



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.09.2024 Bulletin 2024/38

(51) International Patent Classification (IPC):
G03G 15/20 ^(2006.01) **G03G 21/16** ^(2006.01)

(21) Application number: **24162881.7**

(52) Cooperative Patent Classification (CPC):
G03G 15/2028; G03G 15/2053; G03G 21/1619;
G03G 21/1647; G03G 21/1685

(22) Date of filing: **12.03.2024**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

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(30) Priority: **14.03.2023 JP 2023039785**

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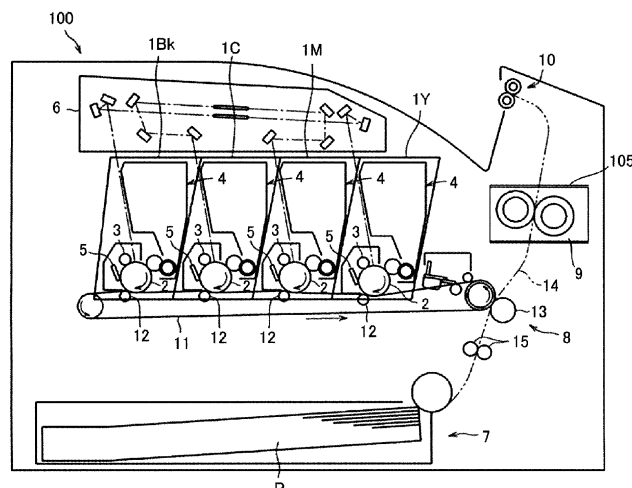
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(54) **FIXING DEVICE AND IMAGE FORMING APPARATUS**

(57) A fixing device (9) to be attached to an image forming apparatus (100) includes a housing frame, a rotatable endless fixing belt (20), a heater (22), a heater holder (23), a stay (24), a pressure roller (21) to form a nip between the fixing belt and the pressure roller, a guide plate (26), and a separation plate (25). The housing frame includes a support plate (29) on a same side as the pressure roller with respect to the nip in a direction intersecting

a longitudinal direction of the support plate and a pair of side plates (28) on both ends of the support plate in the longitudinal direction. The pair of side plates are attached to at least one of the separation plate, the guide plate, and the stay, on a same side as the fixing belt with respect to the nip in the direction intersecting the longitudinal direction.

FIG. 1



Description

BACKGROUND

Technical Field

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

Related Art

[0002] In image forming apparatuses such as copiers, printers, and facsimiles, images are formed by image forming processes such as electrophotographic recording, electrostatic recording, and magnetic recording, and unfixed toner images are formed on recording media (e.g., sheets) by an image transfer method or a direct method. As a fixing device for fixing an unfixed toner image, one is known that includes a heating means and heats and pressurizes a toner image formed on a recording medium in a nip between a fixing member and a pressure roller to perform a fixing process.

[0003] In a fixing device used in an electrophotographic image forming apparatus, a thin belt member (fixing belt) having a low heat capacity is used as a fixing member from the viewpoint of energy saving, and for example, For example, a configuration is known in which a nip is formed between a heating body disposed inside the loop of the fixing belt and a pressure roller with the fixing belt interposed therebetween.

[0004] In a fixing device, the stability of a housing frame and the positional accuracy of constituent members are required. However, in a fixing device including a heating means, the positioning accuracy between constituent members may decrease due to, for example, differences in thermal expansion coefficients of the constituent members.

[0005] On the other hand, Japanese Unexamined Patent Application Publication No. 2020-52345 discloses a configuration that includes a first positioning portion for positioning a heating member and a holding member in a longitudinal direction of the heating member, a second positioning portion for positioning the holding member and an apparatus frame in the longitudinal direction of the heating member, and a third positioning portion for positioning the apparatus frame and an image forming apparatus body in the longitudinal direction of the heating member. The first positioning portion and the second positioning portion or the first positioning portion and the third positioning portion are disposed on the same side with respect to a central portion of a heat generation portion in the longitudinal direction of the heating member.

[0006] According to the configuration of Japanese Unexamined Patent Application Publication No. 2020-52345, in a fixing device including a heating device, it is possible to enhance the accuracy in relative positions of a heating member, a holding member, and a housing

frame.

[0007] However, since the fixing device includes, as its housing frame, a first frame including a pair of side wall portions and a front wall portion and a second frame including a rear wall portion, there are problems such as an increase in the size of the apparatus, an increase in the weight of the apparatus, and an increase in the cost of components.

[0008] On the other hand, it is necessary to stabilize the housing frame in order to stably hold the constituent members disposed in the apparatus.

SUMMARY

[0009] In light of the above-described problem, an object of the present invention is to provide a fixing device in which a housing frame can be stabilized without increasing device weight and cost.

[0010] In order to solve the problems described above, according to an embodiment of the present disclosure, a fixing device to be attached to an image forming apparatus includes a housing frame, a rotatable endless fixing belt, a heater to heat the fixing belt, a heater holder to hold the heater, a stay disposed inside the fixing belt to support the heater holder, a pressure roller to form a nip between the fixing belt and the pressure roller, a guide plate to guide a recording medium to the nip, and a separation plate to separate the recording medium that has passed through the nip from the fixing belt. The housing frame includes a support plate disposed on a same side as the pressure roller with respect to the nip in a direction intersecting a longitudinal direction of the support plate and a pair of side plates disposed on both ends of the support plate in the longitudinal direction. The pair of side plates are attached to at least one of the separation plate, the guide plate, and the stay, on a same side as the fixing belt with respect to the nip in the direction intersecting the longitudinal direction.

[0011] According to the present invention, a fixing device can be provided that allows a housing frame to be stabilized without increasing device weight and cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] 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 cross-sectional view of an image forming apparatus according to an embodiment of the present disclosure;

FIG. 2 is a schematic view of a fixing device incorporated in the image forming apparatus of FIG. 1;

FIG. 3 is a perspective view of a heating device incorporated in the fixing device depicted in FIG. 2;

FIG. 4 is an exploded perspective view of the heating

device depicted in FIG. 3;
 FIG. 5 is a side view of the fixing device of FIG. 2;
 FIG. 6A is a perspective view of the fixing device of FIG. 2;
 FIG. 6B is a schematic plan view of the fixing device of FIG. 6A;
 FIG. 6C is a schematic plan view of a comparative example of a fixing device;
 FIG. 7 is a perspective view of an example of a configuration of positioning and fixing a side plate with a separation plate;
 FIG. 8 is a perspective view of an example of a configuration of positioning and fixing a side plate with a separation plate;
 FIG. 9 is a perspective view of an example of a configuration of positioning and fixing a side plate with a separation plate;
 FIG. 10 is a perspective view of an example of a configuration of positioning and fixing a side plate with a separation plate;
 FIG. 11 is a perspective view of an example of a configuration of positioning and fixing a side plate with a separation plate;
 FIG. 12 is a perspective view of the fixing device and a fixing-device installation frame of the image forming apparatus of FIG. 1;
 FIG. 13A is a perspective view of the fixing device attached to the image forming apparatus illustrated in FIG. 12;
 FIG. 13B is a schematic plan view of the fixing device attached to the image forming apparatus illustrated in FIG. 13A;
 FIG. 13C is a schematic plan view of a comparative example of a fixing device attached to an image forming apparatus;
 FIG. 14 is a partial perspective view of the fixing device attached to the image forming apparatus illustrated in FIG. 13A;
 FIG. 15 is a perspective view of a fixing device and a side plate, illustrating dimensions of the side plate;
 FIG. 16 is a diagram illustrating dimensions of insertion holes in an installation frame wall;
 FIG. 17 is a partial perspective view of protruding ends of the side plate of FIG. 15 and insertion holes of the installation frame wall;
 FIG. 18A is a diagram illustrating the installation frame wall of FIG. 16;
 FIG. 18B is a diagram illustrating the fixing device of FIG. 2 fixed to the installation frame wall;
 FIG. 19A is a diagram illustrating an installation frame wall;
 FIG. 19B is a diagram illustrating the fixing device of FIG. 2 fixed to the installation frame wall;
 FIG. 20 is a schematic view of a fixing device having a configuration different from the configuration of the fixing device of FIG. 2;
 FIG. 21 is a plan view of a heater illustrated in FIG. 20;
 FIG. 22 is a schematic cross-sectional side view of

a fixing device having a configuration different from the configuration of the fixing device of FIG. 2;
 FIG. 23 is a schematic cross-sectional side view of a fixing device having a configuration different from the configuration of the fixing device of FIG. 2;
 FIG. 24 is a schematic cross-sectional side view of a fixing device having a configuration different from the configuration of the fixing device of FIG. 2;
 FIG. 25 is a schematic cross-sectional side view of a fixing device having a configuration different from the configuration of the fixing device of FIG. 2;
 FIG. 26 is a schematic cross-sectional side view of an image forming apparatus having a configuration different from the configuration of the image forming apparatus of FIG. 1;
 FIG. 27 is a cross-sectional view of a fixing device illustrated in FIG. 26;
 FIG. 28 is a plan view of a heater illustrated in FIG. 27;
 FIG. 29 is a partial perspective view of a heater holder and the heater illustrated in FIG. 27;
 FIG. 30 is a perspective view of a connector to be attached to the heater illustrated in FIG. 27;
 FIG. 31A is a diagram illustrating positions of temperature sensors and thermostats included in the fixing device illustrated in FIG. 27;
 FIG. 31B is a diagram illustrating a groove of a flange illustrated in FIG. 30;
 FIG. 32 is a schematic cross-sectional side view of a fixing device having a configuration different from the configuration of the fixing device of FIG. 2;
 FIG. 33 is a perspective view of a heater, a first high-thermal conduction member, and a heater holder that are illustrated in FIG. 32;
 FIG. 34 is a plan view of the heater with an arrangement of the first high-thermal conduction member;
 FIG. 35 is a plan view of the heater with another example of the arrangement of the first high-thermal conduction member;
 FIG. 36 is a plan view of the heater with still another example of the arrangement of the first high-thermal conduction member;
 FIG. 37 is a plan view of the heater with an enlarged separation area;
 FIG. 38 is a cross-sectional view of a fixing device having a configuration different from the configuration of the fixing device of FIG. 2;
 FIG. 39 is a perspective view of a heater, a first high-thermal conduction member, a second high-thermal conduction member, and a heater holder that are illustrated in FIG. 38;
 FIG. 40 is a plan view of the heater with an arrangement of the first high-thermal conduction member and the second high-thermal conduction member;
 FIG. 41 is a plan view of the heater with another example of the arrangement of the first high-thermal conduction member and the second high-thermal conduction member;
 FIG. 42 is a plan view of the heater with still another

example of the arrangement of the second high-thermal conduction member;

FIG. 43 is a cross-sectional view of a fixing device having a configuration different from the configuration of the fixing device of FIG. 2;

FIG. 44 is a schematic diagram illustrating a two-dimensional atomic crystal structure of graphene; and

FIG. 45 is a schematic diagram illustrating a three-dimensional atomic crystal structure of graphite.

[0013] 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

[0014] 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.

[0015] 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.

[0016] Below, with reference to the drawings, a fixing device and an image forming apparatus according to embodiments of the present disclosure will be described. Note that the present invention is not to be considered limited to the following embodiments but can be changed within the range that can be conceived of by those skilled in the art, such as other embodiments, additions, modifications, deletions, and the scope of the present invention encompasses any aspect, as long as the aspect achieves the operation and advantageous effect of the present invention.

[0017] Note that elements (for example, mechanical parts and components) having the same or like functions and shapes are denoted by the same or like reference codes throughout the specification and repeated descriptions thereof may be omitted.

[0018] FIG. 1 is a schematic cross-sectional view of an image forming apparatus 100 according to an embodiment of the present disclosure.

[0019] In the following description, the term "image forming apparatus" includes a printer, a copier, a facsimile machine, or a multifunction peripheral having at least two of printing, copying, scanning, and facsimile functions. The term "image formation" includes the formation

of images with meanings such as characters and figures and the formation of images with no meanings such as patterns.

[0020] Initially, with reference to FIG. 1, a description is given of an overall configuration and operation of the image forming apparatus 100 according to the present embodiment.

[0021] The image forming apparatus 100 illustrated in FIG. 1 includes four image forming units 1Y, 1M, 1C, and 1Bk detachably attached to an apparatus body thereof. The image forming units 1Y, 1M, 1C, and 1Bk have substantially the same configuration except for containing different color developers, i.e., yellow (Y), magenta (M), cyan (C), and black (Bk) toners, respectively. The colors of the developers correspond to color separation components of full-color images. Each of the image forming units 1Y, 1M, 1C, and 1Bk includes a drum-shaped photoconductor 2 as an image bearer, a charging device 3, a developing device 4, and a cleaning device 5. The charging device 3 charges the surface of the photoconductor 2. The developing device 4 supplies toner as the developer to the surface of the photoconductor 2 to form a toner image. The cleaning device 5 cleans the surface of the photoconductor 2.

[0022] The image forming apparatus 100 includes an exposure device 6, a sheet feeding device 7, a transfer device 8, a fixing device 9 as a heating device, and a sheet ejection device 10.

[0023] The exposure device 6 exposes the surface of the photoconductor 2 to form an electrostatic latent image on the surface of the photoconductor 2. The sheet feeding device 7 supplies a recording medium (hereinafter also referred to as a "sheet") P to the sheet conveyance path 14. The transfer device 8 transfers toner images formed on the photoconductors 2 onto the sheet P. The fixing device 9 fixes the toner images transferred onto the sheet P to the surface of the sheet P. The sheet ejection device 10 ejects the sheet P outside the image forming apparatus 100. The image forming units 1Y, 1M, 1C, and 1Bk, the photoconductors 2, the charging devices 3, the exposure device 6, and the transfer device 8 constitute at least part of an image forming device that forms an image on a sheet.

[0024] The image forming apparatus 100 also includes a fixing-device installation frame 105 on which the fixing device 9 is removably disposed.

[0025] The fixing-device installation frame 105 has a structure for positioning the fixing device 9 mounted thereon. A configuration of the positioning will be described later.

[0026] The transfer device 8 includes an intermediate transfer belt 11 having an endless form and serving as an intermediate transferor, four primary transfer rollers 12 serving as primary transferors, and a secondary transfer roller 13 serving as a secondary transferor. The intermediate transfer belt 11 is stretched around a plurality of rollers. Each of the four primary transfer rollers 12 transfers the toner image on each of the photoconductors 2

onto the intermediate transfer belt 11. The secondary transfer roller 13 transfers the toner image transferred onto 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. Thus, the intermediate transfer belt 11 contacts each of the photoconductors 2, forming a primary transfer nip region between the intermediate transfer belt 11 and each of the photoconductors 2. 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, a secondary transfer nip is formed between the secondary transfer roller 13 and the intermediate transfer belt 11.

[0027] A timing roller pair 15 is disposed in a sheet conveyance path 14 at a position between the sheet feeding device 7 and the secondary transfer nip defined by the secondary transfer roller 13.

[0028] Referring to FIG. 1, a description is given of a printing operation performed by the image forming apparatus 100 described above.

[0029] 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 charger 3 charges the surface of the photoconductor 2 uniformly at a high electric potential. The exposure device 6 exposes the surface of each photoconductor 2 based on image data of the document read by the document reading device or print data instructed to be printed from the terminal. As a result, the potential of the exposed portion on the surface of each photoconductor 2 decreases, and an electrostatic latent image is formed on the surface of each photoconductor 2. The developing device 4 supplies toner to the electrostatic latent image formed on the photoconductor 2, forming a toner image thereon.

[0030] The toner image formed on each of the photoconductors 2 reaches the primary transfer nip defined by each of the primary transfer rollers 12 in accordance with rotation of each of the photoconductors 2. The toner images are sequentially transferred and superimposed onto the intermediate transfer belt 11 that is driven to rotate counterclockwise in FIG. 1 to form a full color toner image. Thereafter, the full color toner image formed on the intermediate transfer belt 11 is conveyed to the secondary transfer nip defined by the secondary transfer roller 13 in accordance with rotation of the intermediate transfer belt 11. The full color toner image is transferred onto the sheet P conveyed to the secondary transfer nip. The sheet P is supplied from the sheet feeding device 7. The timing roller pair 15 temporarily halts the sheet P supplied from the sheet feeding device 7. Thereafter, 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. Accordingly, 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.

[0031] 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. Thereafter, 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.

[0032] The examples of a recording medium on which an image is to be formed are not limited to the sheet P (a plain sheet of paper) and include thick paper, postcards, envelopes, plain paper, thin paper, coated paper, art paper, tracing paper, overhead projector (OHP) transparencies, plastic film, and prepreg, copper foil.

[0033] Subsequently, an example of a configuration of a fixing device according to an embodiment of the present disclosure will be described.

[0034] As illustrated in FIG. 2, a fixing device 9 according to the present embodiment that is attachable to an image forming apparatus 100 includes: a housing frame; a rotatable endless fixing belt 20 which is an example of a fixing member; a heater 22 to heat the fixing belt 20; a heater holder 23 to hold the heater 22; a stay 24 disposed inside the fixing belt 20 to support the heater holder 23; a pressure roller 21 to form a nip N between the pressure roller 21 and the fixing belt 20; a guide plate 26 to guide a recording medium (e.g., a sheet P) to the nip N; and a separation plate 25 to separate the recording medium having passed through the nip N from the fixing belt 20.

[0035] As illustrated in FIG. 2, the fixing device 9 includes a heating device 19 inside the loop of the fixing belt 20. The heating device 19 includes the heater 22, the heater holder 23, and the stay 24. The heater 22 is a planar or laminated heater and is an example of a heater or a heating member. The heater holder 23 is an example of a holder that holds or supports the heater 22. The stay 24 is an example of a reinforcement that reinforces the heater holder 23 throughout the entire width of the heater holder 23 in a longitudinal direction thereof.

[0036] A direction orthogonal to the plane on which FIG. 2 is drawn corresponds to a longitudinal direction of each of the fixing belt 20, the pressure roller 21, the heater 22, the heater holder 23, the stay 24, the separation plate 25, and the guide plate 26, and may be hereinafter simply referred to as the longitudinal direction. Note that the longitudinal direction is also a width direction of a sheet P being conveyed, a belt width direction of the fixing belt 20, and an axial direction of the pressure roller 21.

[0037] The fixing belt 20 includes, for example, a tubular base made of polyimide (PI) and having an outer diameter of 25 mm and a thickness of from 40 micrometers (μm) to 120 μm . 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) and polytetrafluoroethylene (PTFE), and has a

thickness of from 5 μm to 50 μm to enhance the durability of the fixing belt 20 and facilitate separation of a sheet P and a foreign substance from the fixing belt 20. Optionally, an elastic layer that is made of, for example, rubber and has a thickness of from 50 μm to 500 μm may be interposed between the base 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 SUS stainless steel, instead of polyimide. The inner circumferential face of the fixing belt 20 may be coated with PI or PTFE as a slide layer.

[0038] 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, for example, 3.5 mm. 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 the releasability.

[0039] 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 nip N is formed between the fixing belt 20 and the pressure roller 21. As a driver drives and rotates the pressure roller 21 in a direction indicated by an arrow in FIG. 2, the fixing belt 20 is rotated along with the rotation of the pressure roller 21.

[0040] The heater 22 extends in a longitudinal direction thereof throughout the entire width of the fixing belt 20 in the width direction of the fixing belt 20. The heater 22 is disposed to contact the inner circumferential surface of the fixing belt 20. The heater 22 may not contact the fixing belt 20 or may be disposed opposite the fixing belt 20 indirectly via, for example, a low friction sheet. However, the heater 22 that directly contacts the fixing belt 20 enhances the conduction of heat from the heater 22 to the fixing belt 20. The heater 22 may contact the outer circumferential surface of the fixing belt 20. However, if the outer circumferential surface of the fixing belt 20 is brought into contact with the heater 22 and damaged, the fixing belt 20 may degrade the quality of fixing the toner image on the sheet P. For this reason, preferably, the heater 22 contacts the inner circumferential surface of the fixing belt 20.

[0041] A detailed description is now given of a 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 includes a channel made of metal. Both lateral ends of the stay 24 in a longitudinal direction thereof are supported by side walls of the fixing device 9. The stay 24 supports a stay-side face of the heater holder 23 that faces the stay 24 and is opposite a heater-side face of the heater holder 23 that faces the heater 22. Accordingly, the stay 24 retains the heater 22 and the heater holder 23 so that the heater 22 and the heater holder 23 are not substantially

bent by the pressure from the pressure roller 21, thus forming the fixing nip N between the fixing belt 20 and the pressure roller 21.

[0042] Since the heater holder 23 is heated to high temperature by heat from the heater 22, the heater holder 23 is preferably made of a heat resistant material. For example, if the heater holder 23 is made of heat resistant resin having a relatively low thermal conductivity, such as liquid crystal polymer (LCP) and PEEK, the conduction of heat from the heater 22 to the heater holder 23 can be reduced, thus facilitating heating of the fixing belt 20.

[0043] When printing starts, the driver drives and rotates the pressure roller 21, and the fixing belt 20 starts rotation in accordance with rotation of the pressure roller 21.

Additionally, as power is supplied to the heater 22, the heater 22 heats the fixing belt 20. In a state in which the temperature of the fixing belt 20 reaches a predetermined target temperature (e.g., a fixing temperature), the sheet P bearing the unfixed toner image is guided by the guide plate 26 and conveyed to the nip N between the fixing belt 20 and the pressure roller 21 as illustrated in FIG. 2. Thus, the unfixed toner image is fixed on the sheet P under heat and pressure. The sheet P on which the toner image has been fixed is separated from the fixing belt 20 and the pressure roller 21 by a separation plate 25.

[0044] A heating device included in the fixing device according to the present embodiment is illustrated in FIGS. 3 and 4.

[0045] FIG. 3 is a perspective view of the heating device 19. FIG. 4 is an exploded perspective view of the heating device 19.

[0046] As illustrated in FIG. 3, the heater holder 23 includes an accommodating recess 23a disposed on the belt-side face of the heater holder 23 that faces the fixing belt 20 and the nip N. The accommodating recess 23a is rectangular and accommodates the heater 22. A connector described below sandwiches the heater 22 and the heater holder 23 in a state in which the accommodating recess 23a accommodates the heater 22, thus holding the heater 22.

[0047] Each of the pair of flanges 32 includes a belt support 32b, a belt restrictor 32c, and a supporting recess 32d. The belt support 32b 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 32c has a flange shape and contacts an end 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 supporting recess 32d 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.

[0048] Furthermore, the flange 32 has guide grooves 32a extending in the direction in which the fixing belt 20 moves toward or away from the pressure roller 21.

[0049] The guide grooves 32a are engaged with a pair of side plates 28 constituting part of the housing frame

of the fixing device 9.

[0050] When the side plates 28 enter along the guide grooves 32a, the heating device 19 is assembled to the housing frame of the fixing device 9. The fixing belt 20 has a configuration in which the side plates 28 relatively move in the guide grooves 32a such that the fixing belt 20 is movable in a direction toward and away from the pressure roller 21.

[0051] Fitting portions 24a that protrude toward the heater holder 23 are disposed at each end of the stay 24 in the longitudinal direction. The fitting portions 24a fit into stay-fitted portions 28b that are fitted portions of each side plate 28.

[0052] The fitting portion 24a and the guide groove 32a are disposed on the same straight line along the direction of entry of the side plate 28 indicated by a dashed arrow in FIG. 4.

[0053] Fitting of the fitting portions 24a of the stay 24 with the stay-fitted portions 28b of each side plate 28 positions the relative positions and defines the separation distance (distance in the longitudinal direction) between the pair of side plates 28.

[0054] The side plates 28 are thus supported by the stay 24, which stabilizes the housing frame of the fixing device 9.

[0055] The width of the recess of each fitting portion 24a of the stay 24 may be any width as long as the recess can engage with the corresponding stay-fitted portion 28b of the side plate 28, and is selectable as appropriate according to the thinness of the side plate 28.

[0056] To ensure the stiffness of the stay 24, the stay 24 is preferably made of an iron-based metal material such as stainless steel or electrogalvanized steel sheet (SECC).

[0057] FIG. 5 is a side view of the fixing device according to the present embodiment. FIG. 6A is a perspective view of the fixing device according to the present embodiment.

[0058] FIGS. 6B and 6C are schematic views of the housing frame of the fixing device 9. FIG. 6B illustrates a configuration of the fixing device 9 of the present embodiment. FIG. 6C illustrates a configuration of a comparative example of a fixing device.

[0059] The housing frame of the fixing device according to the present embodiment includes a support plate 29 and the pair of side plates 28. The support plate 29 is disposed facing the pressure roller 21. The pair of side plates 28 are disposed on both ends of the support plate 29 in the longitudinal direction. When support-plate fitting protrusions 28d of the side plates 28 fit into fitting holes 29b of the support plate 29, the side plates 28 and the support plate 29 are assembled together.

[0060] Each side plate 28 has a bearing 28c that supports a rotation shaft of the pressure roller 21. The pressure roller 21 is rotatably supported by the side plates 28 with both ends of the rotation shaft fitted in the bearings 28c of the side plates 28.

[0061] The side plate 28 has a substantially C-shape

with an opening for supporting the pressure roller 21, and the substantially C-shape have protruding ends 28a, each of which gradually becomes narrower toward the tip thereof.

[0062] The two protruding ends 28a are disposed across an opening of the substantially C-shape and on each one of the pair of right and left side plates 28, and the housing frame as a whole has four protruding ends 28a.

[0063] A drive transmission gear 31 as an example of a driving force transmitter is disposed at one axial end of the rotation shaft of the pressure roller 21. The drive transmission gear 31 is disposed to be exposed outward relative to the side plate 28 in a state in which the pressure roller 21 is supported by the side plate 28. Thus, when the fixing device 9 is mounted in the image forming apparatus 100 (installed in the fixing-device installation frame 105), the drive transmission gear 31 is engaged with a gear of the image forming apparatus 100 to enable transmission of the drive force from a drive source.

[0064] The flanges 32 support the fixing belt 20 in a state in which the fixing belt 20 is not basically applied with tension in a circumferential direction of the fixing belt 20 while the fixing belt 20 does not rotate, that is, by a free belt method.

[0065] Between each flange 32 and the support plate 29, a pair of springs as an example of biasing members is disposed. As the springs 33 bias the flanges 32 toward the pressure roller 21, the fixing belt 20 is pressed against the pressure roller 21 to form the nip N between the fixing belt 20 and the pressure roller 21.

[0066] The pair of side plates 28 are attached to at least one of the separation plate 25, the guide plate 26, and the stay 24 on the fixing belt 20.

[0067] Two or more members selected from the group consisting of the separation plate 25, the guide plate 26, and the stay 24 are preferably used to hold the pair of side plates 28. The combination of the two members is preferably a combination of the separation plate 25 and the guide plate 26.

[0068] As illustrated in FIG. 6C, a comparative example of a fixing device includes a fixing stay 40 as a member constituting part of a housing frame. The fixing stay 40 positions and fixes a pair of side plates 28 together with a support plate 29 to stabilize the housing frame.

[0069] On the other hand, in the fixing device 9 according to the present embodiment illustrated in FIG. 6B, the side plates 28 can be positioned and fixed by at least one of the separation plate 25, the guide plate 26, and the stay 24, which are existing constituent members. Accordingly, the fixing stay 40, which is a large-size member constituting one longitudinal side of the housing frame can be omitted, thus allowing the housing frame to be stabilized while achieving weight saving of the fixing device 9 and reduction of component costs. Stabilizing the housing frame can also prevent constituent members disposed inside from falling or dropping.

[0070] The manner in which the side plates 28 are at-

tached to the separation plate 25 is as follows.

[0071] One of each longitudinal end of the separation plate 25 and each side plate 28 has an engaging part and the other has an engaged part. The engaging part engages with the engaged part to determine the relative positions, and the separation distance of the pair of side plates 28 is defined.

[0072] The manner of the engagement include fitting and fastening.

[0073] The side plates 28 are attached to the separation plate 25 disposed above the fixing belt 20, and thus the upper separation distance between the pair of side plates 28 is defined.

[0074] Furthermore, the separation distance between the pair of side plates 28 on the same side as the pressure roller 21 with respect to the nip N is defined by the support plate 29. Accordingly, when the separation distance between the pair of side plates 28 on the same side as the fixing belt 20 with respect to the nip N is defined by the separation plate 25, the housing frame of the fixing device 9 is maintained in a stable state.

[0075] The manner in which the side plates 28 are attached to the guide plate 26 is as follows.

[0076] One of each longitudinal end of the guide plate 26 and each side plate 28 has an engaging part and the other has an engaged part. The engaging part engages with the engaged part to determine the relative positions, and the separation distance of the pair of side plates 28 is defined.

[0077] The manner of the engagement include fitting and fastening.

[0078] The side plate 28 is attached to the guide plate 26 disposed below the fixing belt 20, and thus the lower separation distance of the pair of side plates 28 is defined.

[0079] Furthermore, the separation distance between the pair of side plates 28 on the same side as the pressure roller 21 with respect to the nip N is defined by the support plate 29. Accordingly, when the separation distance between the pair of side plates 28 on the same side as the fixing belt 20 with respect to the nip N is defined by the guide plate 26, the housing frame of the fixing device 9 is maintained in a stable state.

[0080] The manner in which the stay 24 holds the side plates 28 is as follows.

[0081] One of each longitudinal end of the stay 24 and each side plate 28 has a fitting part and the other has a fitted part. The fitting part engages with the fitted part to determine the relative positions, and the separation distance of the pair of side plates 28 is defined.

[0082] For example, as illustrated in FIGS. 3 and 4, a manner can be given in which the fitting portions 24a at both longitudinal ends of the stay 24 fit into the stay-fitted portions 28b that are fitted portions of the side plates 28.

[0083] Furthermore, the separation distance between the pair of side plates 28 on the same side as the pressure roller 21 with respect to the nip N is defined by the support plate 29. Accordingly, when the separation distance between the pair of side plates 28 on the same side as the

fixing belt 20 with respect to the nip N is defined by the stay 24, the housing frame of the fixing device 9 is maintained in a stable state.

[0084] From the viewpoints of dimensional stability, strength, and thermal expansion, the separation plate 25, the guide plate 26, and the stay 24 that hold the side plates 28 are preferably metal members.

[0085] It is also preferable to have a plurality of combinations of engaging portions and engaged portions in the engagement of the separation plate 25 and the side plates 28 and the engagement of the guide plate 26 and the side plates 28.

[0086] It is also preferable to have a plurality of different combinations of engaging portions and engaged portions.

[0087] It is preferable that the combinations of engaging portions and engaged portions include, for example, both a combination in which the separation distance between the pair of side plates 28 is defined by the separation plate 25 and a combination in which the separation distance between the separation plate 25 and the fixing belt 20 is defined by positioning of the side plates 28 and the separation plate 25 relative to each other.

[0088] Similarly, it is preferable to include both a combination in which the separation distance between the pair of side plates 28 is defined by the guide plate 26 and a combination in which the separation distance between the guide plate 26 and the fixing belt 20 is defined.

[0089] FIGS. 7 to 11 are diagrams illustrating examples in which the separation plate 25 holds the side plates 28.

[0090] Although FIGS. 7 to 11 illustrate the examples of holding the side plates 28 by the separation plate 25, the guide plate 26 can also have a similar configuration.

[0091] In FIGS. 7 to 11, the pair of side plates 28 are a left side plate 28L and a right side plate 28R.

[0092] A description is given below of a first embodiment.

[0093] As illustrated in FIG. 7, both longitudinal ends of the separation plate 25 have bent surfaces facing the side plates 28. The bent surfaces have screw holes 301 as engaging portions. On the other hand, screw holes 201 as engaged sections are disposed at predetermined positions in the side plates 28.

[0094] Screw members are inserted through the screw holes 301 of the separation plate 25 and the screw holes 201 of the side plates 28 from the outside to fasten the separation plate 25 and the side plates 28 together.

[0095] Thus, the separation distance between the pair of side plates 28 is defined by the length of the separation plate 25.

[0096] Further, since the separation plate 25 is positioned relative to the side plates 28, the separation distance from the fixing belt 20 is defined.

[0097] Although two screw holes are disposed at one engagement point in FIG. 7, the number of screw holes is not limited to two.

[0098] A description is given below of a second embodiment.

[0099] As illustrated in FIG. 8, both longitudinal ends of the separation plate 25 have bent surfaces facing the side plates 28. The bent surfaces have screw holes 301 as engaging portions and two bosses (convex portions) 302. On the other hand, screw holes 201 as fitted portions and fitting holes 202 into which the bosses 302 fit are disposed at predetermined positions of the side plates 28.

[0100] The bosses 302 of the separation plate 25 and the fitting holes 202 of the side plates 28 are fitted with each other, and screw members are inserted from outside into the screw holes 301 of the separation plate 25 and the screw holes 201 of the side plates 28 to fasten the separation plate 25 and the side plates 28 together.

[0101] In the present embodiment, the separation plate 25 and the side plates 28 are fastened and fixed to each other, and the separation distance between the pair of side plates 28 is defined by the length of the separation plate 25.

[0102] Further, through fitting of the bosses 302 and the fitting holes 202, the separation plate 25 and the side plates 28 are positioned relative to each other, and the separation distance between the separation plate 25 and the fixing belt 20 is defined.

[0103] In FIG. 8, one screw hole, two bosses, and two fitting holes are disposed at one engagement position, but the number of each of screw hole, boss, and fitting hole is not limited to the example of FIG. 8.

[0104] A description is given below of a third embodiment.

[0105] As illustrated in FIG. 9, both longitudinal ends of the separation plate 25 have bent surfaces facing the side plates 28. The bent surfaces have screw holes 301 as engaging portions. Further, each longitudinal end of the separation plate 25 has a protruding structure 303 as an example of an engaging portion that extends horizontally without being bent. On the other hand, screw holes 201 as an example of fitted portions and fitting holes 203 into which the protruding structures 303 fit are disposed at predetermined positions of the side plates 28.

[0106] The protruding structures 303 of the separation plate 25 and the fitting holes 203 of the side plates 28 are fitted with each other, and screw members are inserted from outside into the screw holes 301 of the separation plate 25 and the screw holes 201 of the side plates 28 to fasten the separation plate 25 and the side plates 28 together.

[0107] In the present embodiment, the separation plate 25 and the side plates 28 are fastened and fixed to each other, and the separation distance between the pair of side plates 28 is defined by the length of the separation plate 25.

[0108] Further, through fitting of the protruding structures 303 and the fitting holes 203, the separation plate 25 and the side plates 28 are positioned relative to each other, and the separation distance between the separation plate 25 and the fixing belt 20 is defined.

[0109] In FIG. 9, one screw hole, one protruding struc-

ture, and one fitting hole are disposed at one engagement position, but the number of each of screw hole, protruding structure, and fitting hole is not limited to the example of FIG. 9.

[0110] A description is given below of a fourth embodiment.

[0111] As illustrated in FIG. 10, both longitudinal ends of the separation plate 25 have protruding structures 303 as engaging portions extending horizontally and engagement recesses 304. On the other hand, as engaged portions, fitting holes 203 into which the protruding structures 303 fit and engagement recesses 204 that engage with the engagement recesses 304 are disposed at predetermined positions of the side plates 28.

[0112] The protruding structures 303 of the separation plate 25 and the fitting holes 203 of the side plates 28 are fitted with each other, and the engagement recesses 304 of the separation plate 25 and the engagement recesses 204 of the side plates 28 are engaged with each other.

[0113] In the present embodiment, through the engagement between the engagement recesses 304 and the engagement recesses 204, the separation distance between the pair of side plates 28 is defined by the length of the separation plate 25.

[0114] Further, through fitting of the protruding structures 303 and the fitting holes 203, the separation plate 25 and the side plates 28 are positioned relative to each other, and the separation distance between the separation plate 25 and the fixing belt 20 is defined.

[0115] The shape of the engagement recesses and the shapes of the protruding structures and the fitting holes are not limited thereto.

[0116] A description is given below of a fifth embodiment.

[0117] As illustrated in FIG. 11, both longitudinal ends of the separation plate 25 have protruding structures 303 as engaging portions extending horizontally and engagement recesses 305 in a bent side face. On the other hand, as engaged portions, fitting holes 203 into which the protruding structures 303 fit and engagement recesses 205 that engage with the engagement recesses 305 are disposed at predetermined positions of the side plates 28.

[0118] The protruding structures 303 of the separation plate 25 and the fitting holes 203 of the side plates 28 are fitted with each other, and the engagement recesses 305 of the separation plate 25 and the engagement recesses 205 of the side plates 28 are engaged with each other.

[0119] In the present embodiment, through the engagement between the engagement recesses 305 and the engagement recesses 205, the separation distance between the pair of side plates 28 is defined by the length of the separation plate 25.

[0120] Further, through fitting of the protruding structures 303 and the fitting holes 203, the separation plate 25 and the side plates 28 are positioned relative to each other, and the separation distance between the separa-

tion plate 25 and the fixing belt 20 is defined.

[0121] The shape of the engagement recesses and the shapes of the protruding structures and the fitting holes are not limited thereto.

[0122] A description is given below of a configuration in which the fixing device 9 according to the present embodiment is installed to a fixing-device installation frame (hereinafter may be referred to simply as "installation frame") 105 of the image forming apparatus 100 and is positioned and fixed to the fixing-device installation frame 105.

[0123] FIG. 12 is a perspective view of the fixing device 9 and the fixing-device installation frame 105 according to the present embodiment. FIG. 13A is a perspective view of the fixing device 9 according to the present embodiment attached to the fixing-device installation frame 105. FIGS. 13B and 13C are schematic diagrams of a housing frame of the fixing device 9 and the installation frame 105 of the image forming apparatus 100. FIG. 13B illustrates a configuration of the present embodiment, and FIG. 13C illustrates a configuration of a comparative example.

[0124] FIG. 14 is a partial perspective view of the fixing device 9 attached to the fixing-device installation frame 105 of FIG. 13A, viewed from the opposite side.

[0125] The support plate 29 of the fixing device 9 has through holes 29a through which a fixing means for positioning and fixing the fixing device 9 to the image forming apparatus 100 (installation frame 105) is inserted.

[0126] The installation frame 105 of the image forming apparatus 100 has slit-shaped insertion holes 111 and fixing portions 112. Protruding ends 28a of the side plates 28 are inserted into the slit-shaped insertion holes 111. The fixing portions 112 have the fixing means to engage with or fit into the through holes 29a of the support plate 29.

[0127] The insertion holes 111 are disposed in an installation frame wall 110.

[0128] Each fixing portion 112 projects from an end portion of a side wall 120 of the installation frame 105 and disposed opposite the installation frame wall 110.

[0129] As illustrated in FIG. 12, when the fixing device 9 is attached to the installation frame 105, the four protruding ends 28a of the side plates 28 are inserted into the corresponding insertion holes 111 in a direction indicated by arrows with dashed lines in FIG. 12.

[0130] The manner in which the fixing device 9 is positioned and fixed relative to the installation frame 105 is determined by the arrangement positions, shape, and dimension of the protruding ends 28a and the arrangement positions, shape, and dimension of the insertion holes 111.

[0131] As illustrated in FIGS. 13A, 13B, and 14, the four protruding ends 28a of the side plates 28 of the fixing device 9 are inserted into the corresponding four insertion holes 111.

[0132] The pair of side plates 28 are also held by the installation frame wall 110 of the installation frame 105

on the same side as the fixing belt 20 with respect to the nip N in the direction intersecting the longitudinal direction of the support plate 29. Further, since the housing frame of the fixing device 9 is held in the up-down direction, the posture of the fixing device 9 is stable in the up-down and right-left directions.

[0133] In addition, in the example illustrated in FIGS. 13A and 13B, one of the two through holes 29a on both longitudinal ends of the support plate 29 is fastened to the fixing portion 112 by a screw 115, and the other is fitted with an embossed portion 114 disposed on the fixing portion 112. As such, the fixing device 9 is positioned and fixed relative to the installation frame 105 in the front-rear direction. As described above, the fixing device 9 is positioned in the up-down and right-left directions by insertion of the protruding ends 28a into the insertion holes 111.

[0134] As illustrated in FIG. 13C, a comparative example of a fixing device includes a fixing stay 40 as a member constituting a housing frame. The fixing stay 40 positions and fixes a pair of side plates 28 together with a support plate 39, and stabilizes a housing.

[0135] On the other hand, in the fixing device 9 according to the present embodiment illustrated in FIG. 13B, the side plates 28 are positioned and fixed by at least one of the separation plate 25, the guide plate 26, and the stay 24. The side plates 28 are also held by the installation frame wall 110, so that the housing frame can obtain sufficient stability even if the fixing stay 40 is omitted.

[0136] Since the housing frame is stable, the drive transmission from the image forming apparatus 100 and the sheet conveyance are also stable. Thus, a high-precision image is obtained.

[0137] The protruding ends 28a of the side plates 28 and the insertion holes 111 of the installation frame wall 110 will be described with reference to FIGS. 15 to 17.

[0138] FIG. 15 is a perspective view the side plate 28, illustrating dimensions of the side plate 28.

[0139] In FIG. 15, T represents a plate thickness of the protruding ends 28a of the side plate 28. The length of the upper protruding end 28a of the substantially C-shape of the side plate 28 is denoted by h1, and the length of the lower protruding end 28a of the substantially C-shape of the side plate 28 is denoted by h2.

[0140] FIG. 16 is a front view of the installation frame wall 110, illustrating the dimensions of the insertion holes 111.

[0141] The lengths of openings of two upper insertion holes 111 are indicated by H1, and the lengths of openings of two lower insertion holes 111 are indicated by H2.

[0142] The insertion hole 111 has a slit shape in which a central part is wide. In FIG. 16, W represents the width of the narrowest part of the insertion hole 111. Among the four insertion holes 111, the width of an upper-right insertion hole 111 in FIG. 16 is represented by W1, the width of a lower-right insertion hole 111 is represented by W2, the width of an upper-left insertion hole 111 is

represented by W3, and the width of a lower-left insertion hole 111 is represented by W4.

[0143] An example of setting of the lengths h1 and h2 of the protruding ends 28a and the lengths H1 and H2 of the insertion holes 111 will be described.

[0144] The two upper insertion holes 111 are disposed at target positions for positioning and fixing the protruding ends 28a, and the length H1 of the two upper insertion holes 111 is set to be substantially equal to the length h1 of the upper protruding ends 28a.

[0145] On the other hand, the length H2 of the two lower insertion holes 111 is set to be greater than the length h2 of the lower protruding ends 28a.

[0146] With the above-described settings, when the protruding ends 28a are inserted, the upper protruding ends 28a and the upper insertion holes 111 in the step are fitted with each other, and positioned and fixed at correct positions.

[0147] On the other hand, since the two lower insertion holes 111 have openings longer than the inserted lower protruding ends 28a, the lower protruding ends 28a are not fixed in the up-down direction. Thus, an error due to dimensional variation and an attachment error can be absorbed.

[0148] An example of settings for the plate thickness T of the protruding end 28a and the widths W1, W2, W3, and W4 of the insertion holes 111 will be described.

[0149] First, as a configuration of a housing frame of the fixing device 9, a description is given of a case where the side plates 28 are positioned only by the separation plate 25.

[0150] In the configuration described above, only the upper side of each of the side plates 28 is attached to and positioned by the separation plate 25 disposed above the fixing device 9. The separation distance between the pair of side plates 28 is accurately defined only on the upper side.

[0151] In this case, the two lower insertion holes 111 and the pair of side plates 28 are set to define a target separation distance, and each of the widths W2 and W4 of the two lower insertion holes 111 is set to be substantially equal to the plate thickness T of the protruding end 28a. Further, each of the widths W1 and W3 of the two upper insertion holes 111 is set to be wider than the plate thickness T of the protruding end 28a.

[0152] With such a setting, the lower separation distance of the side plates 28 whose protruding ends 28a are inserted in the insertion holes 111 is also accurately defined.

[0153] The upper separation distance between the side plates 28 is accurately defined by the separation plate 25, thus obviating the need of being held by the installation frame 105 for adjustment. To avoid adverse effects such as occurrence of distortion due to interference from the installation frame 105, it is preferable that the widths W1 and W3 of the two upper insertion holes 111 be set to be wider than the plate thickness T of the upper protruding ends 28a to be inserted and that there

be play therebetween.

[0154] As a configuration of the housing frame of the fixing device 9, a description is given below of a case where the side plates 28 are positioned only by the guide plate 26.

[0155] In the configuration, only the lower side of each of the side plates 28 is attached to and positioned by the guide plate 26 disposed below the fixing device 9. The separation distance between the pair of side plates 28 is accurately defined only on the lower side.

[0156] In this case, the two upper insertion holes 111 and the pair of side plates 28 are set to define a target separation distance, and each of the widths W1 and W3 of the two upper insertion holes 111 is set to be substantially equal to the plate thickness T of the protruding end 28a. Each of the widths W2 and W4 of the two lower insertion holes 111 is set to be wider than the plate thickness T of the protruding end 28a.

[0157] With such a setting, the upper separation distance of the side plates 28 whose protruding ends 28a are inserted in the insertion holes 111 is also accurately defined. An effect due to interference of the installation frame 105 can also be avoided.

[0158] FIG. 17 is a partial perspective view of the fixing device 9 and the installation frame 105, and also illustrates an enlarged view of the insertion hole 111.

[0159] As illustrated in FIG. 17, the insertion hole 111 has a wide portion 111b that is a central portion expanded from a region 111a of a slit in which a protruding end 28a of the side plate 28 is disposed.

[0160] When the fixing device 9 is attached to the installation frame 105, the protruding end 28a may be inserted with displacement relative to an intended position of the insertion hole 111. Even in such a case, the wide portion 111b provided as a play (clearance) allows the installation frame wall 110 to be attached without causing an adverse effect. The protruding end 28a has a shape of being gradually narrower toward the tip of the protruding end 28a. The wide portion 111b has a shape of being inclined toward the region 111a. Accordingly, even when the protruding end 28a is inserted in a shifted position (wide portion 111b), the protruding end 28a is smoothly guided to the target position (region 111a).

[0161] Such a configuration enhances the workability in attachment and removal of the fixing device 9 as a unit, and facilitates assembly.

[0162] The through holes 29a of the support plate 29 and the fixing portions 112 of the installation frame 105 will be described with reference to FIGS. 18A, 18B, 19A, and 19B.

[0163] As illustrated in FIG. 18A, the installation frame 105 is provided with a pair of fixing portions 112 for fixing the support plate 29. Each fixing portion 112 projects from an end portion of a side wall 120 of the installation frame 105 and are disposed opposite the installation frame wall 110, and includes screw holes 113 and embossed portions 114 to fit into embossment through holes 292 among the through holes 29a of the support plate 29.

[0164] FIG. 18B is a front view of the installation frame 105 attached with the fixing device 9. The embossed portions 114 are fitted into the embossment through holes 292 of the support plate 29 to position the fixing device 9. The screw holes 113 and the screw holes 291 of the support plate 29 are fastened together with screws 115, thus fixing the fixing device 9.

[0165] On the other hand, as described with reference to FIGS. 15 and 16, the fixing device 9 is also positioned by insertion and fitting of the protruding ends 28a of the side plate 28 to the insertion holes 111 of the installation frame wall 110.

[0166] Therefore, as illustrated in FIGS. 19A and 19B, a configuration may be adopted in which only screw holes 113 are disposed in the fixing portions 112 and similarly only screw holes 291 are disposed in the support plate 29 such that the screw holes 113 and the screw holes 291 are fastened together with screws 115.

[0167] With a configuration in which fastening is performed only with the screws 115, a space for providing the embossed portions 114 and the embossment through holes 292 for positioning can be omitted. Accordingly, the width of the support plate 29 indicated by arrows S in FIG. 19B can be shortened, and the width of the fixing device 9 itself can also be reduced. Thus, the size of the apparatus can be reduced.

[0168] In addition, when the support plate 29 is used together with the side plate 28 as members contributing to enhancement in attachment accuracy and stability of the housing frame, the apparatus size and functions can be further optimized.

[0169] According to the fixing device of the present embodiment and the image forming apparatus including the fixing device, size reduction, weight reduction, and cost reduction of the apparatus, as well as stabilization and accurate positioning of the housing frame, can be achieved. In addition, it is possible to prevent the occurrence of, for example, scratches and damage due to dropping or falling of members disposed between the pair of side plates 28 of the fixing device 9. In addition, it is possible to prevent an image defect from occurring due to such a failure.

[0170] The above-described configuration is also applicable to a fixing device and an image forming apparatus according to different embodiments.

[0171] Hereinafter, examples of a fixing device and an image forming apparatus will be further described. In addition, an example of the heater 22 and the heater holder 23 included in the heating device 19 of the fixing device 9 will also be described.

[0172] The fixing device 9 illustrated in FIG. 20 includes, as a heat source, a planar or plate-shaped heater 22 in which resistive heating elements 56 are disposed on a base 55. The base 55 is made of ceramic such as alumina and aluminum nitride, or heat-resistant and insulating material such as glass, mica, and polyimide. Further, the base 55 may be a metal material such as stainless steel, iron, and aluminum, on which an insulation

layer is formed. The resistive heating element 56 is formed by coating a paste, in which, for example, silver palladium (AgPd) and glass powder are mixed, on the surface of the base 55 by screen printing or any other method, and then firing the base 55. The resistive heating element 56 is covered with an insulation layer 57. The insulation layer 57 is made of a material such as heat-resistant glass, ceramic, or polyimide.

[0173] As illustrated in FIG. 21, the heater 22 has a shape of a rectangular plate and is disposed such that the longitudinal direction thereof be parallel to the longitudinal direction of the fixing belt 20. The plurality of resistive heating elements 56 are disposed at intervals in the longitudinal direction of the base 55 (heater 22). In addition, a plurality of electrodes 58 and a plurality of power feeding lines 59 are disposed on the surface of the base 55 on which the resistive heating elements 56 are disposed. The resistive heating elements 56 are connected in parallel to the electrodes 58 disposed at both ends of the base 55 in the longitudinal direction via the power feeding lines 59. Further, the resistive heating elements 56 and the power feed lines 59 are covered with the insulation layer 57. On the other hand, the electrodes 58 are not covered with the insulation layer 57 and are exposed such that connectors as power feeding terminals are connectable to the electrodes 58.

[0174] As illustrated in FIG. 20, the heater 22 is held by the heater holder 23 and is disposed in contact with an inner circumferential surface of the fixing belt 20. Accordingly, when the heater 22 generates heat, the fixing belt 20 is heated from inside.

[0175] The fixing belt 20 and the pressure roller 21 of FIG. 20 have basically the same configurations as those of the fixing belt and the pressure roller according to the above-described embodiment.

[0176] The heater holder 23 is integrated with guides 66. The guides 66 are disposed upstream and downstream from the nip N in a rotation direction of the fixing belt 20. When the fixing belt 20 rotates, the guides 66 contact the inner circumferential surface of the fixing belt 20 to guide the fixing belt 20 from the inside of the fixing belt 20.

[0177] Further, inside the fixing belt 20, a temperature sensor 67 as an example of a temperature detector is disposed to detect the temperature of the heater 22. The temperature sensor 67 is pressed by a spring 70.

[0178] The temperature sensor 67 illustrated in FIG. 20 is a contact-type temperature sensor that contacts a surface of the heater 22 opposite the nip N to detect the temperature of the heater 22. However, a contactless-type temperature sensor may be disposed in non-contact with the heater 22 to detect the ambient temperature in the vicinity of the heater 22.

[0179] In the fixing device 9, when power is supplied to the heater 22 from a power source disposed in a body of an image forming apparatus, resistive heating elements 56 generate heat. Thus, the fixing belt 20 is heated. The amount of heat generated by the heater 22 is con-

trolled on the basis of the temperature of the heater 22 detected by the temperature sensor 67. Thus, the temperature of the fixing belt 20 is maintained at a predetermined temperature (fixing temperature). In this state, as illustrated in FIG. 20, a sheet P bearing unfixed toner enters a space (nip N) between the fixing belt 20 and the pressure roller 21, so that the unfixed toner on the sheet P is pressed and heated, and a toner image is fixed on the sheet P.

[0180] The temperature sensor 67 may be located at the center M of the nip N in the sheet conveyance direction as illustrated in FIG. 20, or may be located upstream from the center M of the nip N in the sheet conveyance direction as in the example illustrated in FIG. 22. In other words, the temperature sensor 67 may be disposed on the inlet side of the nip N. The inlet side of the nip N is a region where the heat of the fixing belt 20 is particularly prone to be lost by the sheet P entering the nip N. For this reason, detecting the temperature of the inlet side with the temperature sensor 67 can ensure the fixing performance of an image and to effectively reduce the occurrence of fixing offset in which a toner image cannot be sufficiently heated.

[0181] In the fixing device 9 illustrated in FIG. 23, a pressure roller 69 is disposed opposite the pressure roller 21 with respect to the fixing belt 20. The pressure roller 69 is a counter rotator that rotates at the position facing the fixing belt 20 that is an example of a rotator. The fixing belt 20 is sandwiched by the pressure roller 69 and the heater 22 and is heated by the heater 22. On the other hand, a nip formation pad 68 as an example of a nip former is disposed inside the loop formed by the fixing belt 20 and disposed opposite the pressure roller 21. The nip formation pad 68 is attached to the stay 24. The nip formation pad 68 sandwiches the fixing belt 20 together with the pressure roller 21 to form a fixing nip N.

[0182] In the fixing device 9 illustrated in FIG. 24, the above-described pressure roller 69 is omitted, and the heater 22 is formed in an arc shape to match the curvature of the fixing belt 20 in order to ensure a circumferential contact length between the fixing belt 20 and the heater 22. Other parts of the fixing device 9 illustrated in FIG. 24 are the same as the fixing device 9 illustrated in FIG. 23.

[0183] The fixing device 9 illustrated in FIG. 25 includes a heating assembly 92, a fixing roller 93 as an example of a fixing member, and a pressure assembly 94 as an example of a counter member. The heating assembly 92 includes the heaters 22, the heater holders 23, the stay 24, and the heating belt 99 as an example of a rotator, as described in the above-described embodiment. The fixing roller 93 is a counter rotator that rotates and faces the heating belt 99, which is an example of a 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 covers the surface of the core 93a. The release layer 93c covers an outer circumferential face of the elastic layer 93b. The pressure

assembly 94 is disposed opposite the heating assembly 92 with respect to the fixing roller 93. The pressure assembly 94 includes a nip formation pad 95, a stay 96, and a pressure belt 97. The pressure belt 97 is rotatably disposed to surround the nip formation pad 95 and the stay 96. A sheet P is heated and pressed while passing through a fixing nip N2 between the pressure belt 97 and the fixing roller 93, so that an image is fixed on the sheet P.

[0184] An image forming apparatus according to an embodiment of the present disclosure is not limited to a color image forming apparatus as illustrated in FIG. 1 and may be, for example, a monochrome image forming apparatus, or may be a copier, a printer, a facsimile machine, or a multifunction peripheral including at least two functions of the copier, printer, and facsimile machine.

[0185] An image forming apparatus according to an embodiment of the present disclosure may be, for example, an image forming apparatus having a configuration as illustrated in FIG. 26.

[0186] An image forming apparatus 100 illustrated in FIG. 26 includes an image forming device 80 including a photoconductor drum, a sheet conveyor including a timing roller pair 81, a sheet feeder 82, a fixing device 9, a sheet ejection device 84, and a reading device 85. The sheet feeder 82 includes a plurality of sheet feeding trays, and the sheet feeding trays store sheets of different sizes.

[0187] The reading device 85 reads an image of an original document Q. The reading device 85 generates image data from the read image. The sheet feeder 82 stores the plurality of sheets P and feeds the sheet P to a conveyance path. The timing roller pair 81 conveys the sheet P on the conveyance path to the image forming device 80.

[0188] The image forming device 80 forms a toner image on the sheet P. For example, the image forming device 80 includes the photoconductor drum, a charging roller, an exposure device, a developing device, a supply device, a transfer roller, a cleaning device, and a charge neutralizing device. The toner image is, for example, an image of the original document Q. The fixing device 9 heats and presses a 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 84. The sheet ejection device 84 ejects the sheet P to the outside of the image forming apparatus 100.

[0189] A description is given below of the fixing device 9 according to an embodiment of the present disclosure. Descriptions of the configurations common to the fixing devices of the above-described embodiments may be omitted as appropriate.

[0190] As illustrated in FIG. 27, the fixing device 9 includes a fixing belt 20, a pressure roller 21, a heater 22, a heater holder 23, a stay 24, and a temperature sensor 67.

[0191] A 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.

[0192] The fixing belt 20 includes a polyimide base and a release layer and does not include an elastic layer. The release layer is formed with a heat-resistant film material made of, for example, fluororesin. The outer diameter of the fixing belt 20 is about 24 mm.

[0193] The pressure roller 21 includes a core 21a, an elastic layer 21b, and a release layer 21c. The pressure roller 21 has an outer diameter of 24 mm to 30 mm, and the elastic layer 21b has a thickness of 3 mm to 4 mm.

[0194] The heater 22 includes a base, a thermal insulation layer, a conductor layer including resistive heating elements, and an insulation layer, and is formed to have a thickness of 1 mm as a whole. A width Y of the heater 22 in a direction intersecting an arrangement direction of the resistive heating elements is 13 mm.

[0195] As illustrated in FIG. 28, the conductor layer of the heater 22 includes a plurality of resistive heating elements 56, power feeding lines 59, and electrodes 58A, 58B, and 58C. As illustrated in the enlarged view of FIG. 28, separation areas B are formed between neighboring resistive heating elements of the plurality of resistive heating elements 56 arranged in the arrangement direction. The enlarged view of FIG. 28 illustrates two separation areas B, but separation areas B are formed between neighboring ones of all the plurality of resistive heating elements 56. The resistive heating elements 56 are grouped to three heat generation portions 35A, 35B, and 35C. When the electrodes 58A and 58B are energized, the heat generation portions 35A and 35C generate heat. When the electrodes 58A and 58C are energized, the heat generation portion 35B generates heat. When the fixing device 9 fixes a toner image onto a small-size sheet, the heat generation portion 35B generates heat. When the fixing device 9 fixes a toner image onto a large-size sheet, the whole heat generation portions 35A, 35B, and 35C generate heat.

[0196] As illustrated in FIG. 29, the heater holder 23 has a recessed portion 23b that accommodates and holds the heater 22. The recessed portion 23b is formed on a side of the heater holder 23 facing the heater 22. Further, the recessed portion 23b has a face (bottom face) 23b1 and four walls (side faces) 23b2 and 23b3. The face 23b1 has a rectangle (oblong) shape of substantially the same size as the heater 22. The four walls 23b2 and 23b3 are disposed to intersect the face 23b1 along four sides forming the outline of the face 23b1. In another configuration, one wall 23b2 may be omitted from the pair of walls 23b2 disposed in a direction intersecting a longitudinal direction X of the heater 22 (a direction in which the resistive heating elements 56 are arranged), and the recessed portion 23b may be formed to be open at one end in the longitudinal direction of the heater 22.

[0197] Further, as illustrated in FIG. 30, the heater 22 and the heater holder 23 are held by a connector 86. The connector 86 includes a housing made of resin such as liquid crystal polymer (LCP) and a plurality of contact terminals disposed inside the housing.

[0198] The connector 86 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 60. In this state, the contact terminals contact and press against the electrodes of the heater 22, and the heat generation portions are electrically coupled to the power supply, which is disposed in the image forming apparatus, via the connector 86. The above-described configuration enables the power supply to supply power to the heat generation portions.

[0199] Flanges 32 are inserted into both longitudinal ends of the stay 24 to hold both ends of the fixing belt 20 from inside of the fixing belt 20. For example, one of the flanges 32 is inserted into corresponding one of the longitudinal ends of the stay 24 in a direction indicated by an arrow in FIG. 30.

[0200] The flanges 32 are fixed to a housing of the fixing device 9. As a configuration of the fixing, for example, the configuration illustrated in FIG. 4 can be applied.

[0201] The connector 86 is attached to the heater 22 and the heater holder 23 in the direction intersecting the arrangement direction (e.g., a direction indicated by an arrow from the connector 86 in FIG. 30). The connector 86 and the heater holder 23 may have a projection and a recess to attach the connector 86 to the heater holder 23. The projection disposed on one of the connector 86 and the heater holder 23 is engaged with the recess disposed on the other of the connector 86 and the heater holder 23 and relatively moves in the recess to attach the connector 86 to the heater holder 23. The connector 86 is attached to one end of the heater 22 and one end of the heater holder 23 in the arrangement direction, which are opposite the one end of the heater 22 and the one end of the heater holder 23 closer to a drive motor for the pressure roller 21.

[0202] FIG. 31A is a diagram illustrating positions of temperature sensors 67 and thermostats 88 serving as an example of current cut-off members.

[0203] As illustrated in FIG. 31A, the temperature sensors 67 are disposed facing an inner circumferential surface of the fixing belt 20 at a position closer to the center C and a position closer to one end in the longitudinal direction of the fixing belt 20. One of the temperature sensors 67 is disposed at a position corresponding to one of the above-described separation areas B (see FIG. 28) between the resistive heating elements of the heater 22.

[0204] The thermostats 88 as an example of current cut-off members are disposed facing the inner circumferential surface of the fixing belt 20 at a position closer to the center C and a position closer to the other end in the longitudinal direction of the fixing belt 20. Each thermostat 88 detects the temperature of the inner circumferential surface of the fixing belt 20 or the ambient temperature in the vicinity of the inner circumferential surface of the fixing belt 20. The thermostat 88 cuts off the current flowing to the heater 22 in response to detection of the

temperature that exceeds a preset threshold value.

[0205] As illustrated in FIGS. 31A and 31B, guide grooves 32a are disposed in the flanges 32 that hold both ends of the fixing belt 20 in the longitudinal direction. The guide groove 32a extends in a direction in which the fixing belt 20 moves toward or away from the pressure roller 21. The guide grooves 32a are engaged with a housing frame (side plates 28) of the fixing device 9, and the housing frame of the fixing device 9 relatively moves within the guide grooves 32a. Thus, the fixing belt 20 is movable in the direction toward or away from the pressure roller 21.

[0206] Some embodiments of the present disclosure are also applicable to a fixing device having the following configuration.

[0207] FIG. 32 is a schematic view of a fixing device 9 according to an embodiment of the present disclosure.

[0208] As illustrated in FIG. 32, the fixing device 9 according to the present embodiment includes a fixing belt 20 as a rotating body or a fixing member, a pressure roller 21 as an opposing rotating body or a pressure member, a heater 22 as a heat source, a heater holder 23 as a heat-source holder, a stay 24 as a flange, a temperature sensor (thermistor) 67 as a temperature detector, and a first high-thermal conduction member 89. The temperature sensor 67 detects the temperature of the first high-thermal conduction member 89.

[0209] The stay 24 has two upright portions 240 extending in the thickness direction of the heater 22 and each having a contact face 241 that contacts the heater holder 23 to hold the heater holder 23, the first high-thermal conduction member 89, and the heater 22. The contact face 241 is located outside an area where resistive heating elements 56 of the heater 22 are arranged, in a direction (vertical direction in FIG. 32) intersecting the arrangement direction of the resistive heating elements 56. The above-described structure prevents heat transfer from the heater 22 to the stay 24 and enables the heater 22 to efficiently heat the fixing belt 20.

[0210] The heater holder 23 is provided with guides 66 that guide the fixing belt 20. The guides 66 are disposed upstream and downstream from the heater 22 in a rotation direction (belt rotation direction) of the fixing belt 21. Upstream ones of the guides 66 are disposed at intervals in the longitudinal direction of the heater 22. Downstream ones of the guides 66 are also disposed at intervals in the longitudinal direction of the heater 22. Each guide 66 is formed in a substantially fan shape, and has an arc-shaped or convexly curved belt-facing surface extending in a circumferential direction of the fixing belt 20 so as to face the inner circumferential surface of the fixing belt 20.

[0211] In the same manner as the heater illustrated in FIG. 28, a plurality of resistive heating elements 56 are arranged at intervals in the longitudinal direction of the heater 22. In the configuration in which the multiple resistive heating elements 56 are arranged at intervals, the temperature of the heater 22 in the separation area B corresponding to the interval between adjacent two of

the resistive heating elements 56 is likely to be lower than the temperature of the heater 22 in a portion entirely occupied by any one of the resistive heating elements 56. For this reason, the temperature of the fixing belt 20 corresponding to the separation area B is also lower, which may cause an uneven temperature distribution of the fixing belt 20 in the longitudinal direction.

[0212] To prevent the above-described temperature drop in the separation area B and reduce the temperature unevenness in the longitudinal direction of the fixing belt 20, the fixing device 9 according to the present embodiment includes the first high-thermal conduction member 89 described above. A detailed description is given below of the first high-thermal conduction member 89.

[0213] As illustrated in FIG. 33, the first high-thermal conduction member 89 is disposed between the heater 22 and the stay 24 in the right-left direction in the drawing and is sandwiched between the heater 22 and the heater holder 23. One side of the first high-thermal conduction member 89 is brought into contact with the back surface of the base 55 of the heater 22, and the other side (that is, the side opposite to the one side) of the first high-thermal conduction member 89 is brought into contact with the heater holder 23.

[0214] The first high-thermal conduction member 89 is a plate-shaped member having a uniform thickness, and is set to, for example, 0.3 mm thick, 222 mm long in the longitudinal direction, and 10 mm wide in the direction intersecting the longitudinal direction. In the present embodiment, the first high-thermal conduction member 89 is made of a single plate but may be made of a plurality of members. In FIG. 33, the guides 66 illustrated in FIG. 32 are omitted.

[0215] The first high-thermal conduction member 89 is fitted into the recessed portion 23b of the heater holder 23, and the heater 22 is mounted on the first high-thermal conduction member 89. Thus, the first high-thermal conduction member 89 is sandwiched and held between the heater holder 23 and the heater 22. In the present embodiment, the length of the first high-thermal conduction member 89 in the longitudinal direction is substantially the same as the length of the heater 22 in the longitudinal direction. The recessed portion 23b has opposite side-walls (longitudinal-direction restricting portions) 23b1 arranged in a direction intersecting the longitudinal direction to restrict the first high-thermal conduction member 89 and the heater 22 from moving in the longitudinal direction. As described above, the positional shift of the first high-thermal conduction member 89 in the longitudinal direction in the fixing device 9 is restricted. Thus, the heat conduction efficiency can be enhanced over an intended range in the longitudinal direction. The recessed portion 23b also has opposite sidewalls (arrangement-intersecting-direction restricting portions) 23b2 arranged in the longitudinal direction to restrict the first high-thermal conduction member 89 and the heater 22 from moving in the longitudinal intersection direction.

[0216] The range in which the first high-thermal con-

duction member 89 is disposed in the longitudinal direction indicated by the arrow X is not limited to the range illustrated in FIG. 33. For example, as illustrated in FIG. 34, the first high-thermal conduction member 89 may be disposed only in the longitudinal range where the resistive heating elements 56 are disposed (see the hatched portion in FIG. 34).

[0217] Furthermore, as in the example illustrated in FIG. 35, first high-thermal conduction members 89 may be disposed only in all areas corresponding to the intervals (separation areas) B in the longitudinal direction (the direction indicated by arrow X). In FIG. 35, for the sake of convenience, the resistive heating elements 56 and the first high-thermal conduction members 89 are shifted in the vertical direction of FIG. 35 but are disposed at substantially the same position in the direction intersecting the longitudinal direction indicated by an arrow Y. In addition, the first high-thermal conduction member 89 may be disposed over a part of the resistive heating element 56 in the direction intersecting the longitudinal direction (the direction indicated by the arrow Y), or as in the example illustrated in FIG. 36, may be disposed to cover all the resistive heating element 56 in the direction intersecting the longitudinal direction (the direction indicated by the arrow Y).

[0218] Further, as illustrated in FIG. 36, in addition to first high-thermal conduction members 89 located at positions corresponding to the separation areas B in the longitudinal direction, one or more first high-thermal conduction members 89 may be disposed such that one first high-thermal conduction member 89 straddles adjacent two resistive heating elements 56 with the separation area B interposed therebetween. The phrase "one first high-thermal conduction member 89 straddles adjacent two resistive heating elements 56" means that one first high-thermal conduction member 89 at least partially overlap each of the two resistive heating elements 56 on both sides in the longitudinal direction. Furthermore, the first high-thermal conduction members 89 may be disposed at positions corresponding to all of the separation areas B of the heater 22, or as in the example illustrated in FIG. 36, may be disposed only at positions corresponding to some of the separation areas B (in this case, one position). The phrase "the first high-thermal conduction members 89 may be disposed at positions corresponding to the separation areas B" means that at least a part of the first high-thermal conduction member 89 may overlap the separation area B in the longitudinal direction.

[0219] Due to the pressing force of the pressure roller 21, the first high-thermal conduction member 89 is sandwiched between the heater 22 and the heater holder 23 and is brought into close contact with the heater 22 and the heater holder 23. Bringing the first high-thermal conduction member 89 into contact with the heater 22 enhances the heat conduction efficiency in the longitudinal direction of the heater 22. The first high-thermal conduction members 89 are disposed at the positions corresponding to the separation areas B in the longitudinal

direction. Thus, the heat conduction efficiency of the separation areas B can be enhanced, the amount of heat transmitted to the separation areas B can be increased, and the temperature of the separation areas B can be raised. Thus, the first high-thermal conduction members 89 can reduce the temperature unevenness of the heater 22 in the longitudinal direction and the temperature unevenness of the fixing belt 20 in the longitudinal direction. As a result, the above-described structure can prevent uneven fixing and uneven gloss in the image fixed on the sheet. Since the heater 22 does not need to generate additional heat to obtain a sufficient fixing performance in the part of the heater 23 facing the separation areas B, energy consumption of the fixing device can be saved. The first high-thermal conduction member 89 disposed over the entire area in which the resistive heating elements 56 are arranged in the longitudinal direction enhances the heat transfer efficiency of the heater 22 over the entire area of a main heating region of the heater 22 (that is, an area facing an image formation area of the sheet passing through the fixing device) and reduces the temperature unevenness of the heater 22 and the temperature unevenness of the fixing belt 20 in the longitudinal direction.

[0220] In addition, the combination of the first high-thermal conduction member 89 and the resistive heating element 56 having a positive temperature coefficient (PTC) characteristic effectively prevents the overheating of the non-sheet passing region (that is the region of the fixing belt that is not in contact with a small-size sheet) of the fixing belt 20 when small-size sheets pass through the fixing device 9. The PTC characteristic is a characteristic in which the resistance value increases as the temperature increases, for example, a heater output decreases under a constant voltage. The resistive heating element 56 having the PTC characteristic effectively reduces the amount of heat generated by the resistive heating element 56 in the non-sheet passing region, and the first high-thermal conduction member 89 effectively transfers heat from the non-sheet passing region in which the temperature rises to a sheet passing region that is a region of the fixing belt contacting the sheet. As a result, the overheating of the non-sheet passing region is effectively prevented.

[0221] The first high-thermal conduction member 89 may be disposed opposite an area around the separation area B because the small heat generation amount in the separation area B decreases the temperature of the heater 22 in the area around the separation area B. For example, the first high-thermal conduction member 89 facing an enlarged separation area C that includes the separation area B and an area around the separation area B as illustrated in FIG. 37 improves the heat transfer efficiency of the separation area B and the area around the separation area B in the longitudinal direction and effectively reduces the temperature unevenness in the longitudinal direction of the heaters 22. In addition, in a case where the first high-thermal conduction member 89 is

disposed over the entirety in the longitudinal direction of the region where all the resistive heating elements 56 are disposed, the temperature unevenness in the longitudinal direction of the heater 22 (fixing belt 20) can be more reliably reduced.

[0222] A description is given below of a fixing device according to an embodiment of the present disclosure.

[0223] A fixing device 9 illustrated in FIG. 38 includes a second high-thermal conduction member 90 between a heater holder 23 and a first high-thermal conduction member 89. The second high-thermal conduction member 90 is disposed at a position different from the position of the first high-thermal conduction member 89 in the left-to-right direction in FIG. 38 that is a direction in which the heater holder 23, the stay 24, and the first high-thermal conduction member 89 are layered. Specifically, the second high-thermal conduction member 90 is disposed to overlap the first high-thermal conduction member 89. Furthermore, although a temperature sensor (thermistor) 67 is provided in the present embodiment as in the embodiment illustrated in FIG. 32 described above, FIG. 38 illustrates a cross section where the temperature sensor 67 is not disposed.

[0224] The second high-thermal conduction member 90 is made of a material having thermal conductivity higher than the thermal conductivity of the base 55, for example, graphene or graphite. In the present embodiment, the second high-thermal conduction member 90 is made of a graphite sheet having a thickness of 1 mm. Alternatively, the second high-thermal conduction member 90 may be a plate made of aluminum, copper, silver, or the like.

[0225] As illustrated in FIG. 39, a plurality of second high-thermal conduction members 90 are disposed in the recessed portion 23b of the heater holder 23, and the second high-thermal conduction members 90 are spaced apart from each other in the longitudinal direction. The recessed portion 23b of the heater holder 23 includes dents deeper than the other areas such that the second high-thermal conduction members 90 are disposed in the dents. Clearances are formed between the heater holder 23 and both sides of the second high-thermal conduction member 90 in the longitudinal direction. The clearance prevents heat transfer from the second high-thermal conduction member 90 to the heater holder 23, and the heater 22 efficiently heats the fixing belt 20. In FIG. 39, the guides 66 illustrated in FIG. 32 are omitted.

[0226] As illustrated in FIG. 40, the second high-thermal conduction member 90 (see the hatched portion) is disposed at a position corresponding to the separation area B in the longitudinal direction (the direction indicated by arrow X) and at a position at which the second high-thermal conduction member 90 at least partially overlaps each resistive heating element of an adjacent pair of the resistive heating elements 56. In particular, each of the second high-thermal conduction members 90 in the present embodiment faces the entire separation area B.

[0227] Although FIG. 40 (and FIG. 41 described later)

illustrates the case where the first high-thermal conduction member 89 is disposed over the entirety in the longitudinal direction of the region where all the resistive heating elements 56 are disposed, the arrangement range of the first high-thermal conduction member 89 is not limited thereto.

[0228] The fixing device according to the present embodiment includes the second high-thermal conduction member 90 disposed at a position corresponding to the separation area B in the longitudinal direction and the position at which at least a part of each of the neighboring resistive heating elements 56 faces the second high-thermal conduction member 90, in addition to the first high-thermal conduction member 89. The above-described structure further enhances the heat transfer efficiency in the separation areas B in the longitudinal direction and more efficiently reduces the temperature unevenness of the heater 22 in the longitudinal direction. Most preferably, as illustrated in FIG. 41, the first high-thermal conduction member 89 and the second high-thermal conduction member 90 are disposed only over the entirety thereof at positions corresponding to the separation area B. The above-described structure enhances the heat transfer efficiency of the part of the heater 23 corresponding to the separation area B to be higher than the heat transfer efficiency of the other part of the heater 23.

[0229] In FIG. 41, for the sake of convenience, the resistive heating element 56, the first high-thermal conduction member 89, and the second high-thermal conduction member 90 are shifted in the vertical direction of FIG. 40 but are disposed at substantially the same position in the direction intersecting the longitudinal direction indicated by the arrow Y. However, the positions of the resistive heating element 56, the first high-thermal conduction member 89, and the second high-thermal conduction member 90 are not limited to the example of FIG. 41. The first high-thermal conduction member 89 and the second high-thermal conduction member 90 may be disposed opposite a part of the resistive heating element 56 in the direction intersecting the longitudinal direction or may be disposed so as to cover the entire resistive heating element 56 in the direction intersecting the longitudinal direction.

[0230] Both the first high-thermal conduction member 89 and the second high-thermal conduction member 90 may be made of a graphene sheet. The first high-thermal conduction member 89 and the second high-thermal conduction member 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 20 in the longitudinal direction and the temperature unevenness of the heater 22 in the longitudinal direction.

[0231] Graphene is a flaky powder. Graphene has a planar hexagonal lattice structure of carbon atoms, as

illustrated in FIG. 44. The graphene sheet is usually 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 typically 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.

[0232] Graphene sheets are artificially made by, for example, a chemical vapor deposition (CVD) method.

[0233] The graphene sheet is commercially available. The size and thickness of the graphene sheet or the number of layers of the graphite sheet described later are measured by, for example, a transmission electron microscope (TEM).

[0234] Graphite obtained by multilayering graphene has a large thermal conduction anisotropy. As illustrated in FIG. 45, the graphite has a crystal structure formed by layering a number of layers each having a condensed six-membered ring layer plane of carbon atoms extending in a planar shape. 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 greater 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 conduction member 89 and the second high-thermal conduction member 90 that are made of graphite each have the heat transfer efficiency in the longitudinal direction greater than the heat transfer efficiency in the thickness direction of the first high-thermal conduction member 89 and the second high-thermal conduction member 90 (that is, the stacking direction of these members), reducing the heat transferred to the heater holder 23. Accordingly, the above-described structure can efficiently decrease the temperature unevenness of the heater 22 in the longitudinal direction and can minimize the heat transferred to the heater holder 23. Since the first high-thermal conduction member 89 and the second high-thermal conduction member 90 that are made of graphite are not oxidized at about 700 degrees or lower, the first high-thermal conduction member 89 and the second high-thermal conduction member 90 each have an excellent heat resistance.

[0235] The physical properties and dimensions of the graphite sheet may be appropriately changed according to the function required for the first high-thermal conduction member 89 or the second high-thermal conduction member 90. For example, the anisotropy of the thermal conduction can be increased by using high-purity graphite or single-crystal graphite or 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. A width of the first high-thermal conduction member 89 or a width

of the second high-thermal conduction member 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 22.

[0236] 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.

[0237] As long as the second high-thermal conduction member 90 faces a part of each of neighboring resistive heating elements 56 and at least a part of the separation area B (and the enlarged separation area C) between the neighboring resistive heating elements 56, the configuration of the second high-thermal conduction member 90 is not limited to the configuration illustrated in FIG. 40. For example, as in the example illustrated in FIG. 42, a second high-thermal conduction member 90A may be disposed to protrude outward beyond both sides of the base 55 in the direction (the direction indicated by arrow Y) intersecting the longitudinal direction. A second high-thermal conduction member 90B faces a range in which the resistive heating elements 56 are disposed in the direction intersecting the longitudinal direction. A second high-thermal conduction member 90C faces a part of the separation area B and a part of each of neighboring resistive heating elements 56.

[0238] The fixing device according to an embodiment illustrated in FIG. 43 has a clearance between the first high-thermal conduction member 89 and the heater holder 23 in the thickness direction that is the lateral direction in FIG. 43. That is, a clearance 23c as an example of a heat insulating layer is disposed in a partial area of the recessed portion 23b (see FIG. 39) in the heater holder 23 in which the heater 22, the first high-thermal conduction member 89, and the second high-thermal conduction member 90 are disposed.

[0239] The clearance 23c is disposed in a partial area in the longitudinal direction other than a portion in which the second high-thermal conduction member 90 (not illustrated in FIG. 43) is disposed. The clearance 23c has a depth deeper than the depth of the recessed portion 23b of the heater holder 23. Thus, the area of contact between the heater holder 23 and the first high-thermal conduction member 89 can be kept to a minimum, so that the heat transfer from the first high-thermal conduction member 89 to the heater holder 23 is reduced, thus allowing the fixing belt 20 to be effectively heated by the heater 22.

[0240] In the cross section where the second high-thermal conduction member 90 is disposed in the longitudinal direction, the second high-thermal conduction member 90 is in contact with the heater holder 23, as in the embodiment illustrated in FIG. 38 described above.

[0241] The clearance 23c in the present embodiment is disposed over the entire area in which the resistive heating elements 56 are disposed in the direction (vertical direction in FIG. 43) intersecting the longitudinal direction. The above-described configuration efficiently

prevents heat transfer from the first high-thermal conduction member 89 to the heater holder 23, and the heater 22 efficiently heats the fixing belt 20. The fixing device 9 may include a thermal insulation layer made of heat insulator having a lower thermal conductivity than the thermal conductivity of the heater holder 23 instead of a space like the clearance 23c serving as the thermal insulation layer.

[0242] In the present embodiment, the second high-thermal conduction member 90 is a member different from the first high-thermal conduction member 89, but the present embodiment is not limited to this. For example, the first high-thermal conduction member 89 may have a thicker portion than the other portion so that the thicker portion faces the separation area B and functions as the second high-thermal conduction member 90.

[0243] Aspects of the present disclosure are, for example, as follows.

First Aspect

[0244] A fixing device is attachable to an image forming apparatus and includes: a housing frame; a rotatable endless fixing belt; a heater to heat the fixing belt; a heater holder to hold the heater; a stay disposed inside the fixing belt to support the heater holder; a pressure roller to form a nip between the fixing belt and the pressure roller; a guide plate to guide a recording medium to the nip; and a separation plate to separate the recording medium that has passed through the nip from the fixing belt. The housing frame includes a support plate and a pair of side plates. The support plate is disposed on the same side as the pressure roller with respect to the nip in a direction intersecting a longitudinal direction of the support plate. The pair of side plates are disposed on both ends of the support plate in the longitudinal direction of the support plate. The pair of side plates are attached to at least one of the separation plate, the guide plate, and the stay, on the same side as the fixing belt with respect to the nip in the direction intersecting the longitudinal direction of the support plate.

Second Aspect

[0245] In the fixing device according to the first aspect, one of each longitudinal end of the separation plate and each side plate of the pair of side plates has an engaging portion and the other of each longitudinal end of the separation plate and each side plate of the pair of side plates has an engaged portion. The engaging and the engaged portion are engaged to determine relative positions between the separation plate and the pair of side plates and define a separation distance between the pair of side plates.

Third Aspect

[0246] In the fixing device according to the first aspect,

one of each longitudinal end of the guide plate and each side plate of the pair of side plates has an engaging portion and the other of each longitudinal end of the guide plate and each side plate of the pair of side plates has an engaged portion. The engaging portion and the engaged portion are engaged to determine relative positions between the guide plate and the pair of side plates and define a separation distance between the pair of side plates.

Fourth Aspect

[0247] In the fixing device according to the first aspect, one of each longitudinal end of the stay and each side plate of the pair of side plates has a fitting portion and the other of each longitudinal end of the stay and each side plate of the pair of side plates has a fitted portion. The fitting portion and the fitted portion are fitted to determine relative positions between the stay and the pair of side plates and define a separation distance between the pair of side plates.

Fifth Aspect

[0248] The fixing device according to any one of the first to third aspects includes a plurality of combinations of the engaging portion and the engaged portion.

Sixth Aspect

[0249] In the fixing device according to any one of the first to fifth aspects, the separation plate, the guide plate, and the stay are made of metal.

Seventh Aspect

[0250] In the fixing device according to any one of the first to sixth aspects, each side plate of the pair of side plates has a substantially C-shape with an opening to support the pressure roller, and the substantially C-shape has protruding ends each of which is narrower toward a tip of each of the protruding ends.

Eighth Aspect

[0251] In the fixing device according to any one of the first to seventh aspects, the support plate has a through hole through which a fixing means for positioning and fixing the support plate to the image forming apparatus is to be inserted.

Ninth Aspect

[0252] In the fixing device according to any one of the first to eighth aspects, when the fixing device is installed in the image forming apparatus, the protruding ends of each side plate are inserted into insertion holes of a fixing-device installation frame of the image forming apparatus,

and the fixing means is inserted into the through hole of the support plate.

Tenth Aspect

[0253] An image forming apparatus includes the fixing device according to any one of the first to ninth aspects.

Eleventh Aspect

[0254] The image forming apparatus according to the tenth aspect further includes a fixing-device installation frame on which the fixing device is installed. The fixing-device installation frame includes slit-shaped insertion holes to be fitted with the pair of side plates of the fixing device and a fixing portion to fix the support plate of the fixing device.

Twelfth Aspect

[0255] In the image forming apparatus according to the eleventh aspect, each of the slit-shaped insertion holes has a central wide portion not to contact the pair of side plates.

Claims

1. A fixing device (9) to be attached to an image forming apparatus (100), the fixing device comprising:

a housing frame;
a rotatable endless fixing belt (20);
a heater (22) to heat the fixing belt;
a heater holder (23) to hold the heater;
a stay (24) disposed inside the fixing belt to support the heater holder;
a pressure roller (21) to form a nip between the fixing belt and the pressure roller;
a guide plate (26) to guide a recording medium to the nip; and
a separation plate (25) to separate the recording medium that has passed through the nip from the fixing belt,
the housing frame including:

a support plate (29) disposed on a same side as the pressure roller with respect to the nip in a direction intersecting a longitudinal direction of the support plate;
a pair of side plates (28) disposed on both ends of the support plate in the longitudinal direction,
the pair of side plates attached to at least one of the separation plate, the guide plate, and the stay, on a same side as the fixing belt with respect to the nip in the direction intersecting the longitudinal direction.

2. The fixing device according to claim 1,

wherein one of each longitudinal end of the separation plate (25) and each side plate of the pair of side plates (28) has an engaging portion and the other of each longitudinal end of the separation plate and each side plate of the pair of side plates has an engaged portion, and the engaging portion and the engaged portion are engaged to determine relative positions between the separation plate and the pair of side plates and define a separation distance between the pair of side plates.

3. The fixing device according to claim 1,

wherein one of each longitudinal end of the guide plate (26) and each side plate of the pair of side plates (28) has an engaging portion and the other of each longitudinal end of the guide plate and each side plate of the pair of side plates has an engaged portion, and the engaging portion and the engaged portion are engaged to determine relative positions between the guide plate and the pair of side plates and define a separation distance between the pair of side plates.

4. The fixing device according to claim 1,

wherein one of each longitudinal end of the stay (24) and each side plate of the pair of side plates (28) has a fitting portion and the other of each longitudinal end of the stay and each side plate of the pair of side plates has a fitted portion, and the fitting portion and the fitted portion are fitted to determine relative positions between the stay and the pair of side plates and define a separation distance between the pair of side plates.

5. The fixing device according to claim 2 or 3, further comprising a plurality of combinations of engaging portions and engaged portions including the engaging portion and the engaged portion.

6. The fixing device according to any one of claims 1 to 5, wherein the separation plate, the guide plate, and the stay are made of metal.

7. The fixing device according to any one of claims 1 to 6,

wherein each side plate of the pair of side plates (28) has a substantially C-shape with an opening to support the pressure roller, and the substantially C-shape has protruding ends each of which is narrower toward a tip thereof.

8. The fixing device according to any one of claims 1 to 7,
wherein the support plate (29) has a through hole (29a) through which a fixing means for positioning and fixing the support plate to the image forming apparatus is to be inserted. 5
9. The fixing device according to claim 7,
wherein when the fixing device is installed in the image forming apparatus, the protruding ends of each side plate are inserted into insertion holes of a fixing-device installation frame (105) of the image forming apparatus. 10
10. The fixing device according to any one of claims 1 to 9,
wherein no support plate is disposed on the same side as the fixing belt with respect to the nip in the direction intersecting the longitudinal direction of the support plate, when the fixing device is detached from the image forming apparatus. 15 20
11. An image forming apparatus (100), comprising the fixing device according to any one of claims 1 to 10. 25
12. The image forming apparatus according to claim 11,
further comprising a fixing-device installation frame (105) on which the fixing device is installed,
wherein the fixing-device installation frame includes: 30
- insertion slits (111) to be fitted with the pair of side plates of the fixing device; and
a fixing portion (112) to fix the support plate of the fixing device. 35
13. The image forming apparatus according to claim 12,
wherein each of the insertion slits has a central wide portion not to contact the pair of side plates. 40

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FIG. 1

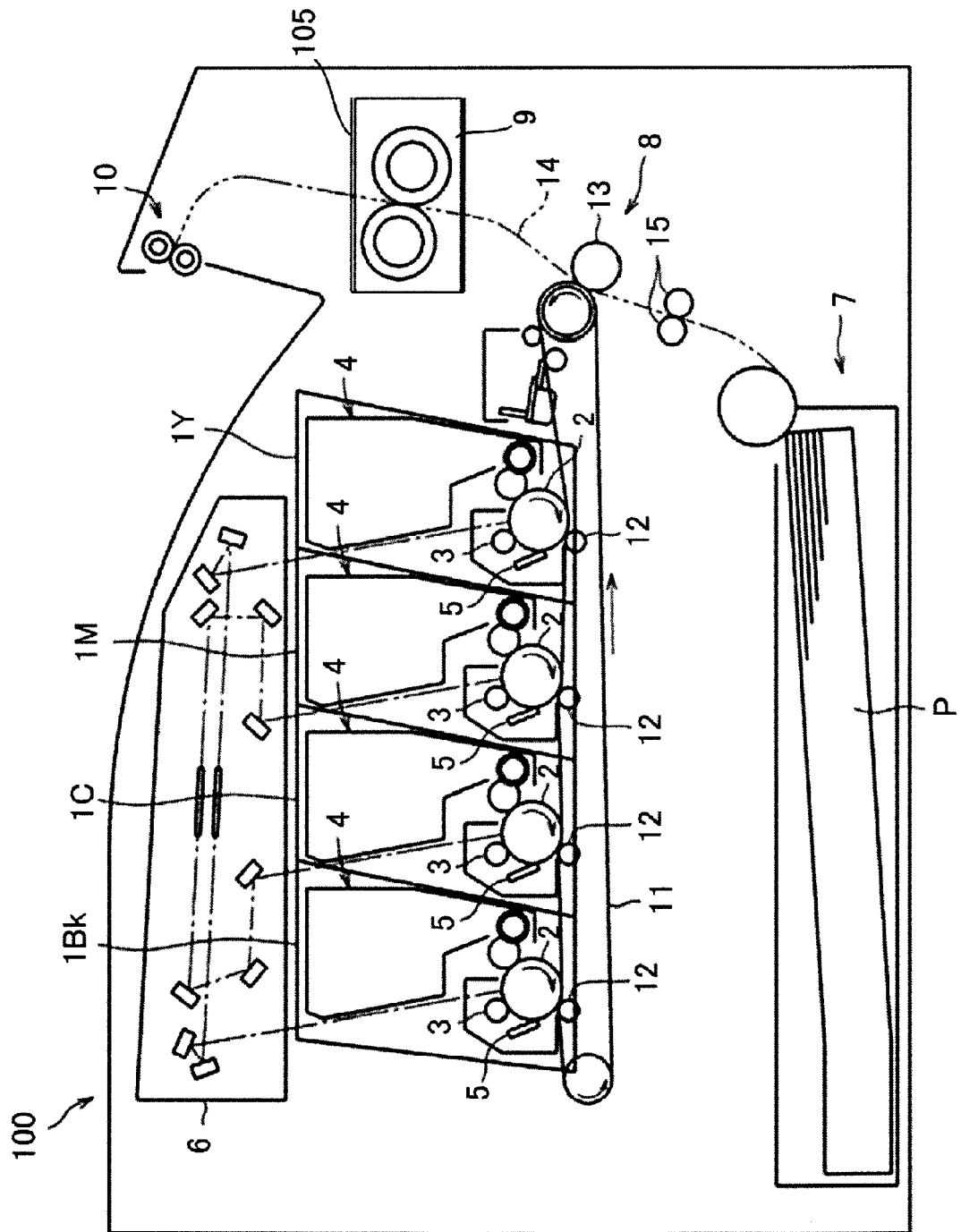


FIG. 2

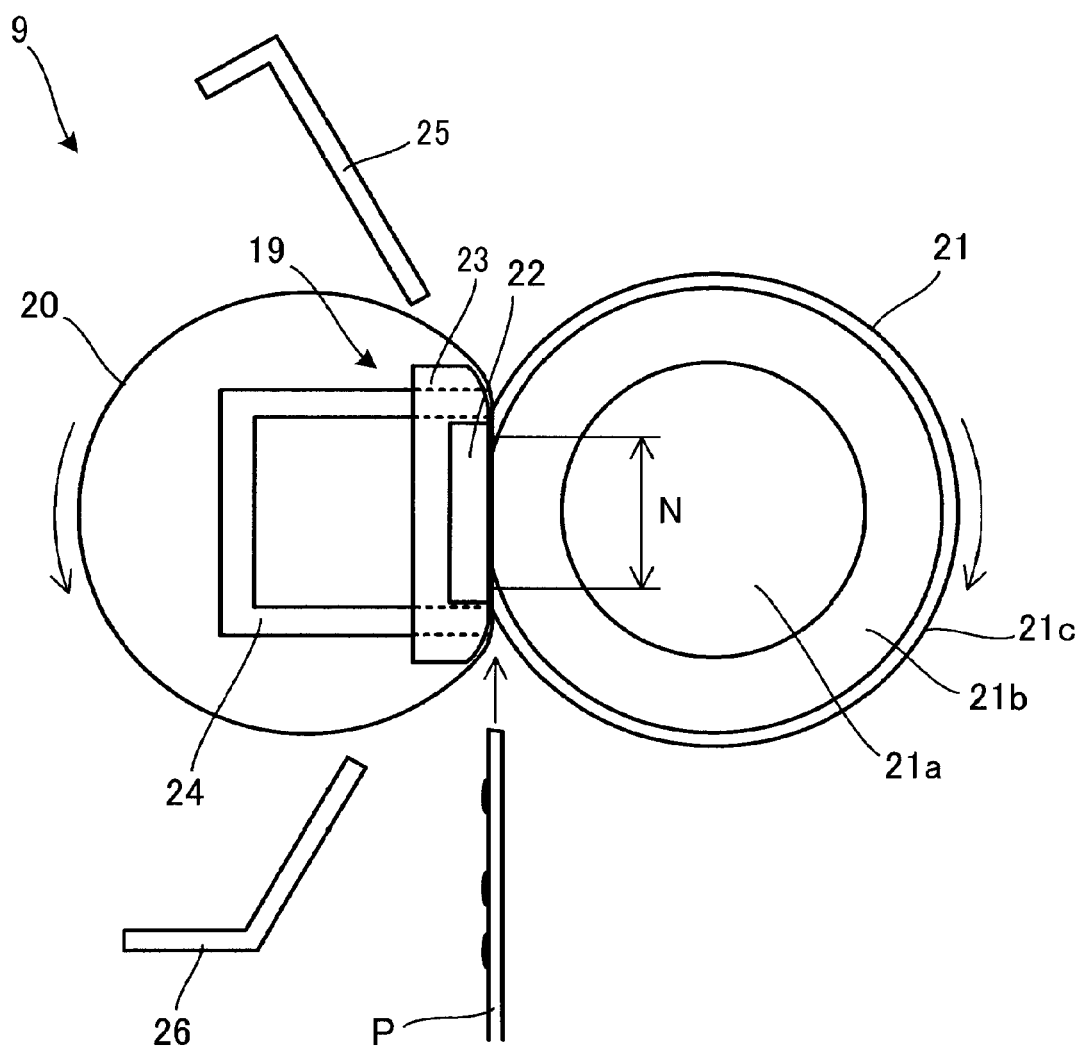


FIG. 3

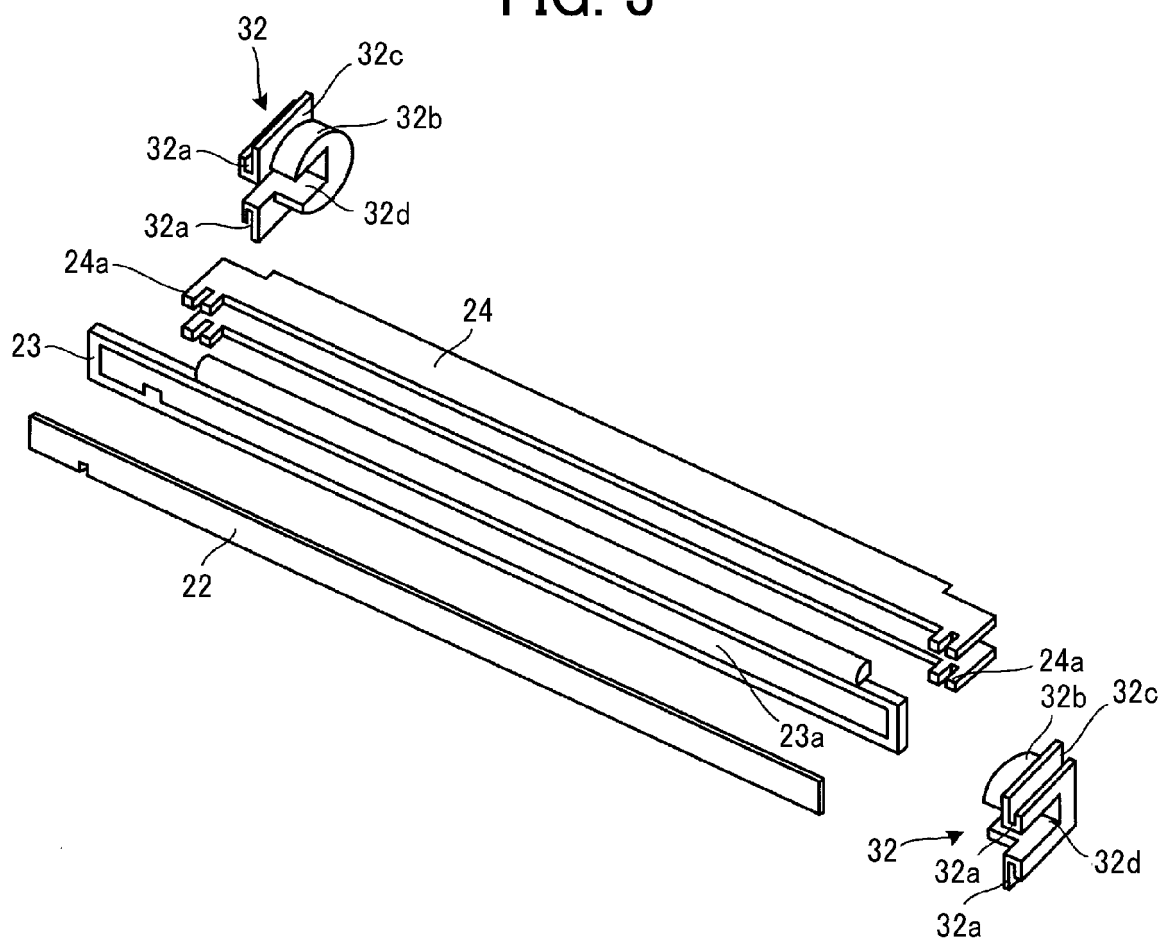


FIG. 4

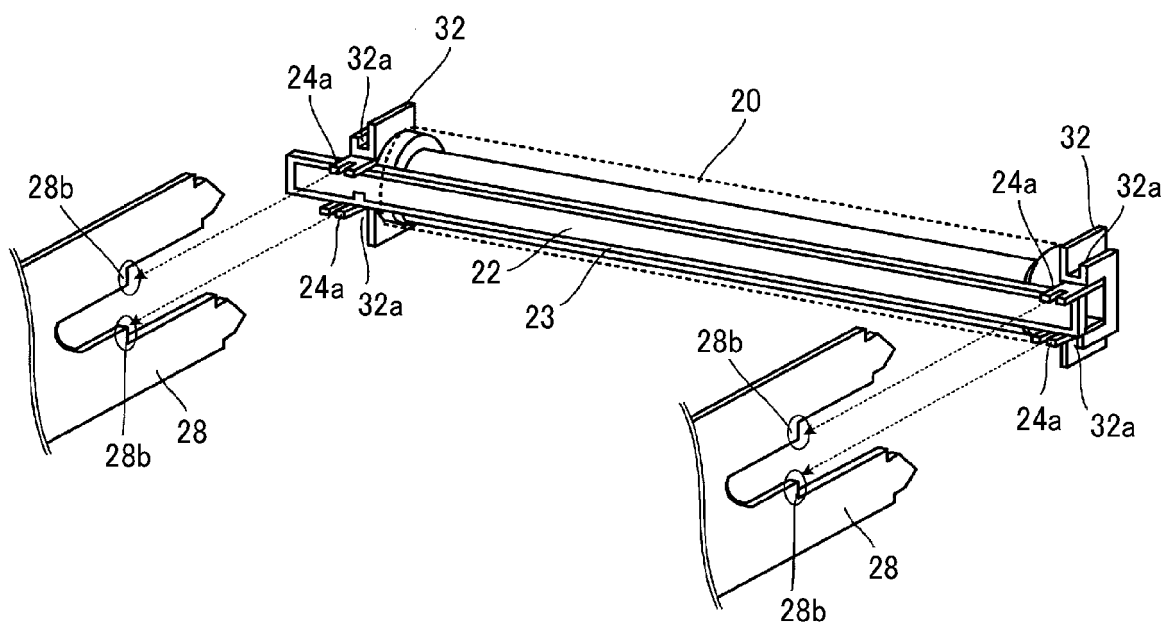


FIG. 5

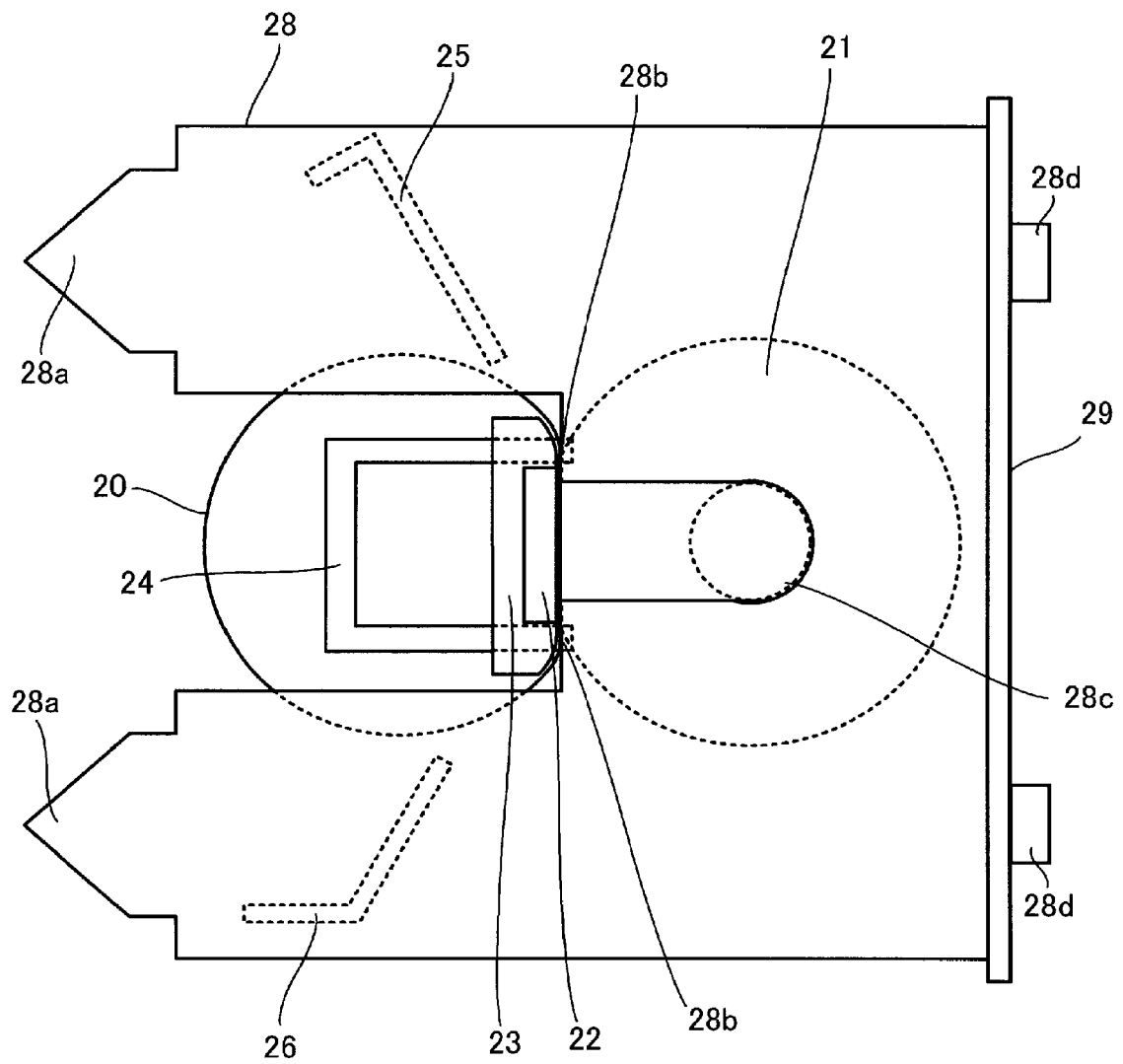


FIG. 6A

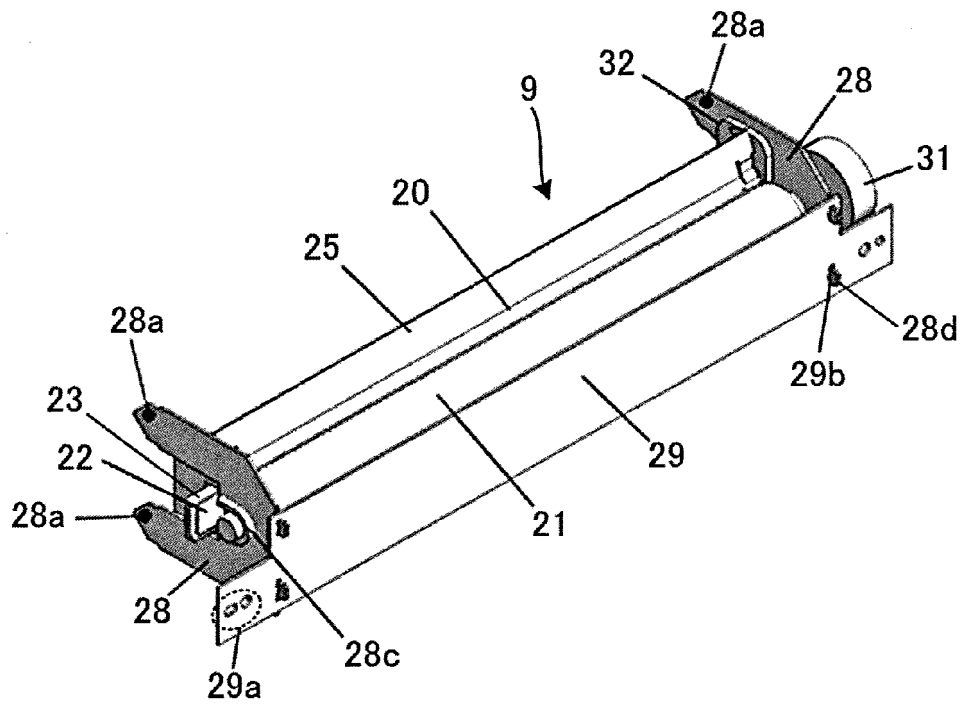


FIG. 6B

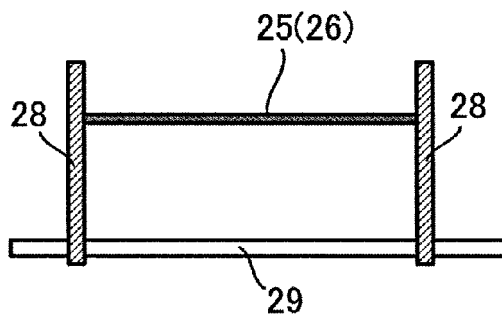


FIG. 6C

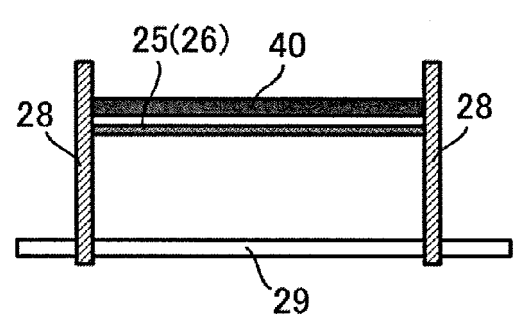


FIG. 7

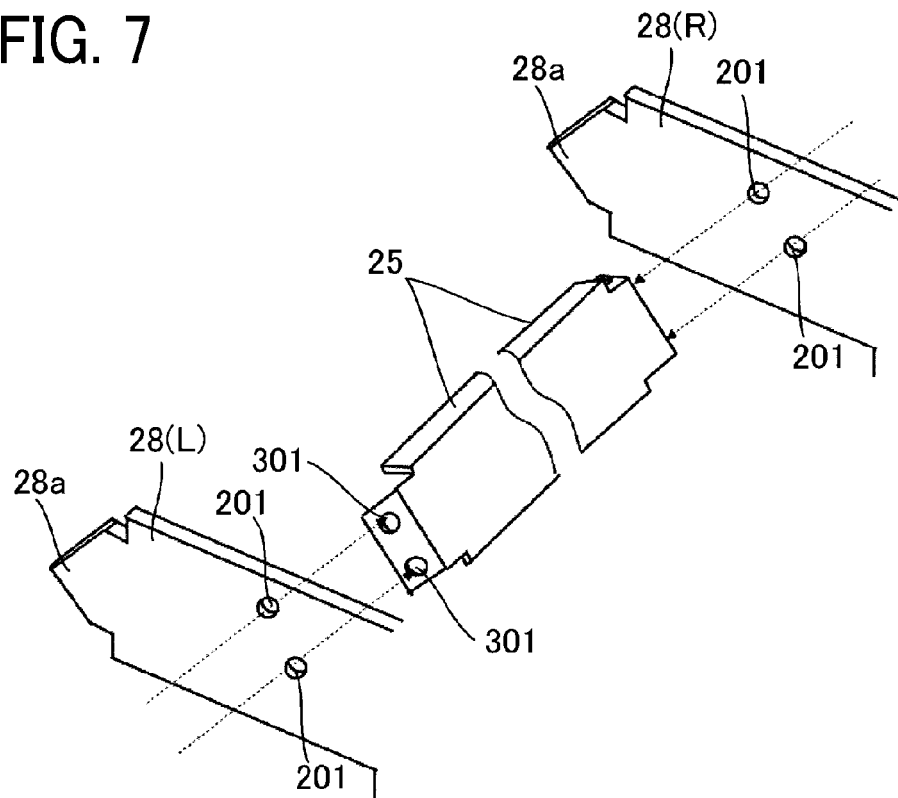


FIG. 8

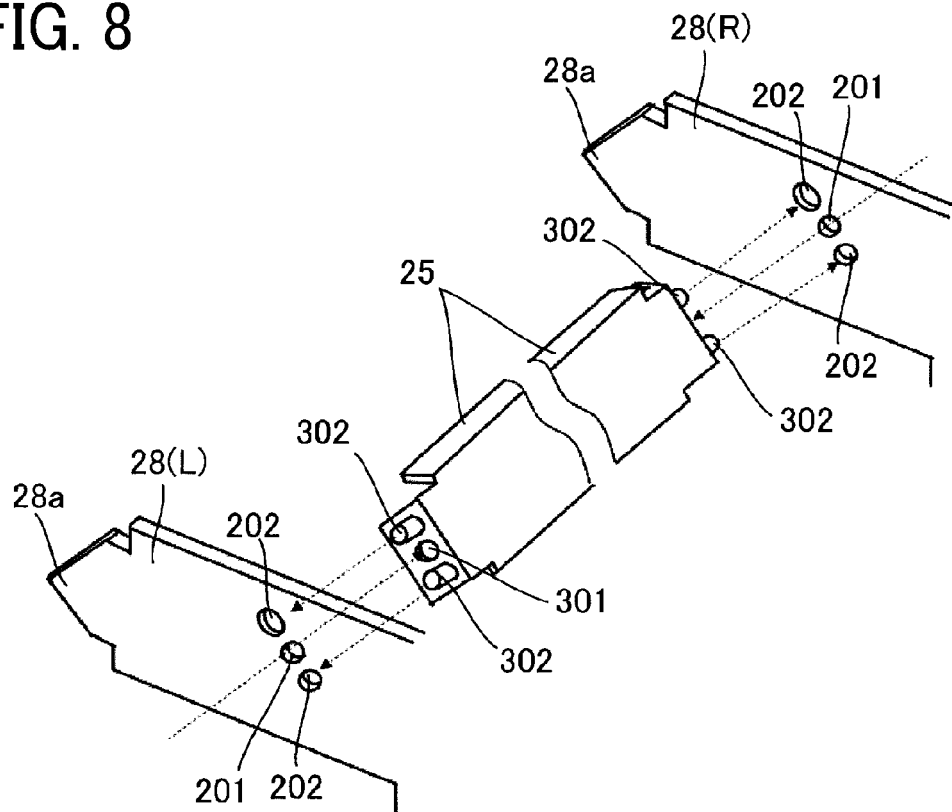


FIG. 9

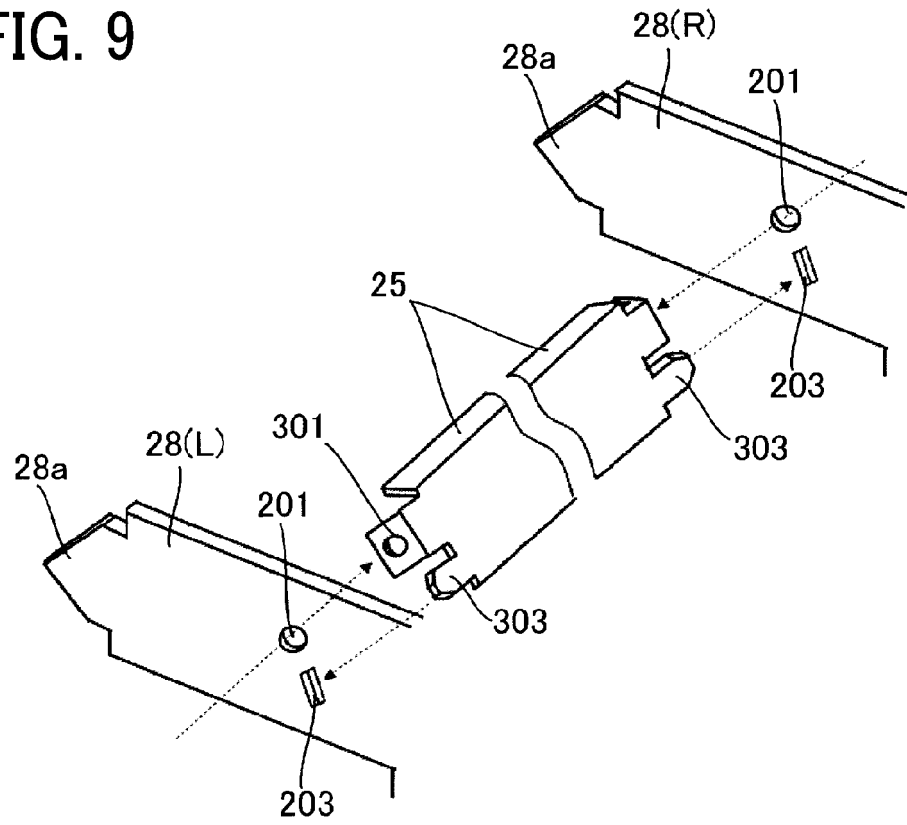


FIG. 10

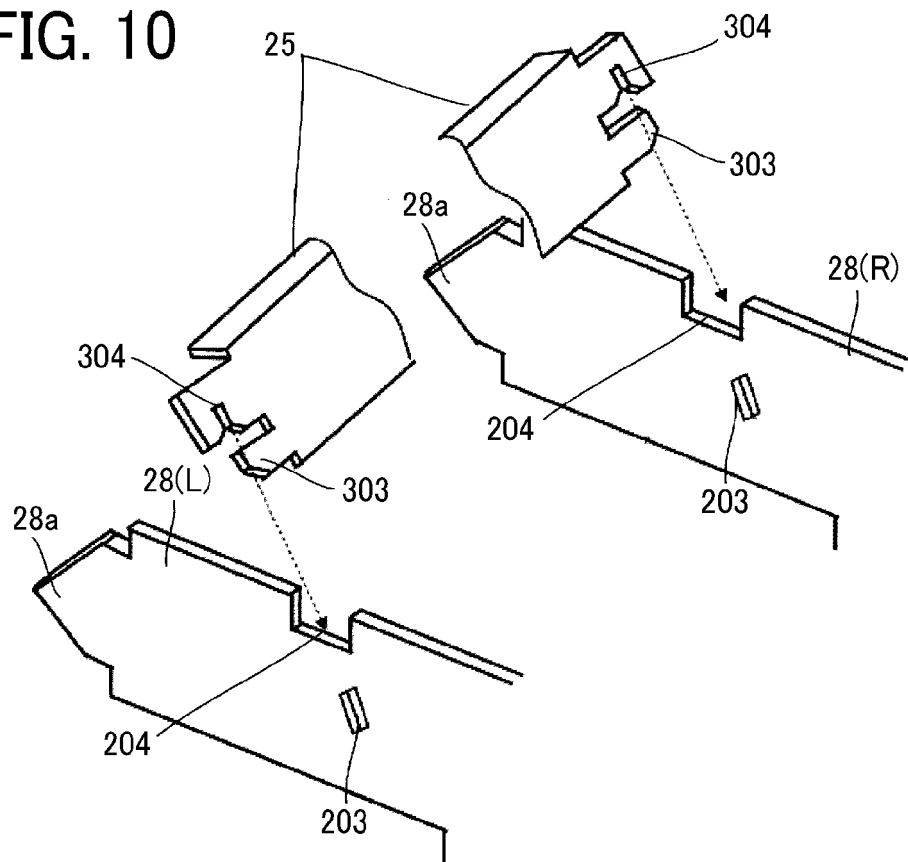


FIG. 11

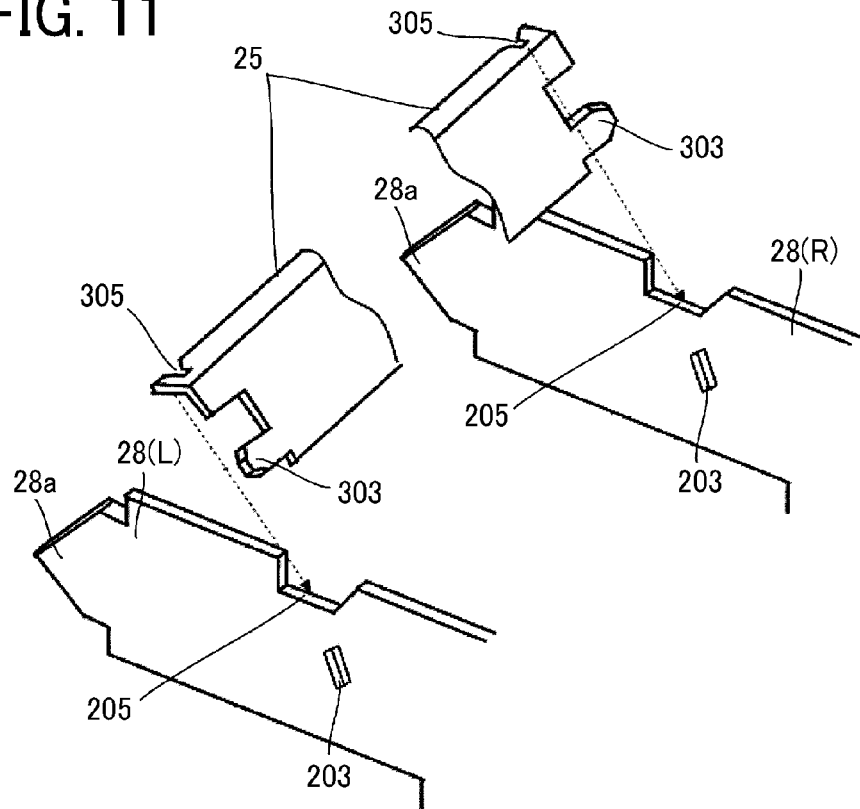


FIG. 12

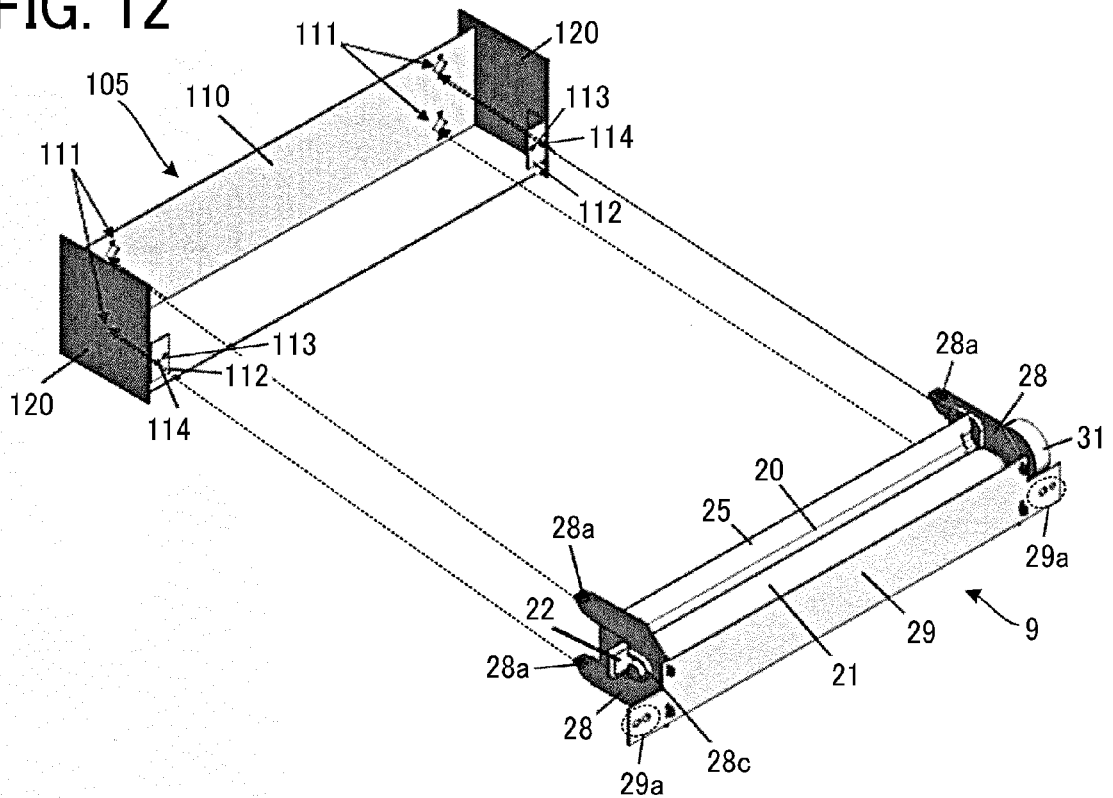


FIG. 13A

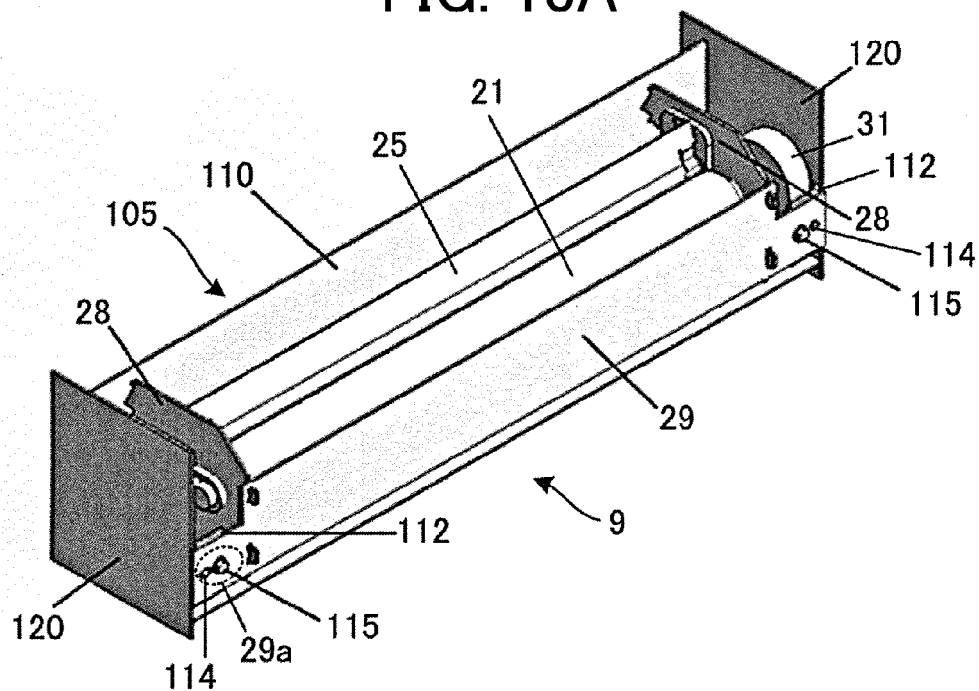


FIG. 13B

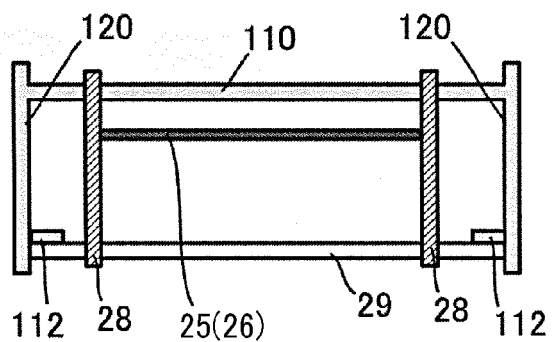


FIG. 13C

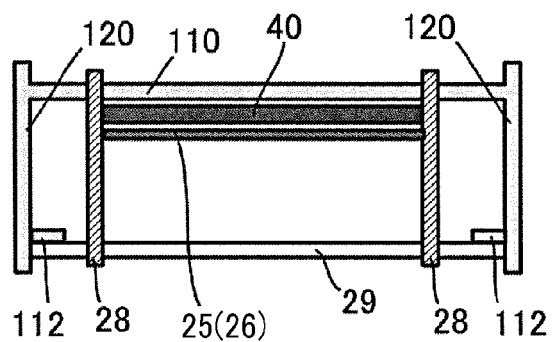


FIG. 14

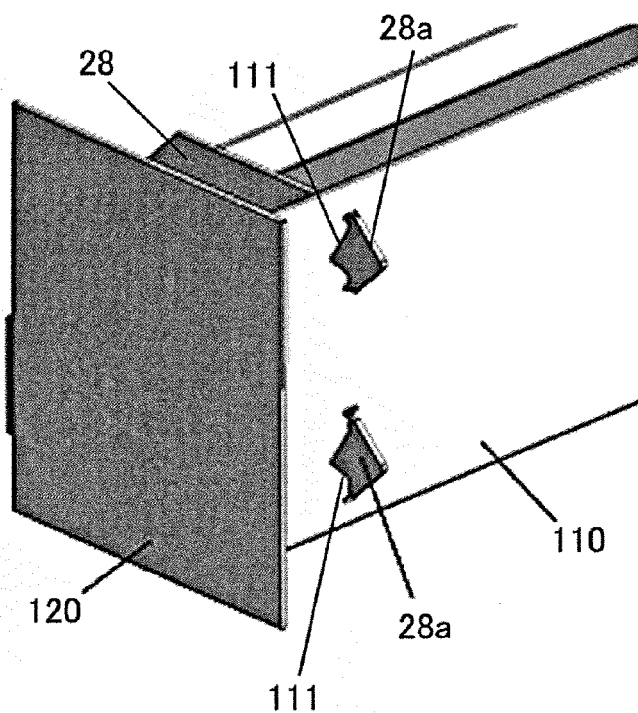


FIG. 15

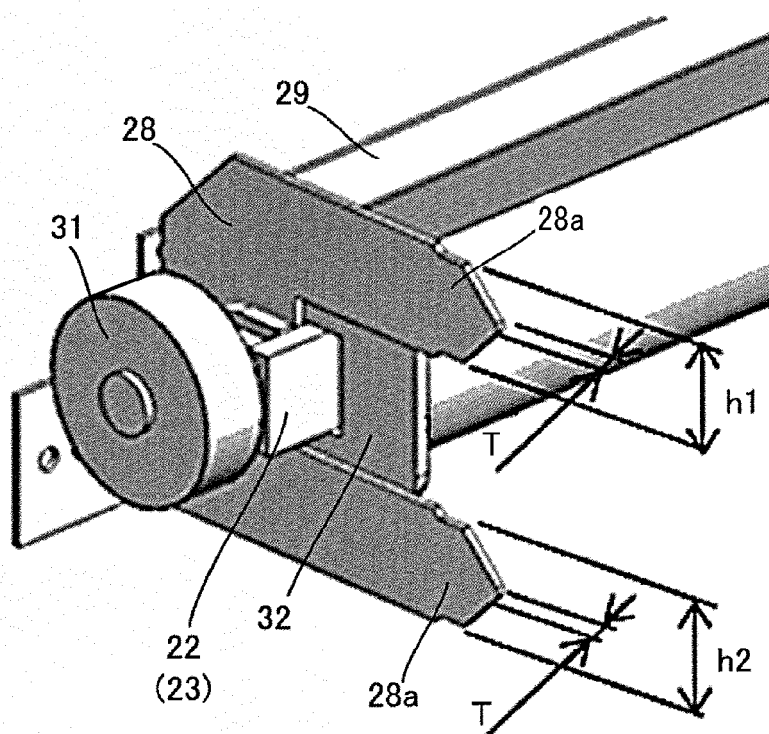


FIG. 16

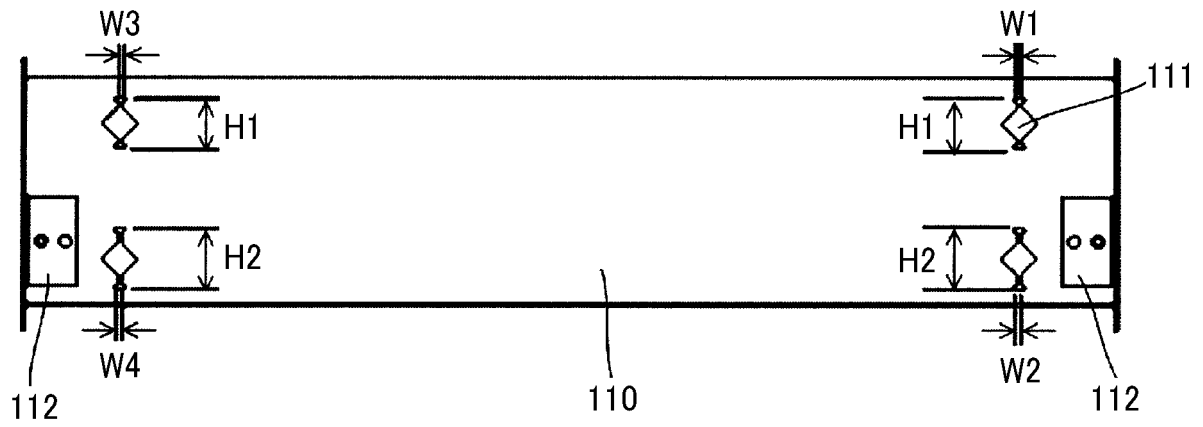


FIG. 17

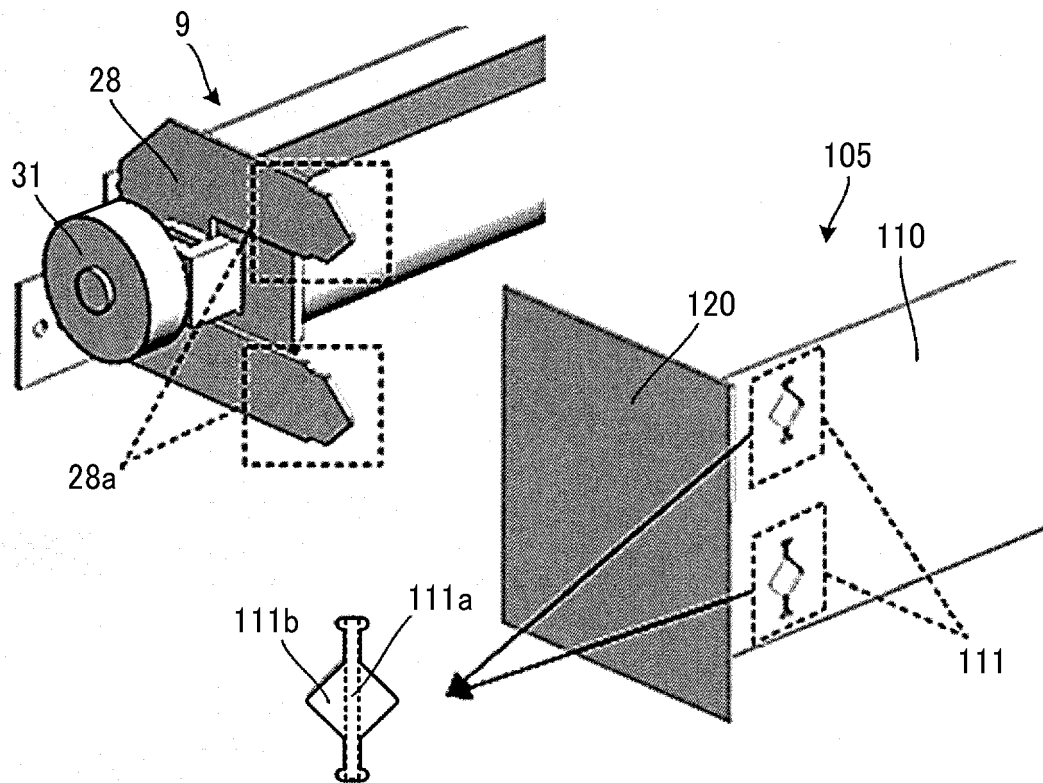


FIG. 18A

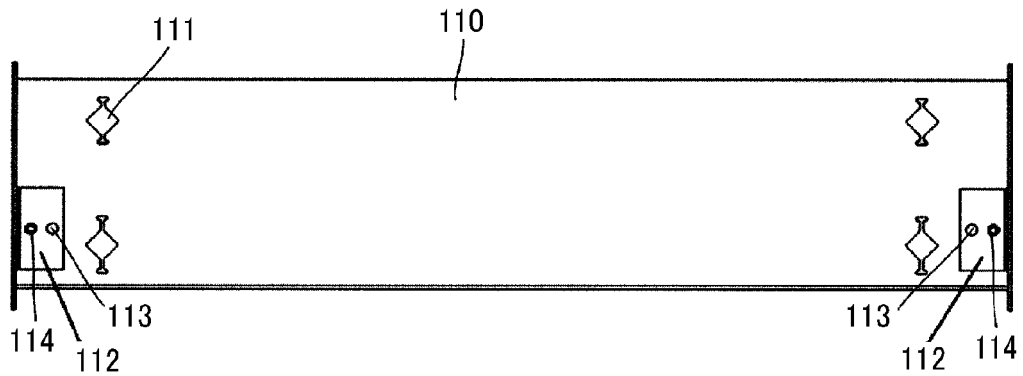


FIG. 18B

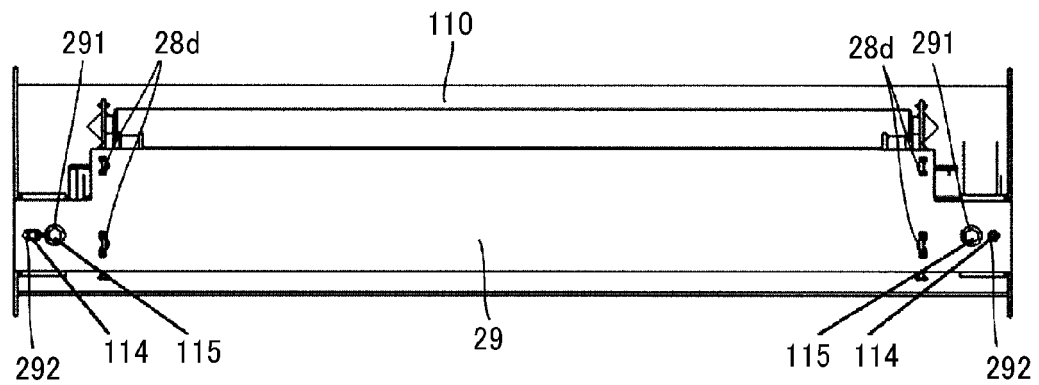


FIG. 19A

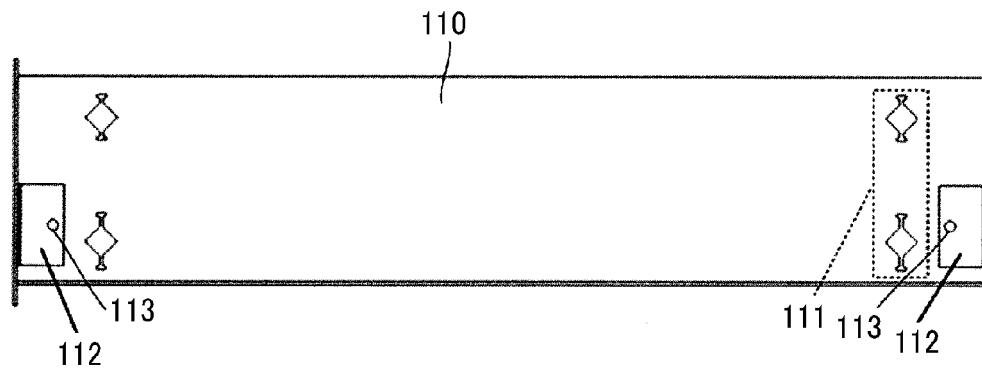


FIG. 19B

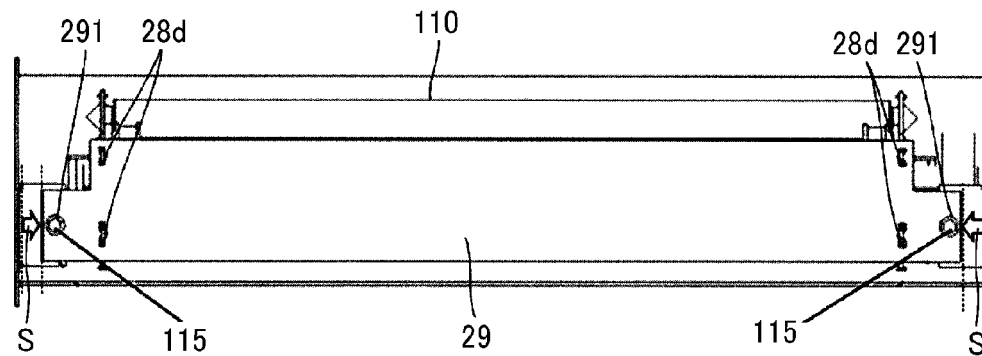


FIG. 20

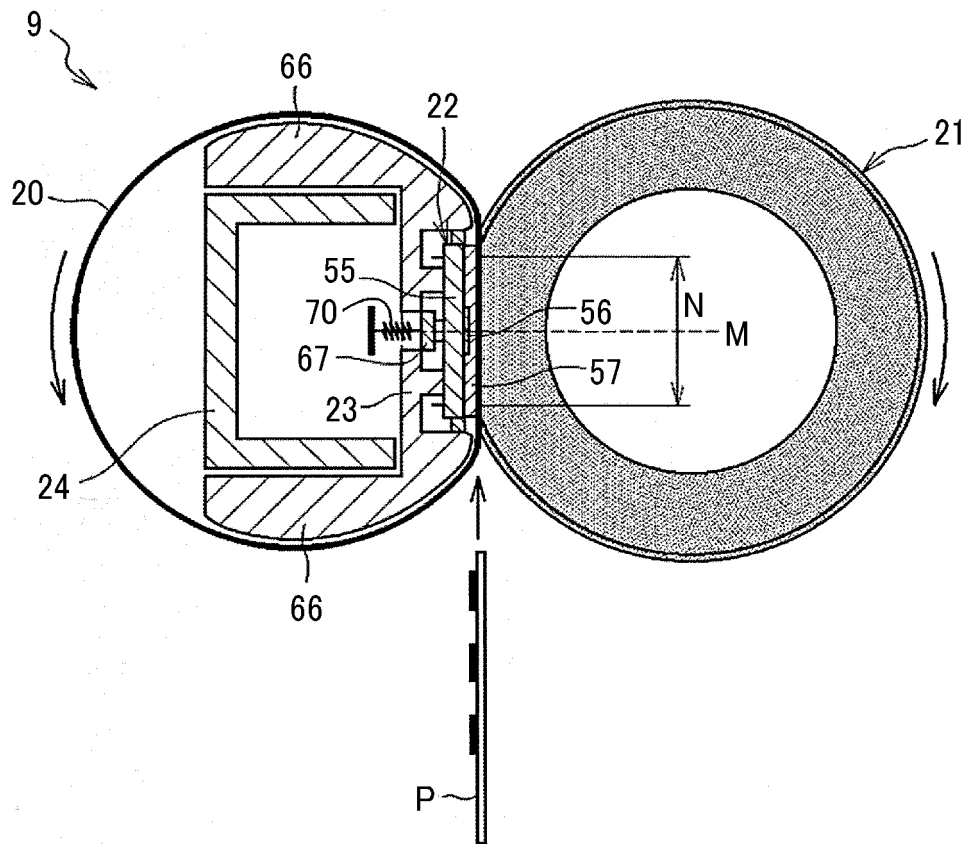


FIG. 21

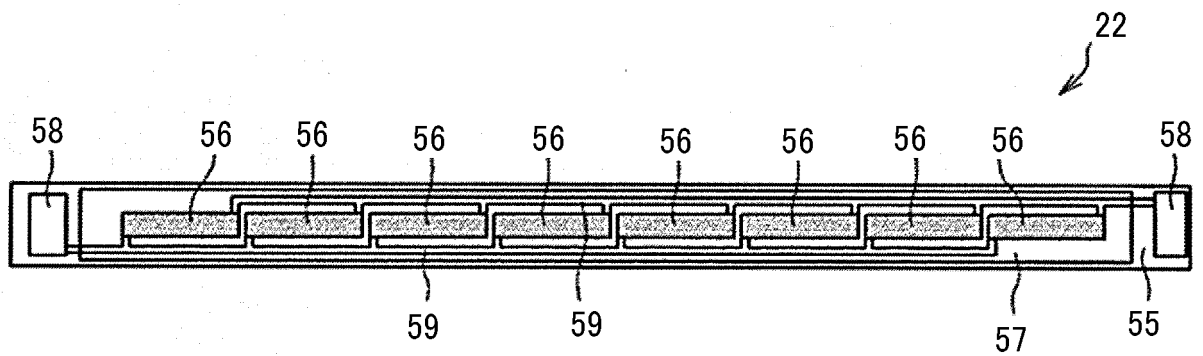


FIG. 22

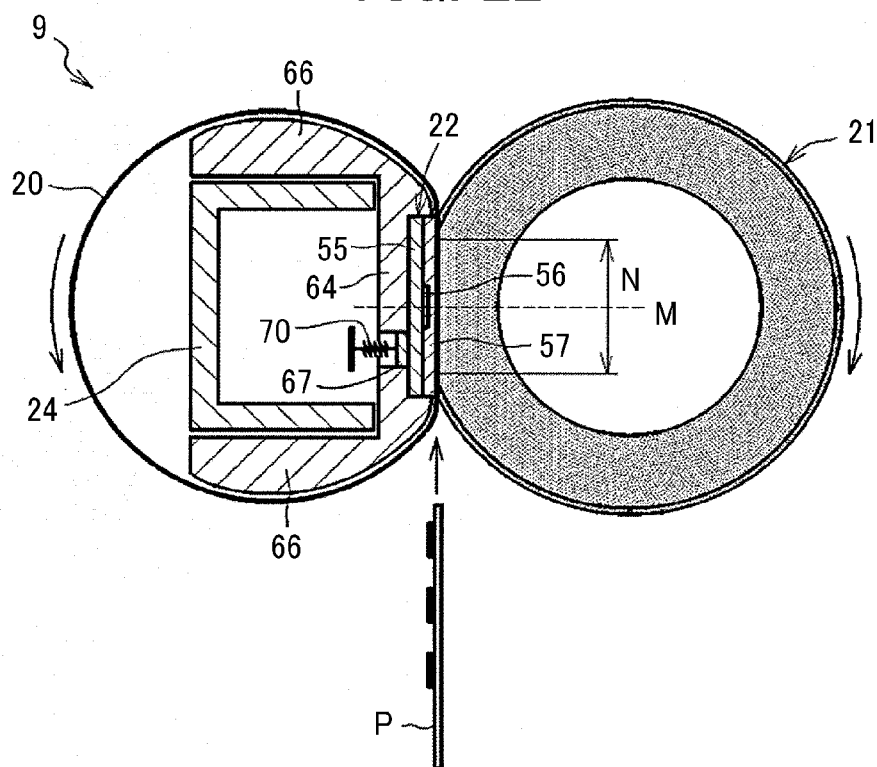


FIG. 23

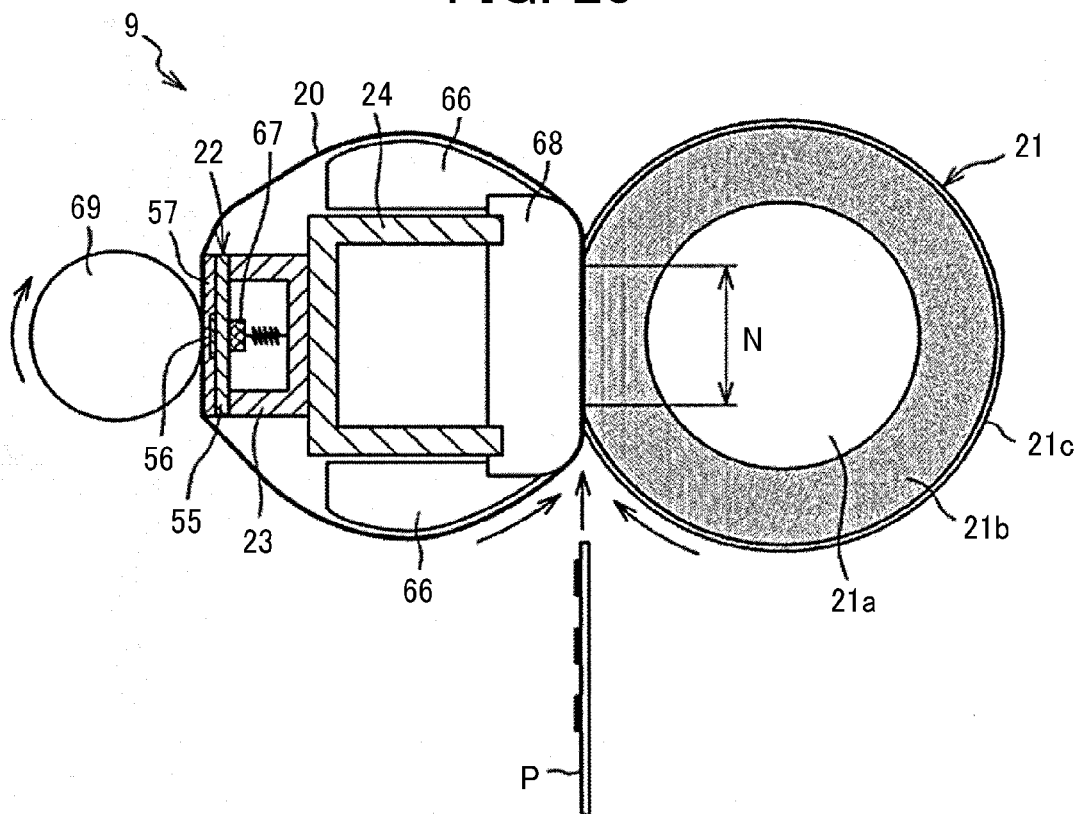


FIG. 24

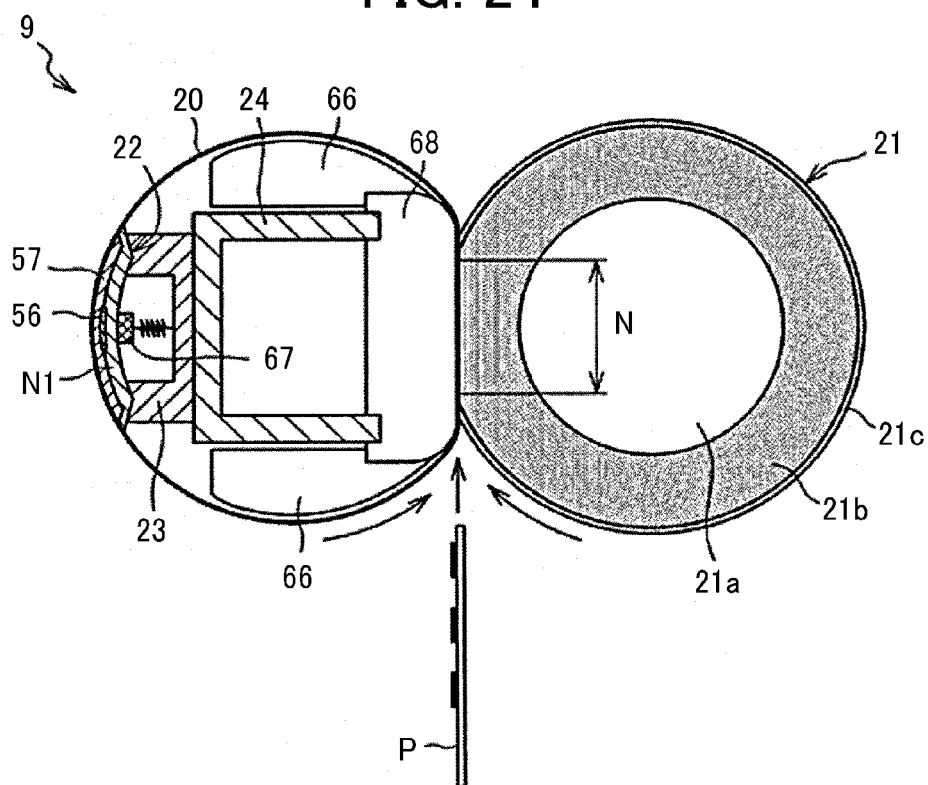


FIG. 25

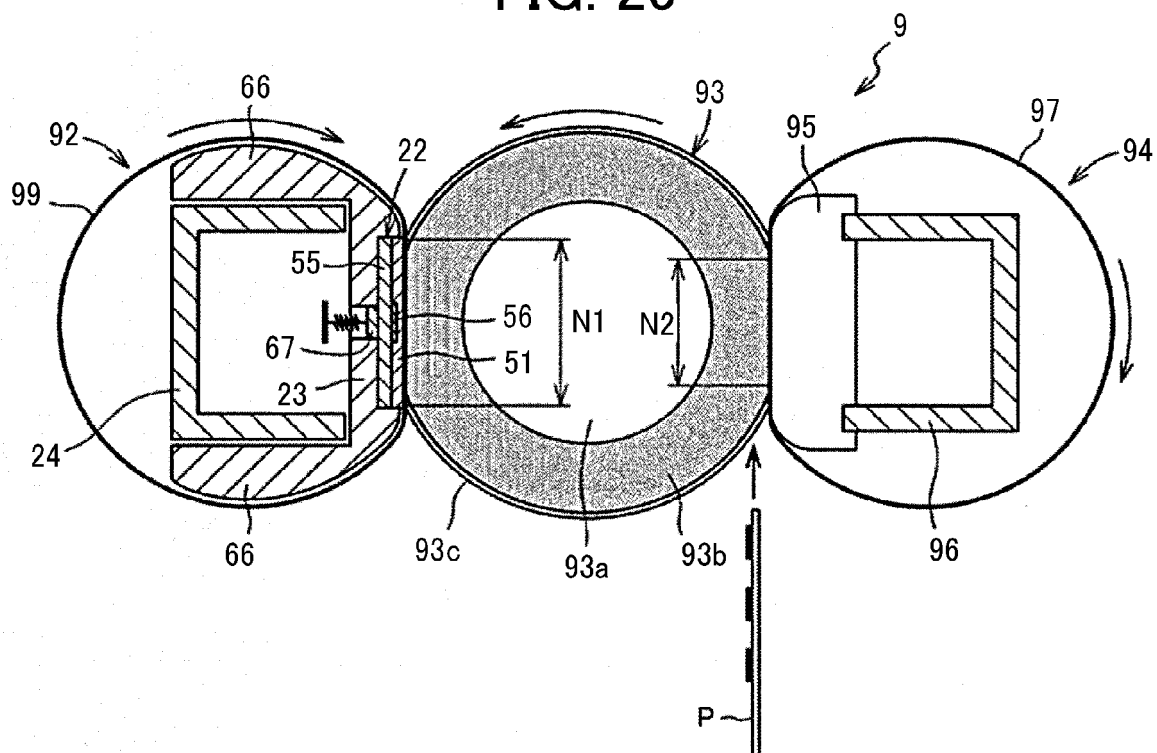


FIG. 26

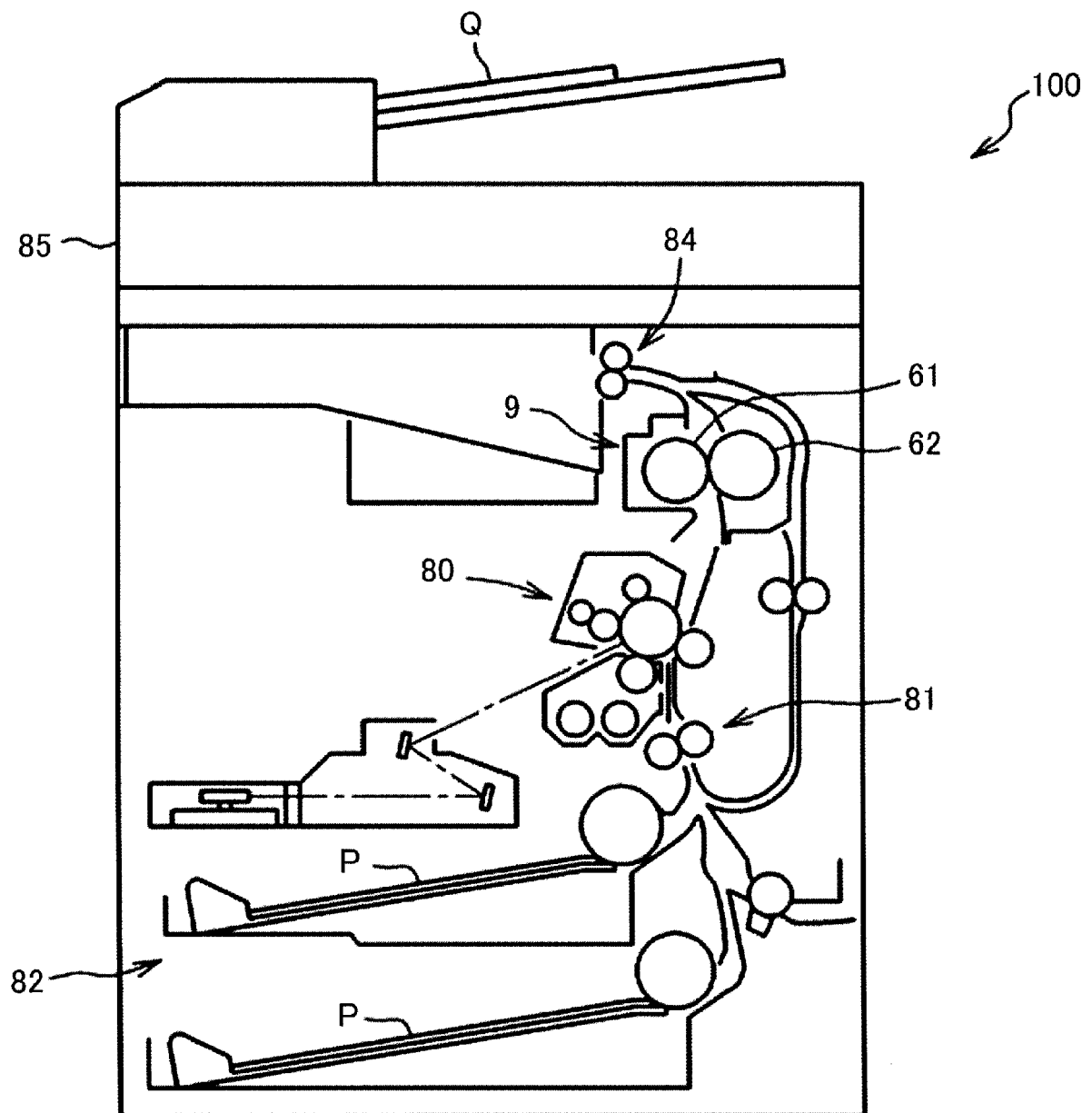


FIG. 27

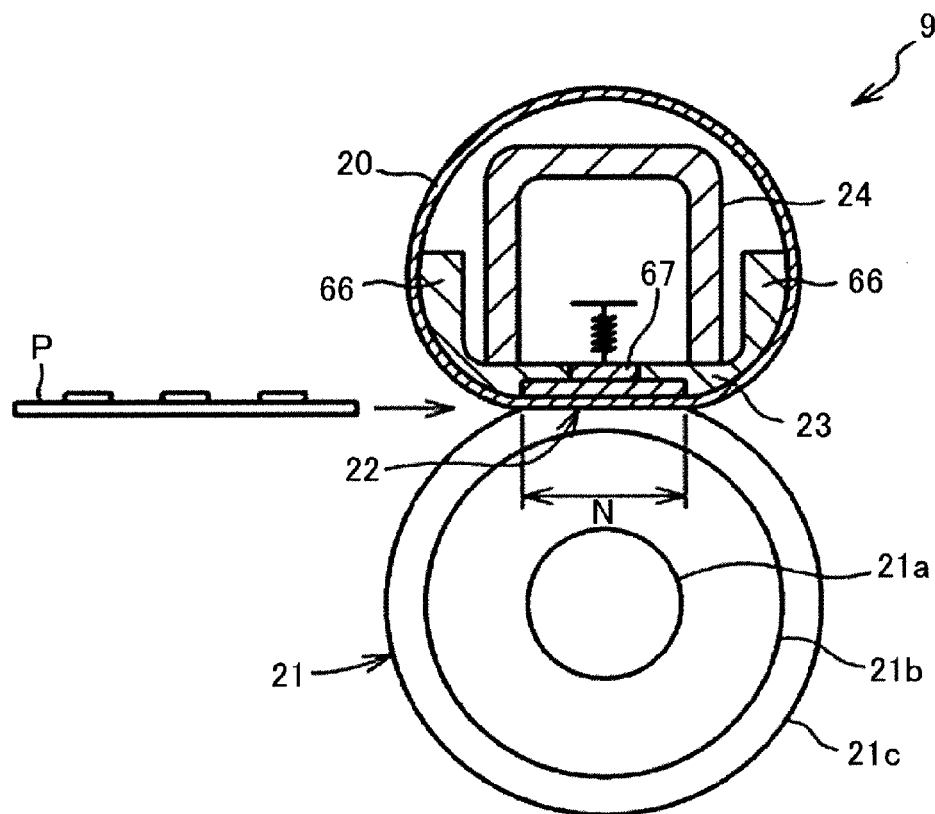


FIG. 28

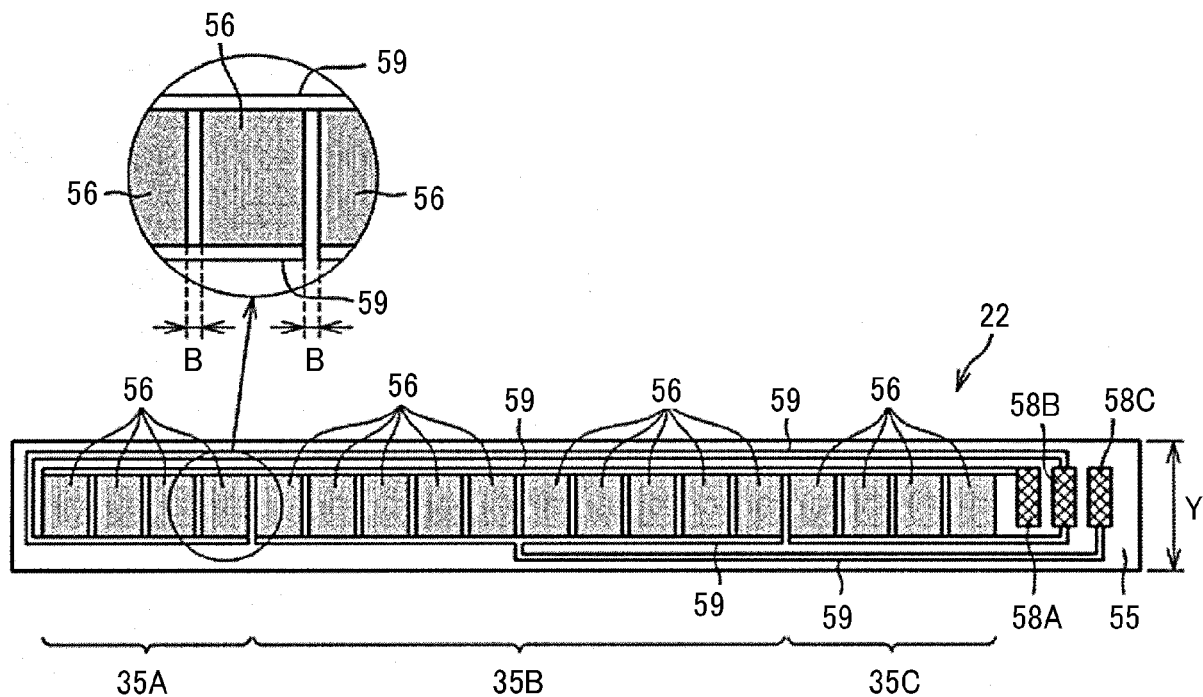


FIG. 29

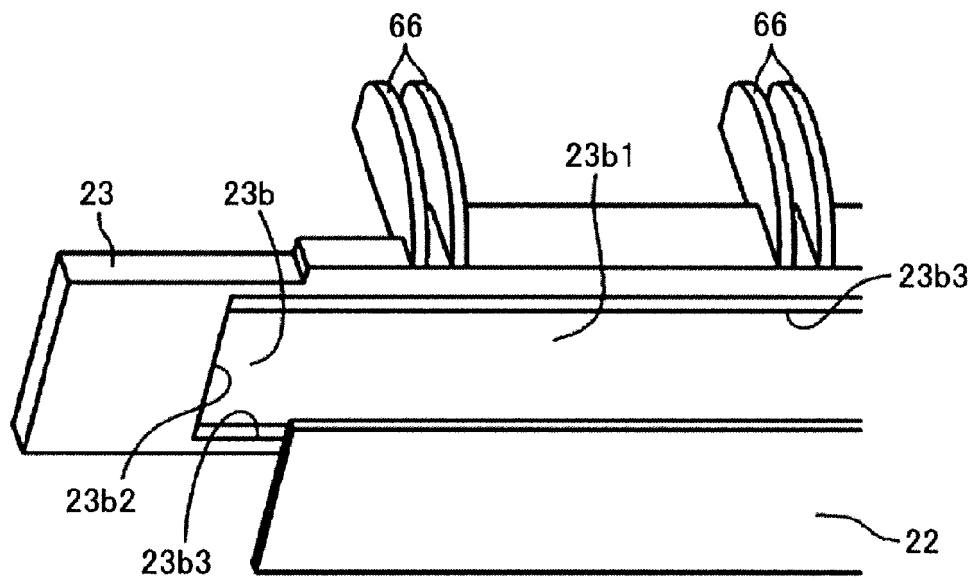


FIG. 30

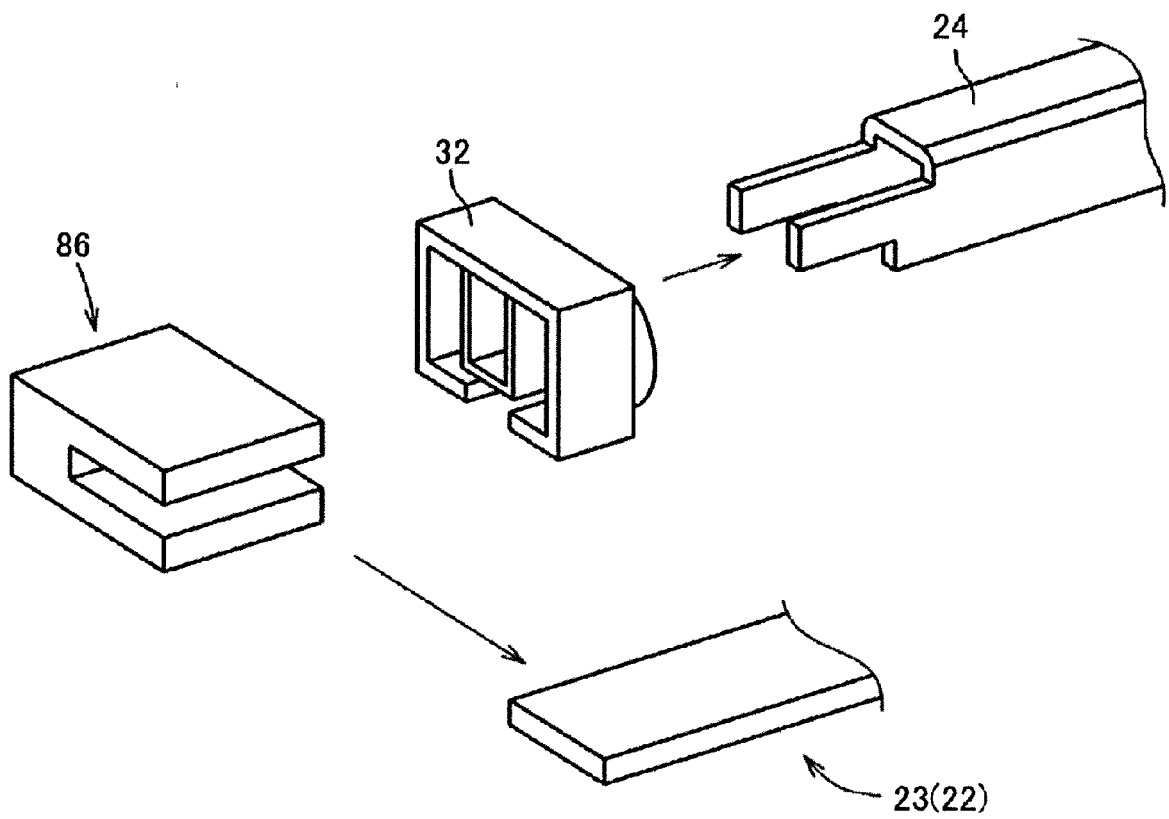


FIG. 31A

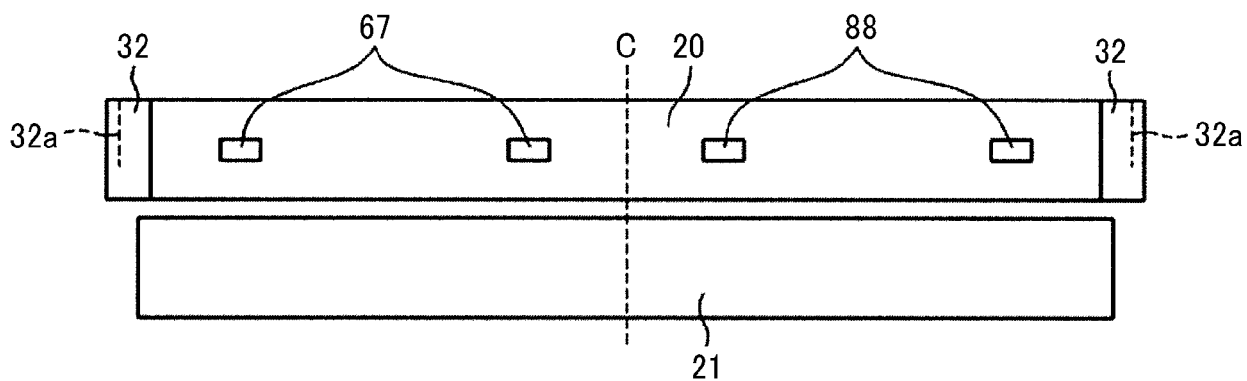


FIG. 31B

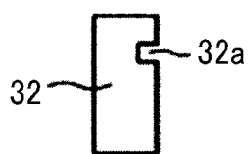


FIG. 32

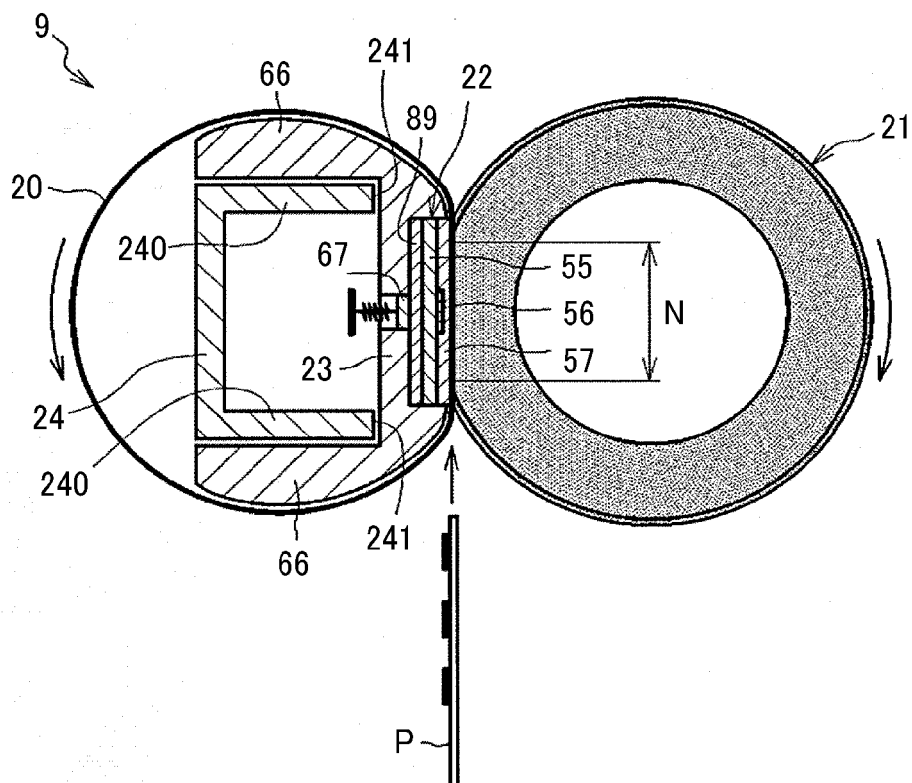


FIG. 33

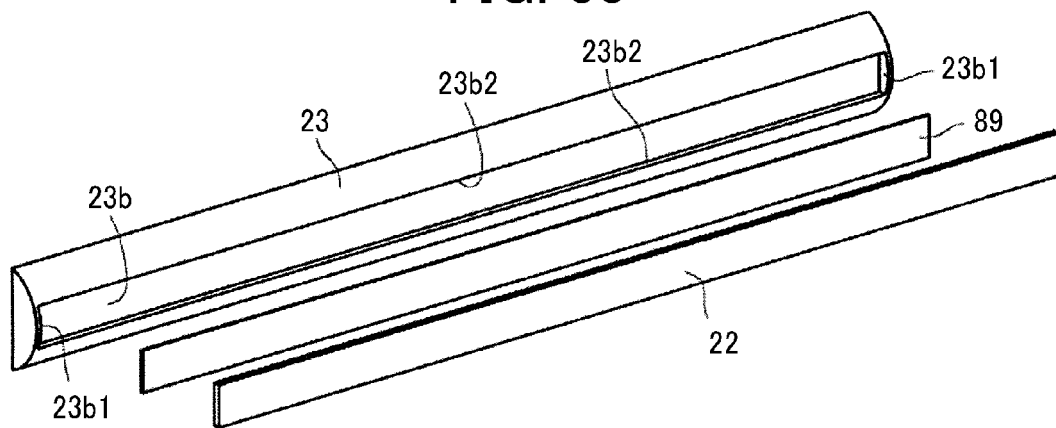


FIG. 34

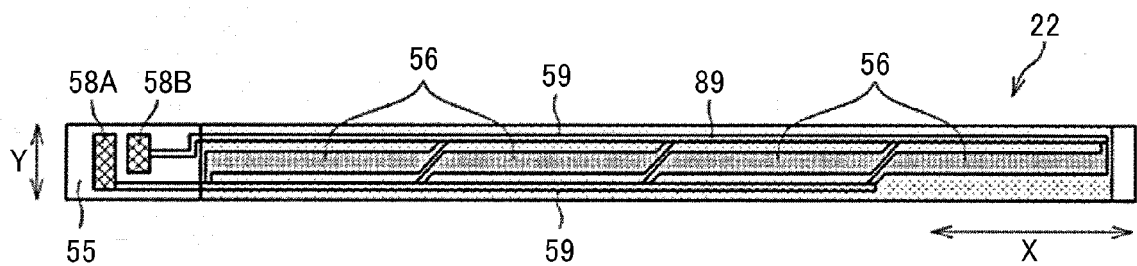


FIG. 35

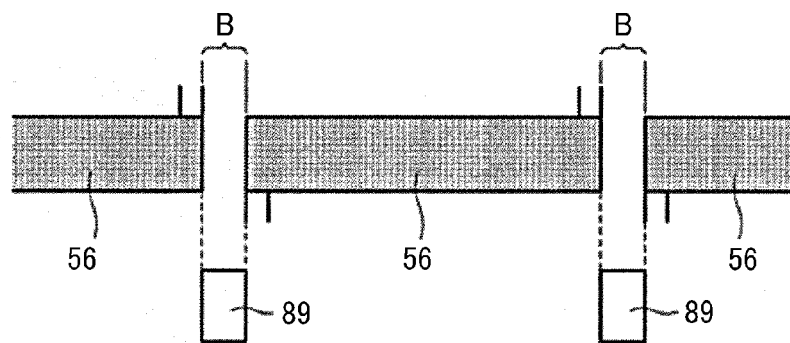


FIG. 36

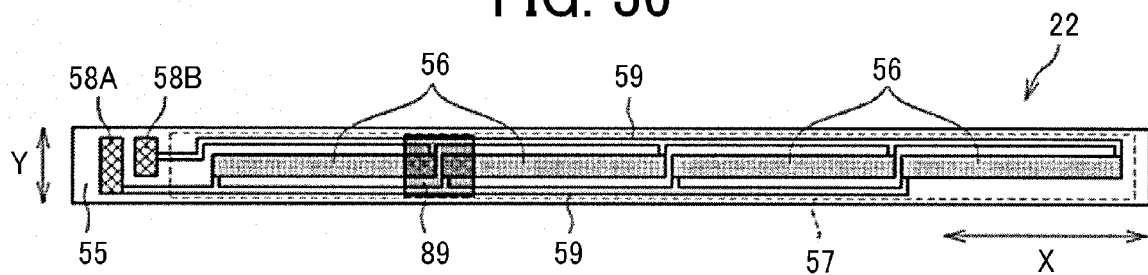


FIG. 37

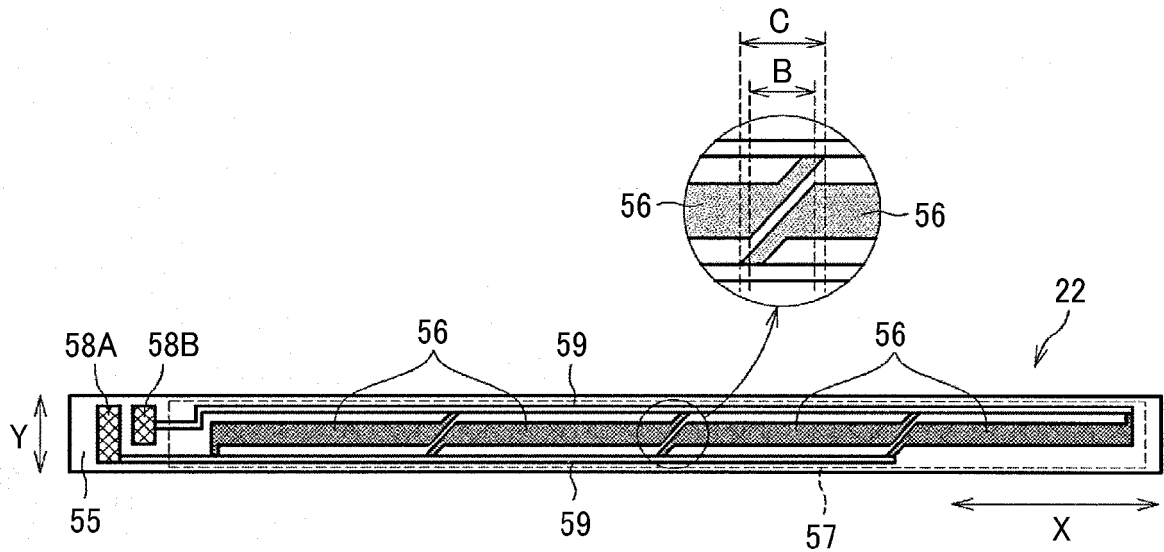


FIG. 38

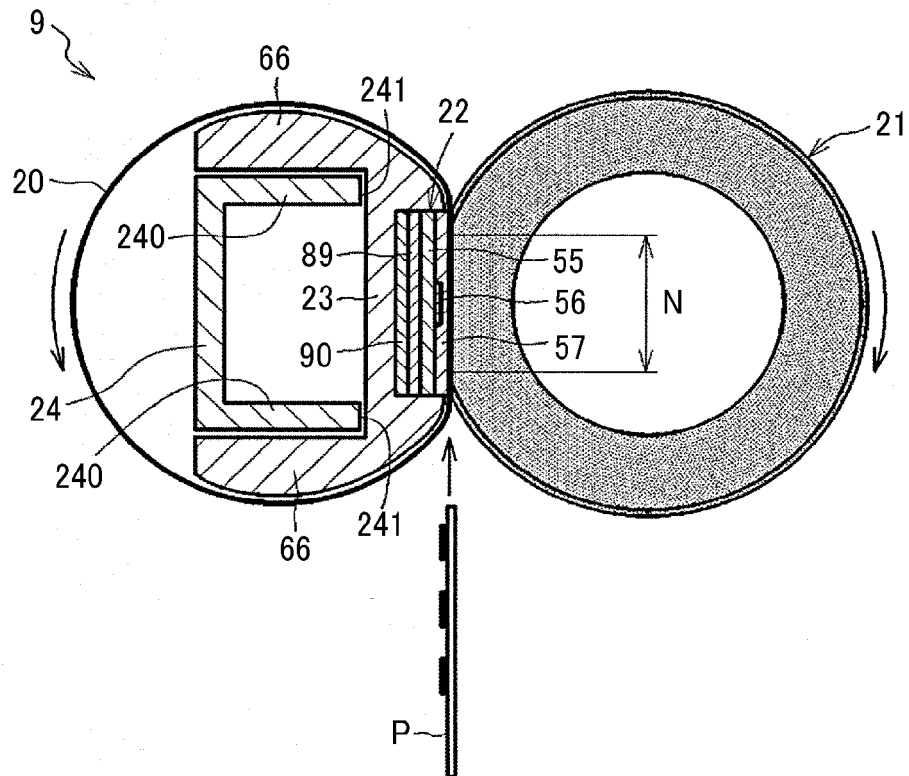


FIG. 39

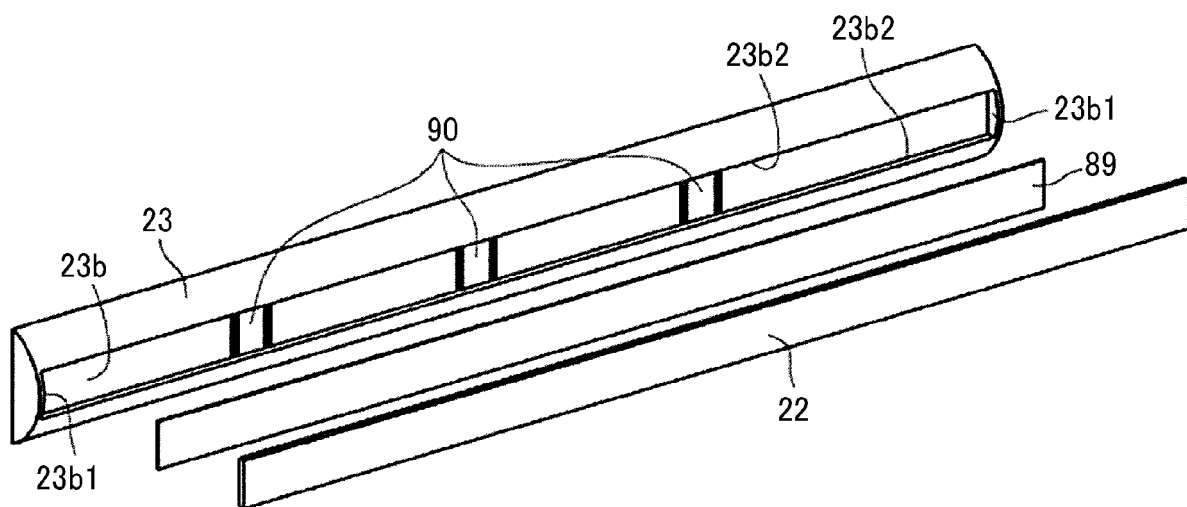


FIG. 40

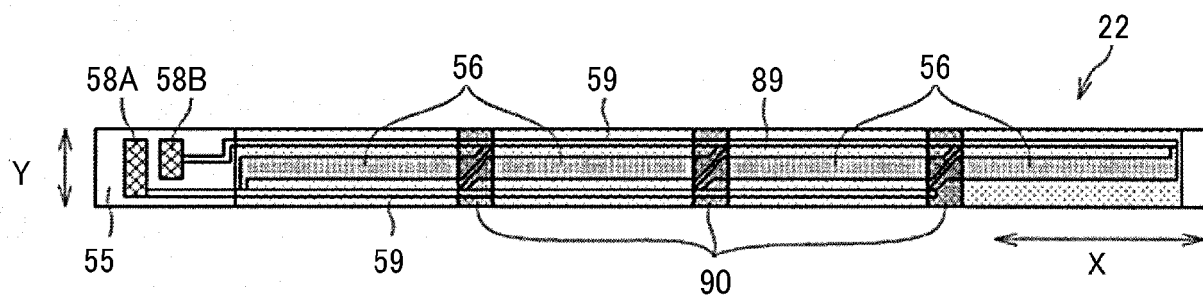


FIG. 41

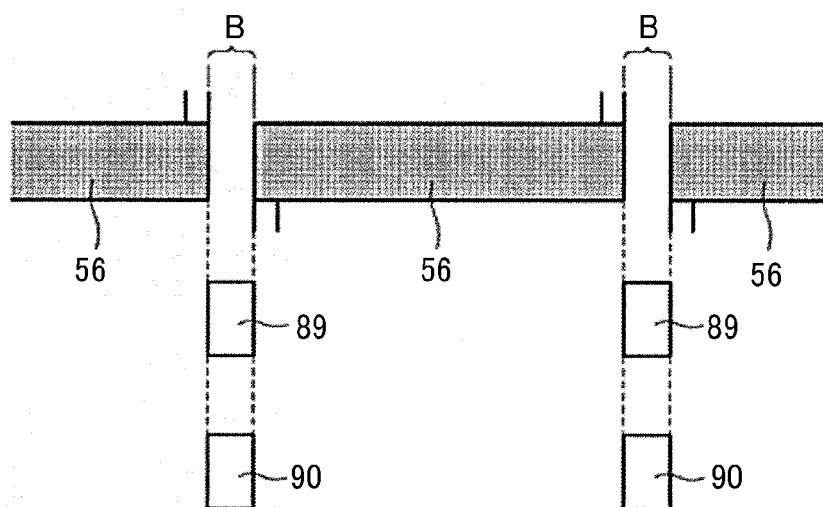


FIG. 42

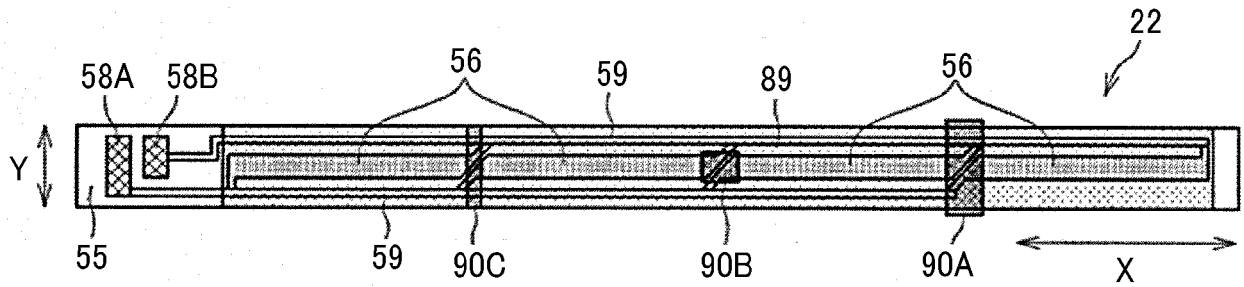


FIG. 43

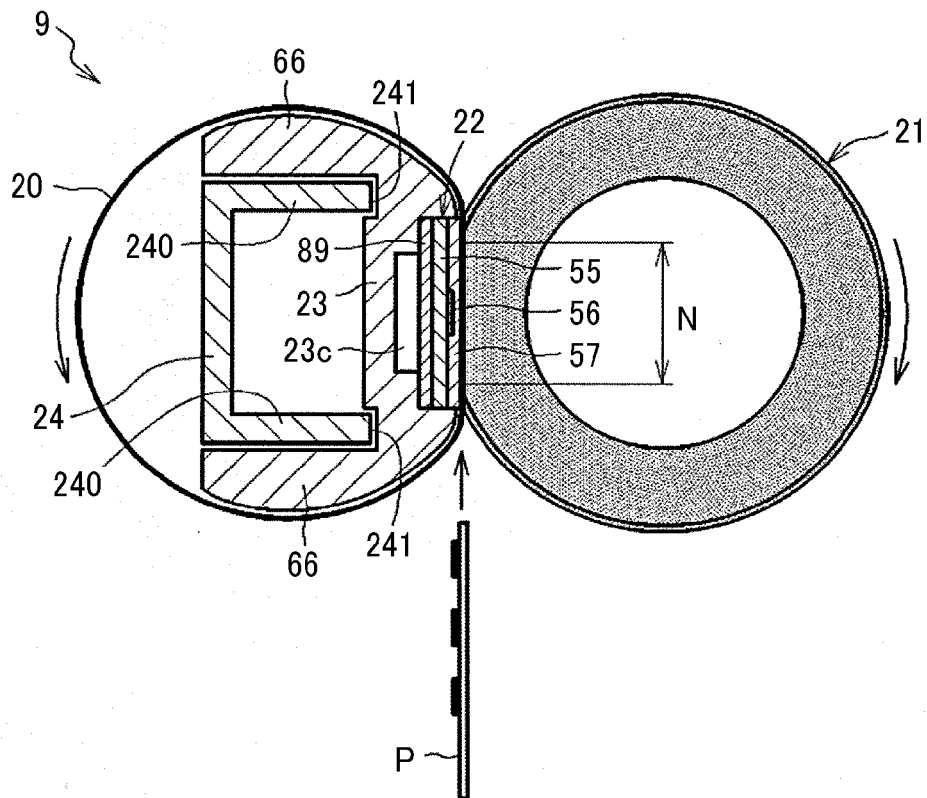


FIG. 44

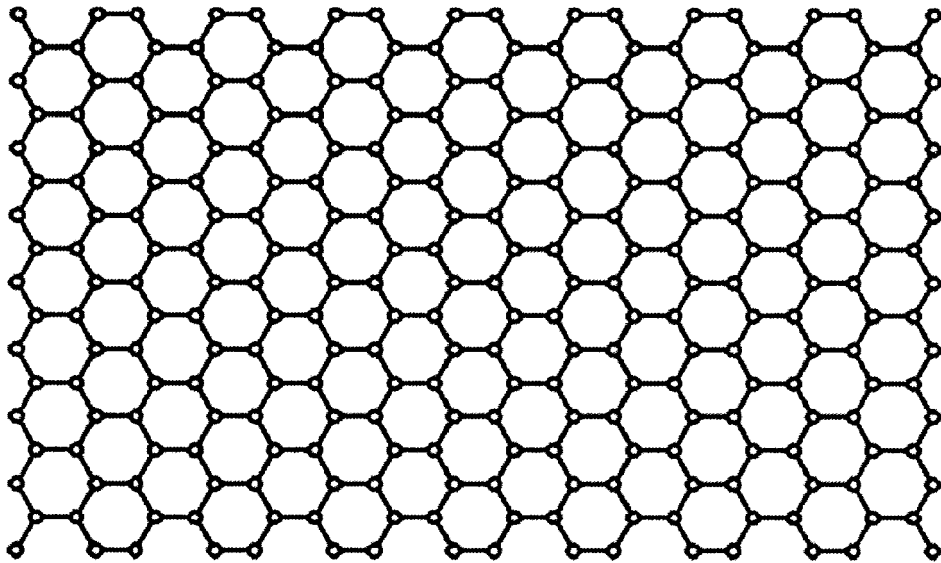
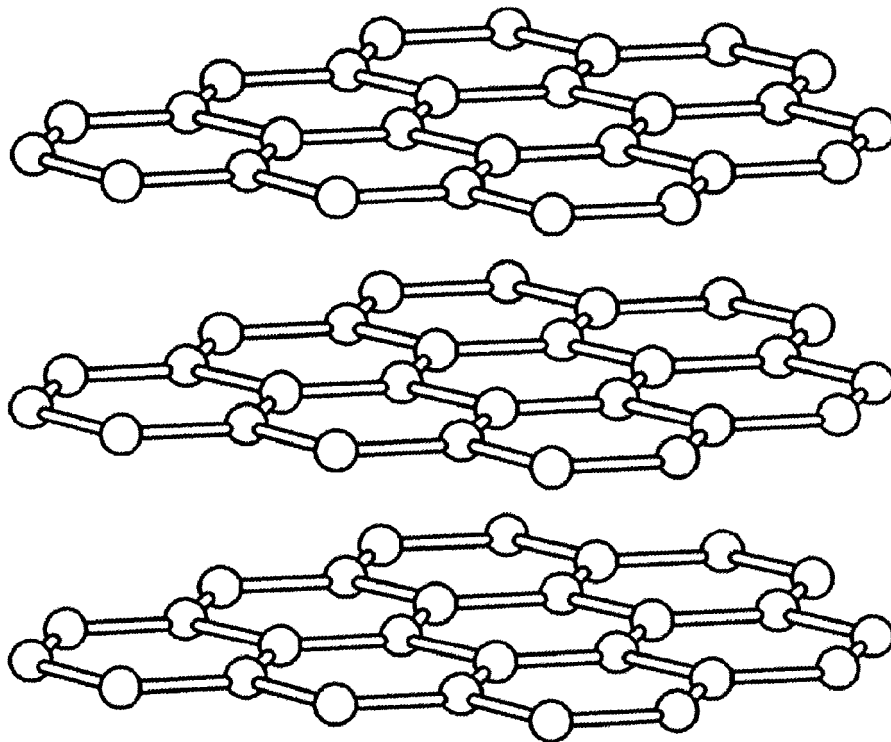


FIG. 45





EUROPEAN SEARCH REPORT

Application Number

EP 24 16 2881

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Y	* 1-73, Fig. 1-9 * -----	2,3,5,8	G03G21/16
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Y	* col. 1-12, Fig. 1-15 * -----	2,3,5,8	
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Y	* 1-146, Fig. 1-18 * -----	2,3,5,8, 10	
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	- / - -		
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		23 July 2024	Scarpa, Giuseppe
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Application Number

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		23 July 2024	Scarpa, Giuseppe
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