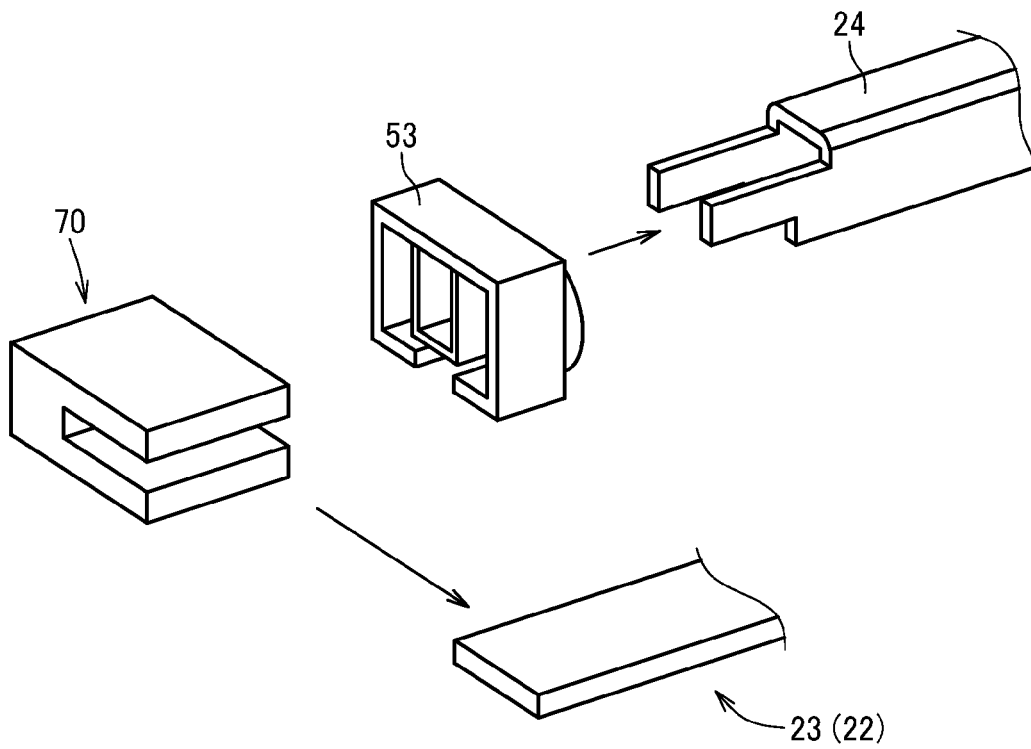


FIG. 26

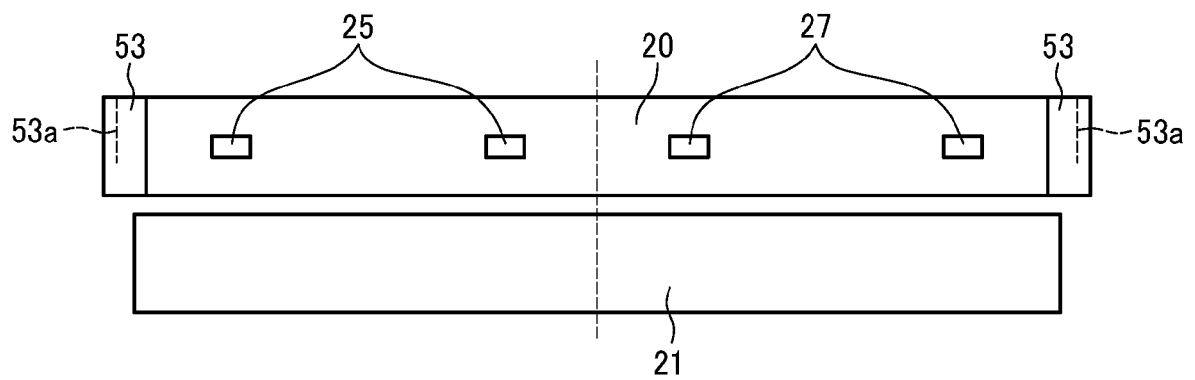


FIG. 27

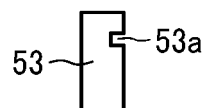


FIG. 28

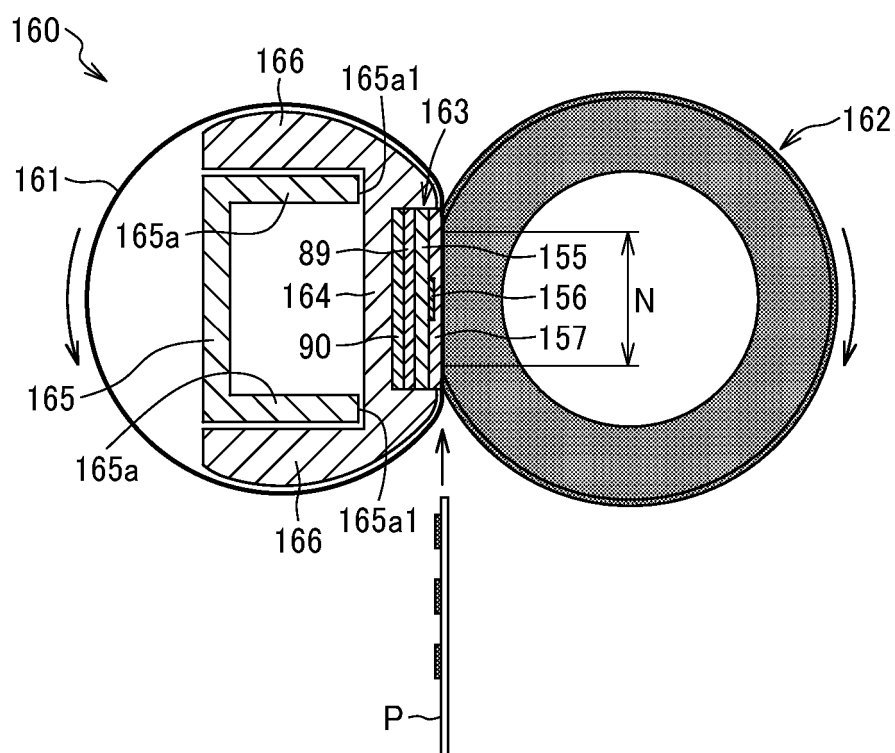


FIG. 29

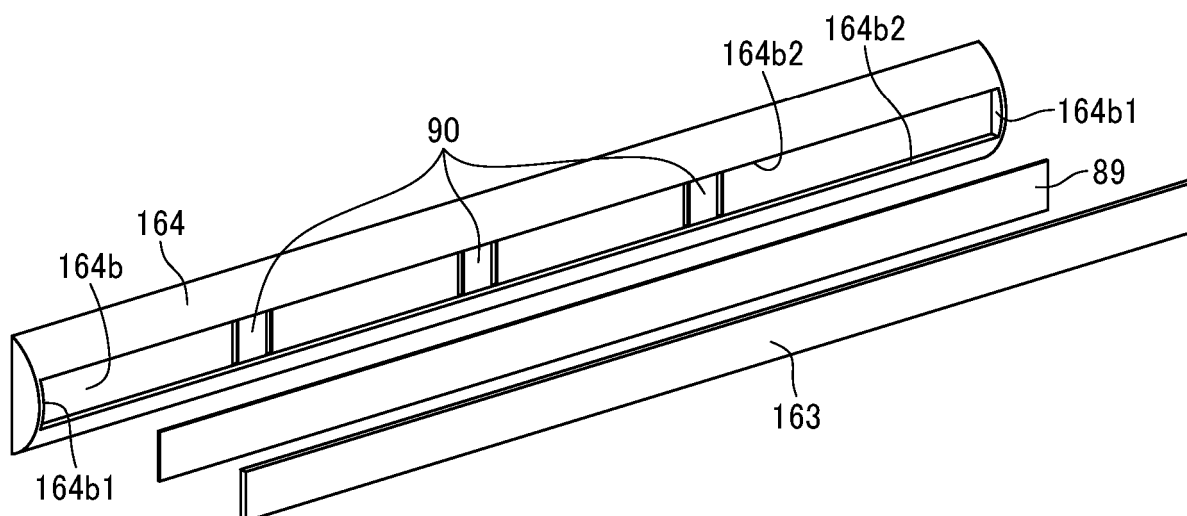


FIG. 30

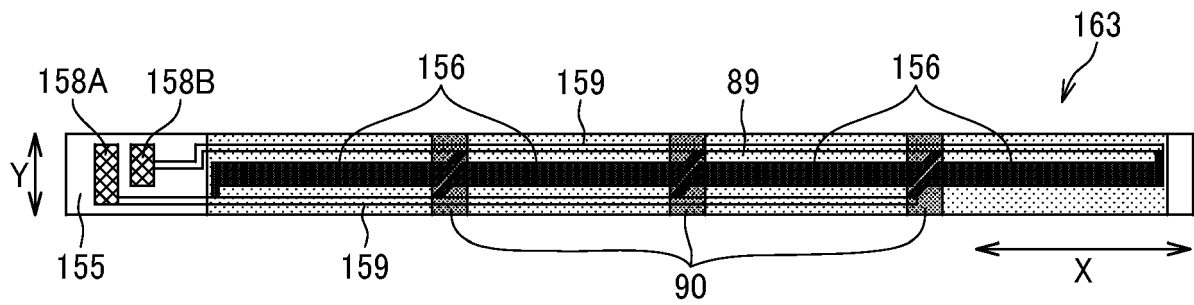


FIG. 31

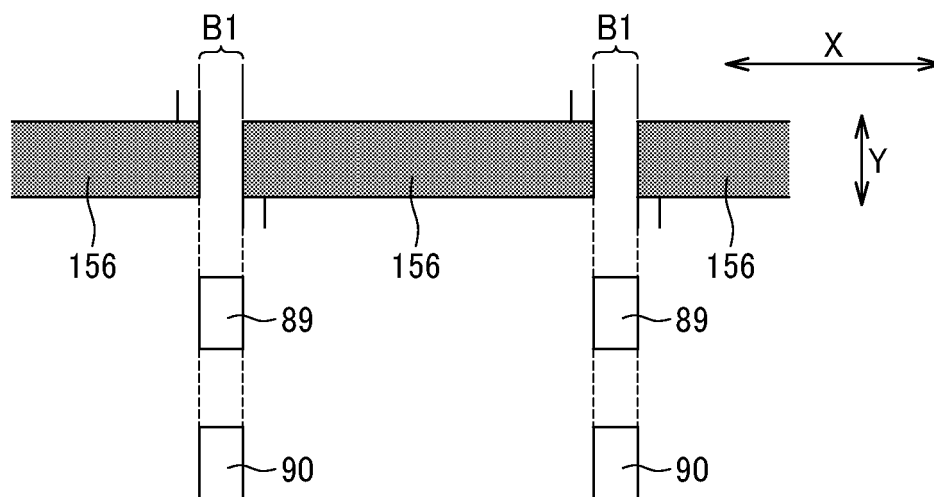


FIG. 32

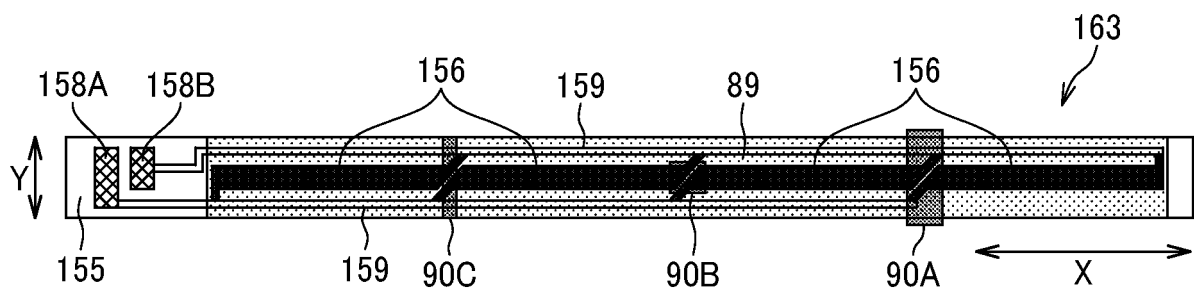


FIG. 33

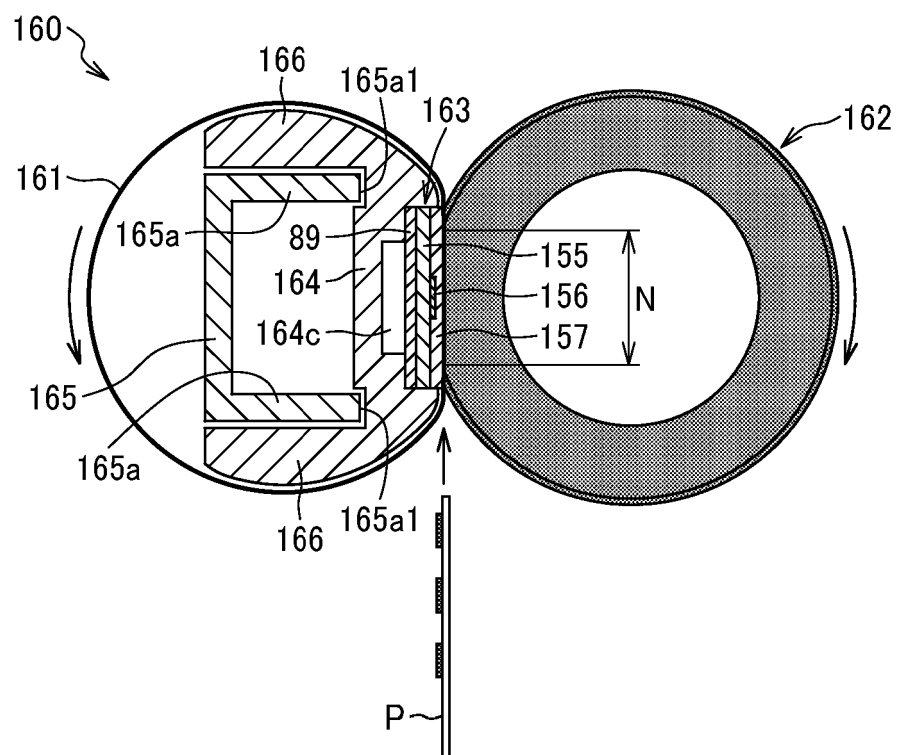


FIG. 34

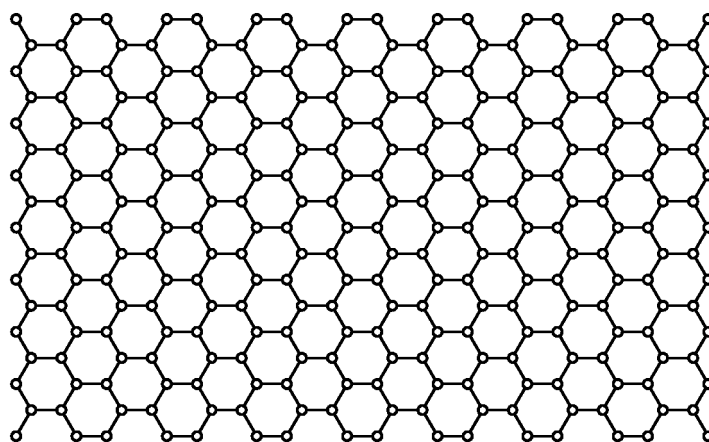
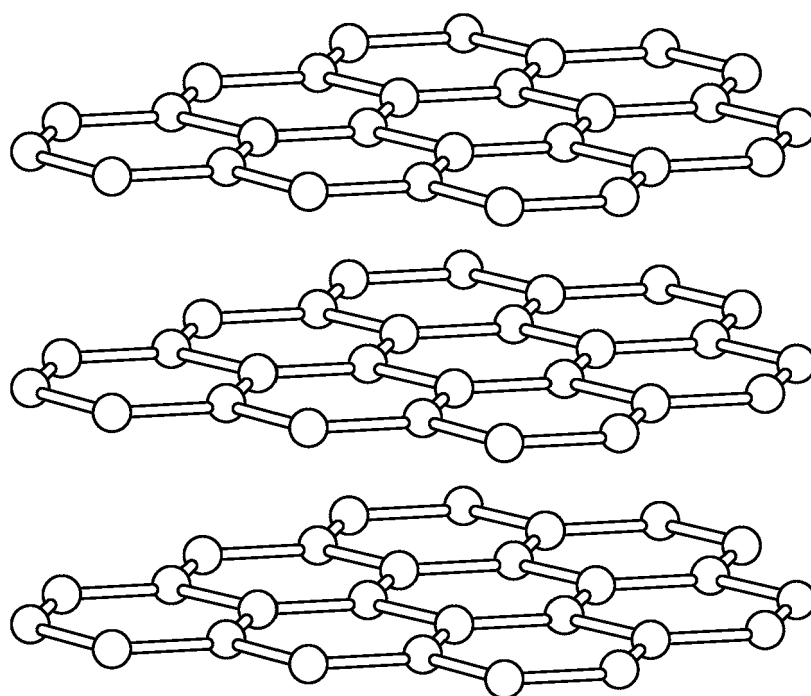


FIG. 35





EUROPEAN SEARCH REPORT

Application Number

EP 24 22 2679

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2020/103814 A1 (SOMEYA YUKIMICHI [JP] ET AL) 2 April 2020 (2020-04-02)	1,3-5	INV. G03G15/20
A	* 2-158, Fig. 1-28 *	2	

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A	* 2-238, Fig. 1-70 *	2	

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A	* 2-71, Fig. 1-18 *	2	

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A	* 2-91, Fig. 1-27 *	2	

The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			G03G
Place of search			Examiner
Munich			Scarpa, Giuseppe
Date of completion of the search			
11 April 2025			
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