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(71) Applicant: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.** [US/US]; 10300 Energy Drive, Spring, Texas 77389 (US).

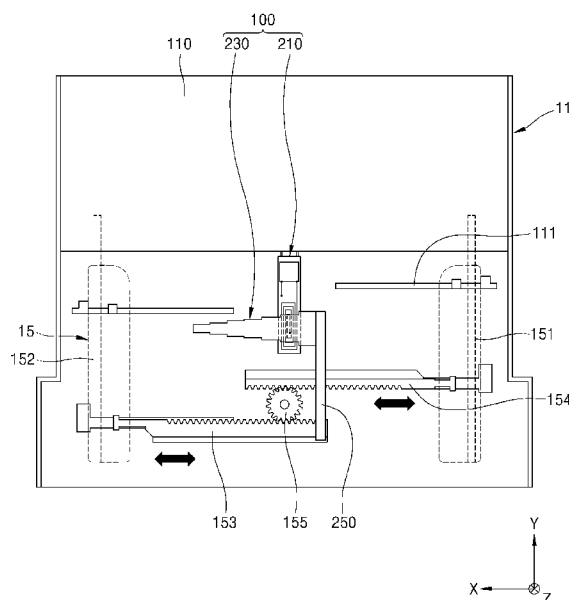
(72) Inventors: **KIM, Kiyoun**; Alphadom Tower 3, 152, Pangyoyeok-ro, Bundang-gu, Seongnam-si, Gyeonggi-do 13529 (KR). **KIM, Myungwon**; Alphadom Tower 3, 152, Pangyoyeok-ro, Bundang-gu, Seongnam-si, Gyeonggi-do 13529 (KR). **PARK, Kwangsung**; Alphadom Tower 3, 152, Pangyoyeok-ro, Bundang-gu, Seongnam-si, Gyeonggi-do 13529 (KR).

(74) Agent: **KO, Steve Sokbong** et al.; 3390 E. Harmony Road, Mailstop 35, Fort Collins, Colorado 80528 (US).

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(54) Title: PAPER SIZE DETECTION STRUCTURE USING INDUCTIVE SENSOR

FIG. 2



(57) Abstract: An example paper feeding apparatus includes a paper feed tray on which to load paper, a paper guide movable in a width direction of the paper, and a paper size detection apparatus to detect a size of the paper based on a movement distance of the paper guide. The paper size detection apparatus may include an electromagnetic induction sensor mounted on the paper guide or the paper feed tray and a metal member mounted on the other one of the paper guide or the paper feed tray and having a height that varies in a longitudinal direction of the paper according to a width direction of the paper. As the paper guide moves, an overlapping area of the electromagnetic induction sensor and the metal member varies, and an inductance value detected by the electromagnetic induction sensor varies which may be used to determine the size of the paper.

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PAPER SIZE DETECTION STRUCTURE USING INDUCTIVE SENSOR

BACKGROUND

[0001] An image forming apparatus may print an image on a printing medium conveyed along a conveying path by a conveying roller. For example, an electrophotographic image forming apparatus may form an electrostatic latent image by scanning light on a photoreceptor charged with a uniform potential, and supply toner to the electrostatic latent image to form a toner image on the photoreceptor. The toner image may be transferred to a printing medium that is conveyed along the conveying path, and, while the printing medium passes through a fixing unit, the toner image may be fixed as a permanent image on the printing medium by heat and pressure.

[0002] By using such an image forming apparatus, a user may print images on various sizes of a printing medium, such as paper. The image forming apparatus may detect a paper size and support a printing environment suitable therefor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] FIG. 1 is a perspective view showing a paper feeding apparatus according to an example.

[0004] FIG. 2 is a diagram of a paper feeding apparatus viewed from the bottom according to an example.

[0005] FIG. 3 is a diagram illustrating a paper feeding apparatus according to an example.

[0006] FIG. 4 is a diagram illustrating an electromagnetic induction sensor according to an example.

[0007] FIG. 5 is a diagram illustrating a metal member according to an example.

[0008] FIG. 6 is a diagram illustrating a metal member according to an example.

[0009] FIG. 7 is a diagram illustrating a paper guide to move in the paper feeding apparatus of FIG. 2 according to an example.

[0010] FIGS. 8A to 8F are diagrams illustrating a change in an overlapping area of a metal member and an electromagnetic induction sensor according to a movement of the metal member in a paper size detection apparatus according to an example.

[0011] FIG. 9 is a graph showing a change in a magnetic field detected by an electromagnetic induction sensor according to an example.

[0012] FIG. 10 is a diagram illustrating a size of a coil portion according to an example.

[0013] FIG. 11 is a diagram illustrating a metal member according to an example.

[0014] FIG. 12 is a diagram illustrating a paper size detection apparatus according to an example.

[0015] FIG. 13 is a conceptual diagram illustrating an image forming apparatus including a paper feeding apparatus according to an example.

DETAILED DESCRIPTION OF EXAMPLES

[0016] An example image forming apparatus includes a paper size detection apparatus for detecting a size of a printed paper.

[0017] A paper size detection apparatus may use a photo interrupter sensor of which an operation changes according to a size of a paper. However, the use of a photo interrupter sensor requires a photo interrupter sensor for each position according to the paper size. Accordingly, in a case where the size of the paper to be detected varies, the volume of the paper size detection apparatus increases, and the cost also increases.

[0018] A paper size detection apparatus may also use a matrix method in which a paper guide positioned in a width direction and/or a longitudinal direction of the paper and a structure in conjunction with the paper guide selectively press a plurality of switches arranged in the form of a matrix. In that case, the paper size may be determined according to a position of a pressed switch. However,

such a paper size detection apparatus using the matrix method has a complex mechanical structure in which a switch is pressed with the movement of the paper guide. Also, the paper size detection apparatus may erroneously recognize the paper size in a case where the assembly of the mechanical structure is defective. There is also a space limitation due to the mechanical structure.

[0019] An example paper size detection apparatus detects a movement distance of a paper guide by using an electromagnetic induction sensor. In that case, even if the paper size changes, the paper size detection apparatus does not include a separate sensor and may not use the complex mechanical structure for interoperation. Accordingly, the paper size detection apparatus according to an example may minimize the space limitation.

[0020] FIG. 1 is a perspective view showing a paper feeding apparatus according to an example. FIG. 2 is a diagram of a paper feeding apparatus viewed from the bottom according to an example. FIG. 3 is a diagram illustrating a paper feeding apparatus according to an example.

[0021] Referring to FIG. 1, a paper feeding apparatus 10 is an apparatus for loading and supplying a plurality of papers P to an image forming apparatus and may include a paper feed tray 11 on which the papers P may be loaded and a paper guide 15 to align at least one side of the papers P.

[0022] The paper feed tray 11 may include a slit 111 extending in a direction parallel to a width direction X of the paper P.

[0023] The paper guide 15 may move in the width direction X of the paper P with respect to the paper feed tray 11. The paper guide 15 may move in a direction in which the slit 111 extends. A user may move the paper guide 15 in the width direction X of the paper P such that the paper guide 15 fits the width of the loaded paper P.

[0024] The paper guide 15 may include a pair of guide members 151 and 152. The pair of guide members 151 and 152 may move in opposite directions. However, the paper guide 15 is not necessarily a pair, and may be singular if necessary.

[0025] Referring to FIGS. 1 and 2, the paper guide 15 may include the pair of guide members 151 and 152 to guide side surfaces of the paper P, a pair of

racks 153 and 154 connected to the guide members 151 and 152, and a pinion gear 155 disposed between the pair of racks 153 and 154. The pinion gear 155 may be disposed at a center portion of the paper feed tray 11.

[0026] The racks 153 and 154 and the guide members 151 and 152 may be connected through the slit 111 of the paper feed tray 11. However, an operating method of the paper guide 15 is not limited to the racks 153 and 154 and the pinion gear 155 and may be variously modified as long as it is a method suitable for the operation of the paper guide 15.

[0027] In a case where the user moves one of the guide members 151 or 152 in any one direction, the rack 153 or 154 connected to the guide member 151 or 152 also moves and rotates the pinion gear 155. In that case, the other rack 153 or 154 located in the opposite direction and the other guide member 151 or 152 moves in the opposite direction.

[0028] Referring to FIG. 2, for example, in a case where the user moves the left guide member 152 toward the right side of the figure (e.g., -X direction) to press one side of the paper P, the right guide member 151 moves toward the left side of the figure (e.g., X direction) to press the other side of the paper P by the pair of racks 153 and 154 and the pinion gear 155.

[0029] For example, in a case where the user moves the left guide member 152 toward the left side of the figure (e.g., X direction) to be away from one side of the paper P, the right guide member 151 moves toward the right side of the figure (e.g., -X direction) to be away from the other side of the paper P by the pair of racks 153 and 154 and the pinion gear 155.

[0030] The paper feed apparatus 10 according to an example may include a paper size detection apparatus 100 to detect a size of the paper P based on a movement distance of the paper guide 15.

[0031] Because the paper size detection apparatus 100 has a structure in which the size of the paper P is detected based on the movement distance of the paper guide 15, the paper size detection apparatus 100 may have less space limitation and require less cost compared to a method of using a photo interrupter sensor.

[0032] The paper size detection apparatus 100 according to an example

may include an electromagnetic induction sensor 210 located on the paper guide 15 or the paper feed tray 11, and a metal member 230 located on the other one of the paper guide 15 or the paper feed tray 11 and having a dimension (e.g., height) that varies in a longitudinal direction Y of the paper P according to the width direction X of the paper P.

[0033] The metal member 230 may include a metal material capable of causing a change in a magnetic field generated around a coil portion (i.e., coil portion 211, FIG. 4). For example, the metal member 230 may include stainless steel, tin, aluminum, copper, iron, etc. The metal member 230 may have a flat plate shape, a film shape, or the like.

[0034] As the paper guide 15 moves, the metal member 230 may move relative to the electromagnetic induction sensor 210. According to a movement of the paper guide 15, an overlapping area of the electromagnetic induction sensor 210 and the metal member 230 may vary. Accordingly, an inductance value detected by the electromagnetic induction sensor 210 may vary.

[0035] The paper size detection apparatus 100 may determine a size of the paper P based on the inductance value detected by the electromagnetic induction sensor 210. For example, the paper size detection apparatus 100 may determine a width of the paper P based on the inductance value detected by the electromagnetic induction sensor 210.

[0036] The paper size detection apparatus 100 may detect a change in a magnetic field while the electromagnetic induction sensor 210 and the metal member 230 are not in contact but are separated from each other by a certain interval, thereby omitting a complex mechanical configuration and minimizing a physical deformation.

[0037] Referring to FIGS. 2 and 3, the electromagnetic induction sensor 210 may be mounted to be fixed to the paper feed tray 11 and the metal member 230 may be located on the paper guide 15. In a case where the paper guide 15 moves, the metal member 230 may move together with the paper guide 15.

[0038] The electromagnetic induction sensor 210 may be disposed on a lower surface 110 of the paper feed tray 11. In an example, the electromagnetic induction sensor 210 may be disposed in a center portion of the paper feed tray

11. The electromagnetic induction sensor 210 and the pinion gear 155 may be arranged in the longitudinal direction Y of the paper P.

[0039] The metal member 230 may be connected to the rack 153 or the rack 154 of the paper guide 15. For example, the metal member 230 may be connected to the rack 153 by a connecting member 250 extending in the longitudinal direction Y of the paper P. However, the connection between the metal member 230 and the racks 153 and 154 is not limited thereto and may be variously modified. For example, as shown in FIG. 3, the metal member 230 may be connected to the rack 154 by a connecting member 250A having a frame shape that surrounds the metal member 230.

[0040] FIG. 4 is a diagram illustrating an electromagnetic induction sensor according to an example.

[0041] Referring to FIG. 4, the electromagnetic induction sensor 210 includes a coil portion 211 through which a current may flow, and a sensor circuit portion 213 that is connected to the coil portion 211. The sensor circuit portion 213 may detect a magnitude of a magnetic field generated in the coil portion 211. The coil portion 211 may include a pattern coil disposed on a printed circuit board (PCB) 212 in a certain pattern. In an example, the coil portion 211 may have a swirl pattern.

[0042] In a case where a current flows through the coil portion 211, a certain magnetic field is generated around the coil portion 211. The magnitude of the magnetic field generated around the coil portion 211 may vary according to a position of the metal member 230 that will be described later. The sensor circuit portion 213 may detect an inductance value that changes by the metal member 230.

[0043] The paper size detection apparatus 100 may further include a control portion 270 to receive an inductance value detected from the electromagnetic induction sensor 210 and determine a size of the paper P based on the received inductance value.

[0044] The sensor circuit portion 213 may be connected to the control portion 270 and may transmit a detected inductance value to the control portion 270. The sensor circuit portion 213 and the control portion 270 may be connected

using a serial communication method or another communication method.

[0045] FIG. 5 is a diagram illustrating a metal member according to an example. FIG. 6 is a diagram illustrating a metal member according to an example.

[0046] Referring to FIG. 5, the metal member 230 may extend in the width direction X of the paper P. The height of the metal member 230 may vary at different positions in the width direction X of the paper P. Here, the height may be a height according to the longitudinal direction Y of the paper P, which is perpendicular to the width direction X of the paper P. For example, a height h1 of one end of the metal member 230 may be the smallest in the width direction X of the paper P, and a height h7 of the other end of the metal member 230 may be the greatest in the width direction X of the paper P.

[0047] For example, the height of the metal member 230 may vary in a stepwise manner in the width direction X of the paper P. For example, a shape of the metal member 230 may have a height increasing in the stepwise manner in the width direction X of the paper P.

[0048] For example, the metal member 230 may include a plurality of regions 231 to 237 arranged in the width direction X of the paper P. Heights h1 to h7 of the plurality of regions 231 to 237 may increase in the stepwise manner. For example, the first region 231 may have the first height h1, the second region 232 may have the second height h2 greater than the first height h1, the third region 233 may have the third height h3 greater than the second height h2, the fourth region 234 may have the fourth height h4 greater than the third height h3, the fifth region 235 may have the fifth height h5 greater than the fourth height h4, the sixth region 236 may have the sixth height h6 greater than the fifth height h5, and the seventh region 237 may have the seventh height h7 greater than the sixth height h6.

[0049] Widths of at least some of the plurality of regions 231 to 237 may be different from widths of the other regions such that various widths of the paper P may be detected. For example, widths w1 to w7 of the plurality of regions 231 to 237 may be different from each other. For example, in the plurality of regions 231 to 237, the first width w1 of the first region 231 may be the largest, and the seventh width w7 of the seventh region 237 may be the smallest. For example,

the first width w_1 of the first region 231 may be larger than the second width w_2 of the second region 232, the second width w_2 of the second region 232 may be larger than the third width w_3 of the third region 233, the third width w_3 of the third region 233 may be smaller than the fourth width w_4 of the fourth region 234, the fourth width w_4 of the fourth region 234 may be larger than the fifth width w_5 of the fifth region 235, the fifth width w_5 of the fifth region 235 may be smaller than the sixth width w_6 of the sixth region 236, and the sixth width w_6 of the sixth region 236 may be larger than the seventh width w_7 of the seventh region 237. In the plurality of regions 231 to 237, the first width w_1 of the first region 231 may be the largest, and the seventh width w_7 of the seventh region 237 may be the smallest. In the example, the number of the plurality of regions is seven, but the disclosure is not limited thereto. If there is a plurality of regions, the number regions may variously change as necessary.

[0050] The plurality of regions 231 to 237 may have a symmetrical shape such that the coil portion 211 passes through a center of the plurality of regions 231 to 237. To this end, the center of the plurality of regions 231 to 237 may be arranged in the width direction X of the paper P as illustrated in FIG. 5. However, the plurality of regions 231 to 237 do not necessarily have the symmetrical shape. Referring to FIG. 6, a metal member 230A is illustrated in which the plurality of regions 231 to 237 are asymmetric.

[0051] FIG. 7 is a diagram illustrating a paper guide to move in the paper feeding apparatus of FIG. 2 according to an example.

[0052] Referring to FIG. 7, in a case where a user moves the paper guide 15, the metal member 230 located on the paper guide 15 may move together with the movement of the paper guide 15. In a case where the metal member 230 moves, an overlapping area of the metal member 230 and the electromagnetic induction sensor 210 after the movement is different from an overlapping area of the metal member 230 and the electromagnetic induction sensor 210 before the movement.

[0053] FIGS. 8A to 8F are diagrams illustrating a change in an overlapping area of a metal member and an electromagnetic induction sensor according to a movement of the metal member in a paper size detection apparatus according to

an example. FIG. 9 is a graph showing a change in a magnetic field detected by an electromagnetic induction sensor according to an example.

[0054] Referring to FIGS. 8A to 8F, as the metal member 230 moves toward the left of the figure, an area in which the electromagnetic induction sensor 210 overlaps the metal member 230 may gradually increase. In the examples illustrated in FIGS. 8A to 8F, the overlapping area in which the electromagnetic induction sensor 210 overlaps the metal member 230 may increase in the order of the first region 231, the second region 232, the third region 233, the fourth region 234, the fifth region 235, and the sixth region 236.

[0055] As the overlapping area of the metal member 230 and the coil portion 211 increases, an inductance value detected by the electromagnetic induction sensor 210 may be reduced. For example, in a structure in which the height of the metal member 230 varies in a stepwise manner, the inductance value detected by the electromagnetic induction sensor 210 may be reduced in the stepwise manner as shown in FIG. 9.

[0056] Referring to FIGS. 8A and 9, in a case where a part of the coil portion 211 of the electromagnetic induction sensor 210 overlaps the metal member 230 on the first region 231, an inductance value detected by the sensor circuit portion 213 of the electromagnetic induction sensor 210 may be relatively large. Referring to FIGS. 8F and 9, in a case where a part of the coil portion 211 of the electromagnetic induction sensor 210 overlaps the metal member 230 on the sixth region 236, an inductance value detected by the sensor circuit portion 213 of the electromagnetic induction sensor 210 may be relatively small.

[0057] The detected inductance value may be transmitted to the control portion 270. The control portion 270 may determine the width of the paper P based on the detected inductance value. In an example, the control portion 270 may previously store a width of the paper P corresponding to a detected inductance value.

[0058] Based on the detected inductance value, the control portion 270 may determine whether the coil portion 211 is overlapping the metal member 230 and which region of the plurality of regions 231 to 237 of the metal member 230 the coil portion 211 is overlapping.

[0059] FIG. 10 is a diagram illustrating a size of a coil portion according to an example.

[0060] Referring to FIG. 10, a size of the coil portion 211 may be determined in consideration of a resolution of a detected inductance value.

[0061] For example, a width W of the coil portion 211 may be smaller than each of the respective widths w_1 to w_7 of the plurality of regions 231 to 237 of the metal member 230. In a case where the width W of the coil portion 211 is larger than the width w_1 to w_7 of one region of the metal member 230, while the metal member 230 moves, the coil portion 211 may simultaneously overlap three regions of the metal member 230, which may cause deterioration in the resolution of the electromagnetic induction sensor 210.

[0062] For example, a height H of the coil portion 211 may be greater than the height of a second highest region among the plurality of regions 231 to 237. For example, the height H of the coil portion 211 may be greater than the sixth height h_6 of the sixth region 236. For example, the height H of the coil portion 211 may be equal to or greater than the height of a highest region among the plurality of regions 231 to 237. For example, the height H of the coil portion 211 may be equal to or greater than the seventh height h_7 of the seventh region 237.

[0063] The metal member 230 may be spaced apart from the coil portion 211 by a certain distance G . Based on a received inductance value, the control portion 270 may determine a size of the paper P loaded on the paper feed tray 11. For example, in a case where the received inductance value is large, the control portion 270 may determine the size of the paper P loaded on the paper feed tray 11 as the size of the paper P corresponding to a case where the metal member 230 does not overlap the coil portion 211.

[0064] In an example, the paper size detection apparatus 100 including the metal member 230 and the electromagnetic induction sensor 210, based on the detected inductance value, may determine the size of the paper P as the size of the paper P corresponding to a case where the coil portion 211 does not overlap the metal member 230, the size of the paper P corresponding to a case where the coil portion 211 overlaps the first region 231, the size of the paper P corresponding to a case where the coil portion 211 overlaps the second region

232, the size of the paper P corresponding to a case where the coil portion 211 overlaps the third region 233, the size of the paper P corresponding to a case where the coil portion 211 overlaps the fourth region 234, the size of the paper P corresponding to a case where the coil portion 211 overlaps the fifth region 235, the size of the paper P corresponding to a case where the coil portion 211 overlaps the sixth region 236, or the size of the paper P corresponding to a case where the coil portion 211 overlaps the seventh region 237.

[0065] In the above-described example, the shape of the metal member 230 has a height varying in a stepwise manner in the width direction X of the paper P. However, this is merely an example and the disclosure is not limited thereto. For example, as shown in FIG. 11, a metal member 230B may have a structure in which the height of the metal member 230B continuously varies in the width direction X of the paper P.

[0066] In addition, in the paper size detection apparatus 100 of the above-described example, the electromagnetic induction sensor 210 is fixedly mounted on the paper feed tray 11, and the metal member 230 is mounted on the paper guide 15 to be movable. However, this is merely an example and the disclosure is not necessarily limited thereto. For example, as shown in FIG. 12, a paper size detection apparatus 100A may be mounted such that the electromagnetic induction sensor 210 is movable on the paper guide 15, and the metal member 230 may be mounted to be fixed to the paper feed tray 11. In this case, a wire 215 may be connected to the electromagnetic induction sensor 210. In an example, a length of the wire 215 may be greater than a movement distance of the paper guide 15.

[0067] FIG. 13 is a conceptual diagram illustrating an image forming apparatus including a paper feeding apparatus according to an example.

[0068] Referring to FIG. 13, an image forming apparatus 1 may include the paper feeding apparatus 10 according to the above-described examples, an image forming unit 30 to form a recording image on paper P fed from the paper feeding apparatus 10, and a paper discharge unit 20 in which the paper P on which image formation is completed may be loaded. A printing path 2 connects the paper feeding apparatus 10 and the paper discharge unit 20. The image

forming unit 30 is arranged in the printing path 2.

[0069] A pickup roller 12 withdraws paper P from the paper feed tray 11 one by one. Conveying rollers 13 convey the withdrawn paper P along the printing path 2.

[0070] The paper P loaded in the paper feeding apparatus 10 is withdrawn one by one and conveyed along the printing path 2. In an example, the paper feeding apparatus 10 is in the form of a paper feeding cassette. However, the paper feeding apparatus 10 is not limited thereto.

[0071] The image forming unit 30 may print an image to the paper P conveyed along the printing path 2 using an electrophotographic method. The image forming unit 30 may include a developing device 40, an exposure device 50, a fixing device 60, and a transfer device 70.

[0072] In an example, the image forming unit 30 may selectively print a monochrome image and a color image on the paper P.

[0073] For color printing, the developing device 40 may include, for example, four developing devices 40 to develop images of cyan (C:cyan), magenta (M:magenta), yellow (Y:yellow), and black (K:black) colors. Each of the four developing devices 40 may contain a developer of cyan (C:cyan), magenta (M:magenta), yellow (Y:yellow), or black (K:black) color, such as a toner. The toners of cyan (C:cyan), magenta (M:magenta), yellow (Y:yellow), and black (K:black) colors may be respectively contained in four toner supply containers 45, and may be respectively supplied from the four toner supply containers 45 to the four developing devices 40. The image forming apparatus 1 may further include a developer containing developing toners of various colors such as light magenta and white in addition to the above-described colors. The toner supply container 45 may be replaced in a case where the contained toner is consumed. The developing device 40 may be attached to or detached from the image forming apparatus 1 through a door that is not shown.

[0074] Hereinafter, the image forming unit 30 including the four developing devices 40 will be described. Unless otherwise noted, reference numerals with C, M, Y, and K refer to components developing images of cyan (C:cyan), magenta (M:magenta), yellow (Y:yellow), and black (K:black) colors, respectively.

[0075] The developing device 40 may supply toner contained therein to an electrostatic latent image formed on a photosensitive drum 41.

[0076] The photosensitive drum 41 is an example of a photoreceptor having an electrostatic latent image formed on its surface and may include a conductive metal pipe and a photosensitive layer formed on the outer circumference thereof. A charging roller 42 may charge the surface of the photosensitive drum 41 to a uniform potential.

[0077] The exposure device 50 is to irradiate the photosensitive drum 41 with light modulated in correspondence with image information to form the electrostatic latent image on the photosensitive drum 41. As the exposure device 50, a laser scanning unit (LSU) using a laser diode as a light source, a light emitting diode (LED) exposure device using an LED as a light source, and the like may be employed.

[0078] A developing roller 43 is to supply a developer contained in the developing device 40, for example, toner, to the photosensitive drum 41 to develop the electrostatic latent image into a visible toner image. A developing bias voltage may be applied to the developing roller 43. In a case where a one-component developing method is employed, the toner may be contained in a toner supply container of the developing device 40. In a case where a two-component developing method is employed, the toner or toner and carrier may be contained in the toner supply container of the developing device 40. Although not shown in the drawing, the developing device 40 may further include a supply roller to supply the developer contained in the toner supply container to the developing roller 43, a regulating member attached to the surface of the developing roller 43 to regulate an amount of the developer supplied to a developing region where the photosensitive drum 41 and the developing roller 43 face each other, and an agitating member to agitate the developer contained in the toner supply container, etc.

[0079] The transfer device 70 may include an intermediate transfer belt 71, an intermediate transfer roller 72, and a transfer roller 73. The toner image developed on the photosensitive drum 41 of each of the developing device 40C, 40M, 40Y, and 40K may be intermittently transferred to the intermediate transfer

belt 71. The intermediate transfer belt 71 is supported by support rollers 74 and 75 to circulate.

[0080] The intermediate transfer belt 71 is a member on which the toner image may be formed on its surface, and the surface on which the toner image is formed is movable toward the transfer roller 73. The intermediate transfer belt 71 functions as an image conveying member to convey the toner image.

[0081] Four intermediate transfer rollers 72 are respectively arranged at positions facing the photosensitive drum 41 of the developing devices 40C, 40M, 40Y, and 40K with the intermediate transfer belt 71 interposed therebetween. An intermediate transfer bias voltage for intermediately transferring the toner image developed on the photosensitive drum 41 to the intermediate transfer belt 71 may be applied to the four intermediate transfer rollers 72. Instead of the intermediate transfer roller 72, a corona transfer device or a pin scorotron transfer device may be employed. The transfer roller 73 is positioned to face the intermediate transfer belt 71. A transfer bias voltage for transferring the toner image intermediately transferred to the intermediate transfer belt 71 to the paper P may be applied to the transfer roller 73.

[0082] The toner images overlapping and transferred onto the intermediate transfer belt 71 by the transfer bias voltage applied to the transfer roller 73 may be transferred to the paper P.

[0083] The fixing device 60 may apply heat and pressure to the paper P on which the toner image is transferred to fix the toner image on the paper P. The fixing device 60 may be implemented in various forms. For example, the fixing device 60 may include a heating member and a pressing member. The heating member and the pressing member may elastically press against each other to form a fixing nip. The heating member may be implemented in the form of, for example, a heat roller or a fixing belt. The heating member may be heated by a heat source. As the heat source, for example, a halogen lamp may be employed. The heating member may contact an image surface of the paper P. The image surface is a surface to which the toner image is transferred. In a case where the paper P to which the toner image is transferred passes through the fixing nip, the toner image may be fixed to the paper P by heat and pressure. Thus, a recording

image may be formed on the sheet P in the image forming unit 30.

[0084] It should be understood that examples described herein should be considered in a descriptive sense only and not for purposes of limitation. Descriptions of features or aspects within each example should typically be considered as available for other similar features or aspects in other examples. While one or more examples have been described with reference to the figures, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope as defined by the following claims.

WHAT IS CLAIMED IS:

1. A paper feeding apparatus comprising:
a paper feed tray on which to load paper;
a paper guide movable in a width direction of the paper to align at least one side of the paper; and
a paper size detection apparatus to detect a size of the paper based on a movement distance of the paper guide,
wherein the paper size detection apparatus comprises:
an electromagnetic induction sensor mounted on the paper guide or the paper feed tray; and
a metal member mounted on the other one of the paper guide or the paper feed tray and having a height that varies in a longitudinal direction of the paper according to a width direction of the paper,
wherein, as the paper guide moves, an overlapping area of the electromagnetic induction sensor and the metal member varies and an inductance value detected by the electromagnetic induction sensor varies, and
wherein the paper size detection apparatus is determine the size of the paper based on the inductance value detected by the electromagnetic induction sensor.
2. The paper feeding apparatus of claim 1,
wherein the electromagnetic induction sensor is fixedly mounted on the paper feed tray, and
wherein the metal member is disposed on the paper guide to move together with the paper guide in a case where the paper guide moves.
3. The paper feeding apparatus of claim 1,
wherein the metal member is fixedly mounted on the paper feed tray, and
wherein the electromagnetic induction sensor is disposed on the paper guide to move together with the paper guide in a case where the paper guide moves.

4. The paper feeding apparatus of claim 1, wherein the electromagnetic induction sensor comprises a coil portion through which a current is to flow, and a sensor circuit portion connected to the coil portion to detect a magnitude of a magnetic field generated around the coil portion.

5. The paper feeding apparatus of claim 4, wherein the coil portion includes a swirl pattern.

6. The paper feeding apparatus of claim 4, wherein the metal member extends in the width direction of the paper and has a height varying for each position in the width direction of the paper.

7. The paper feeding apparatus of claim 6, wherein a height of the metal member increases in a stepwise manner in the width direction of the paper.

8. The paper feeding apparatus of claim 7,
wherein the metal member comprises a plurality of regions arranged in the width direction of the paper, and

wherein the plurality of regions have a height increasing from one end of the metal member to another end of the metal member in the width direction of the paper.

9. The paper feeding apparatus of claim 8, wherein a width of the coil portion is less than a width of each of the plurality of regions.

10. The paper feeding apparatus of claim 8, wherein a height of the coil portion is greater than or equal to a height of a highest region among the plurality of regions.

11. The paper feeding apparatus of claim 6, wherein a height of the metal member continuously increases in the width direction of the paper.

12. The paper feeding apparatus of claim 1,
wherein the paper guide comprises a pair of guide members to guide side surfaces of the paper, a pair of racks connected to the pair of guide members, and a pinion gear disposed between the pair of racks, and
wherein the metal member is connected to the pair of racks.

13. The paper feeding apparatus of claim 12, further comprising a connecting member disposed between the metal member and the pair of racks.

14. The paper feeding apparatus of claim 1, further comprising a control portion to receive the inductance value detected by the electromagnetic induction sensor and determine the size of the paper based on the received inductance value.

15. An image forming apparatus comprising:
a paper feed tray on which a paper is loaded;
a paper guide movable in a width direction of the paper to align at least one side of the paper; and
a paper size detection apparatus to detect a size of the paper based on a movement distance of the paper guide,
wherein the paper size detection apparatus comprises:
an electromagnetic induction sensor mounted on the paper guide or the paper feed tray; and
a metal member mounted on the other one of the paper guide or the paper feed tray and having a height that varies in a longitudinal direction of the paper according to a width direction of the paper,
wherein, as the paper guide moves, an overlapping area of the electromagnetic induction sensor and the metal member varies and an inductance value detected by the electromagnetic induction sensor varies, and
wherein the paper size detection apparatus is to determine the size of the paper based on the inductance value detected by the electromagnetic induction

sensor.

FIG. 1

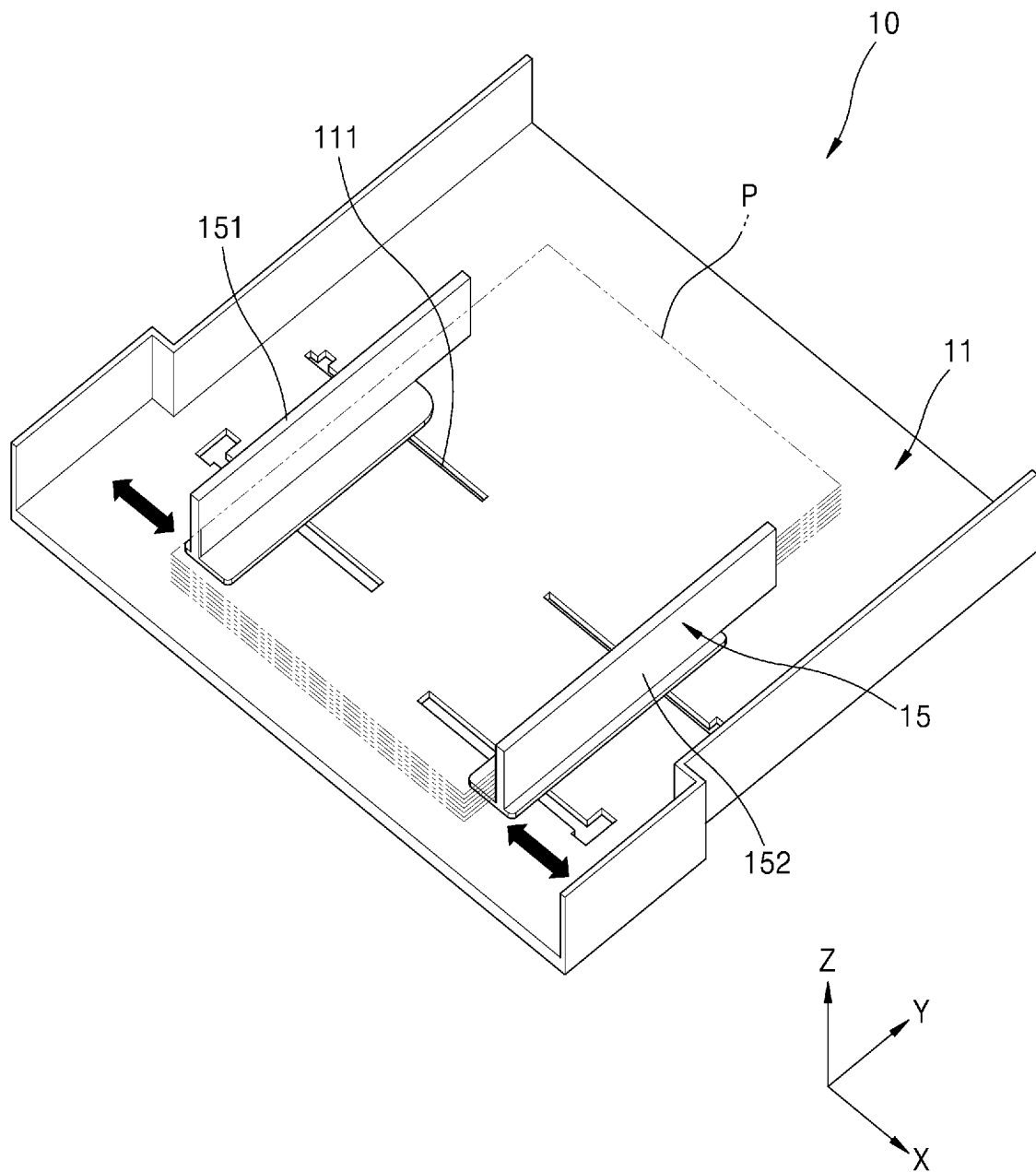


FIG. 2

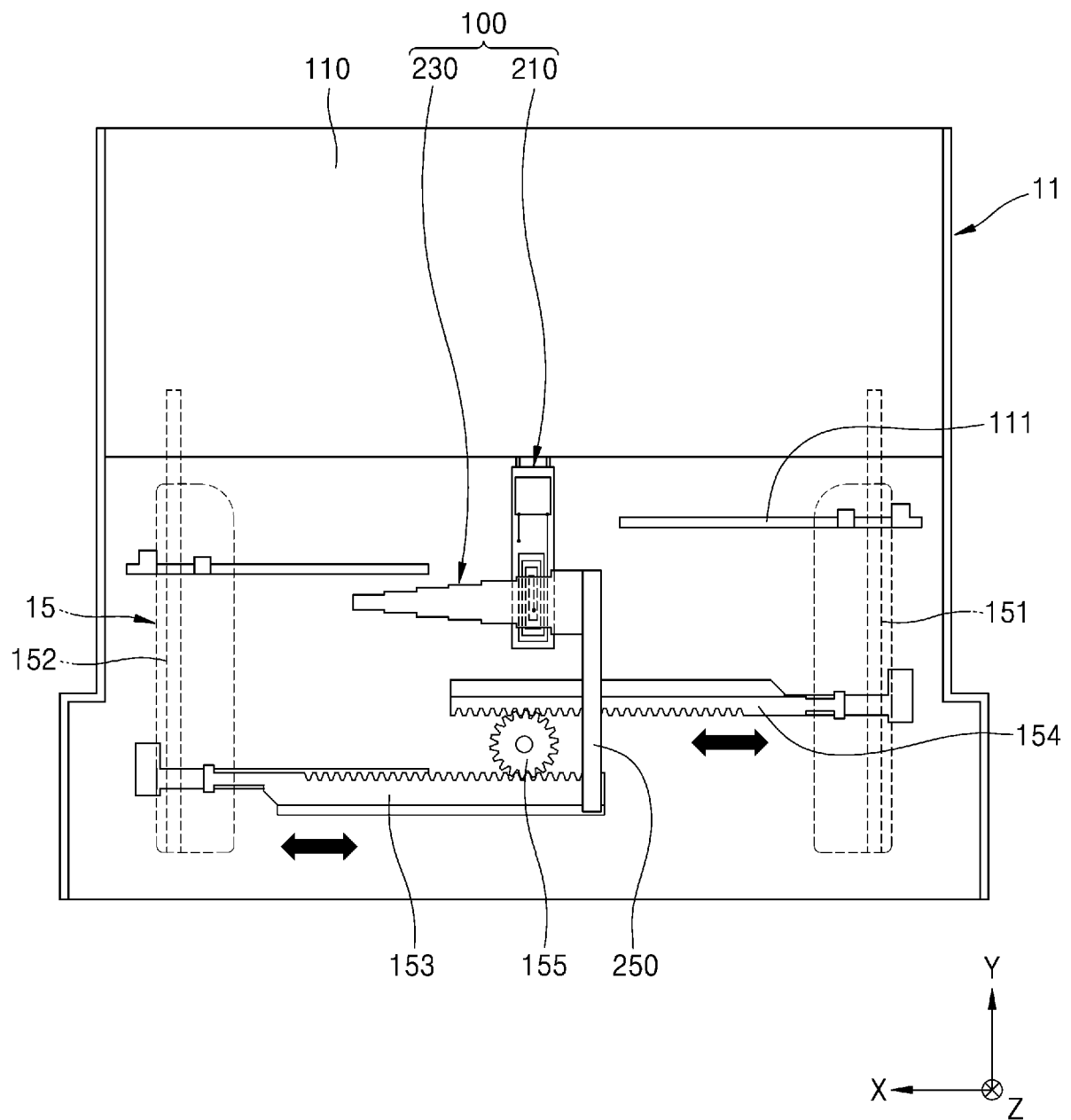


FIG. 3

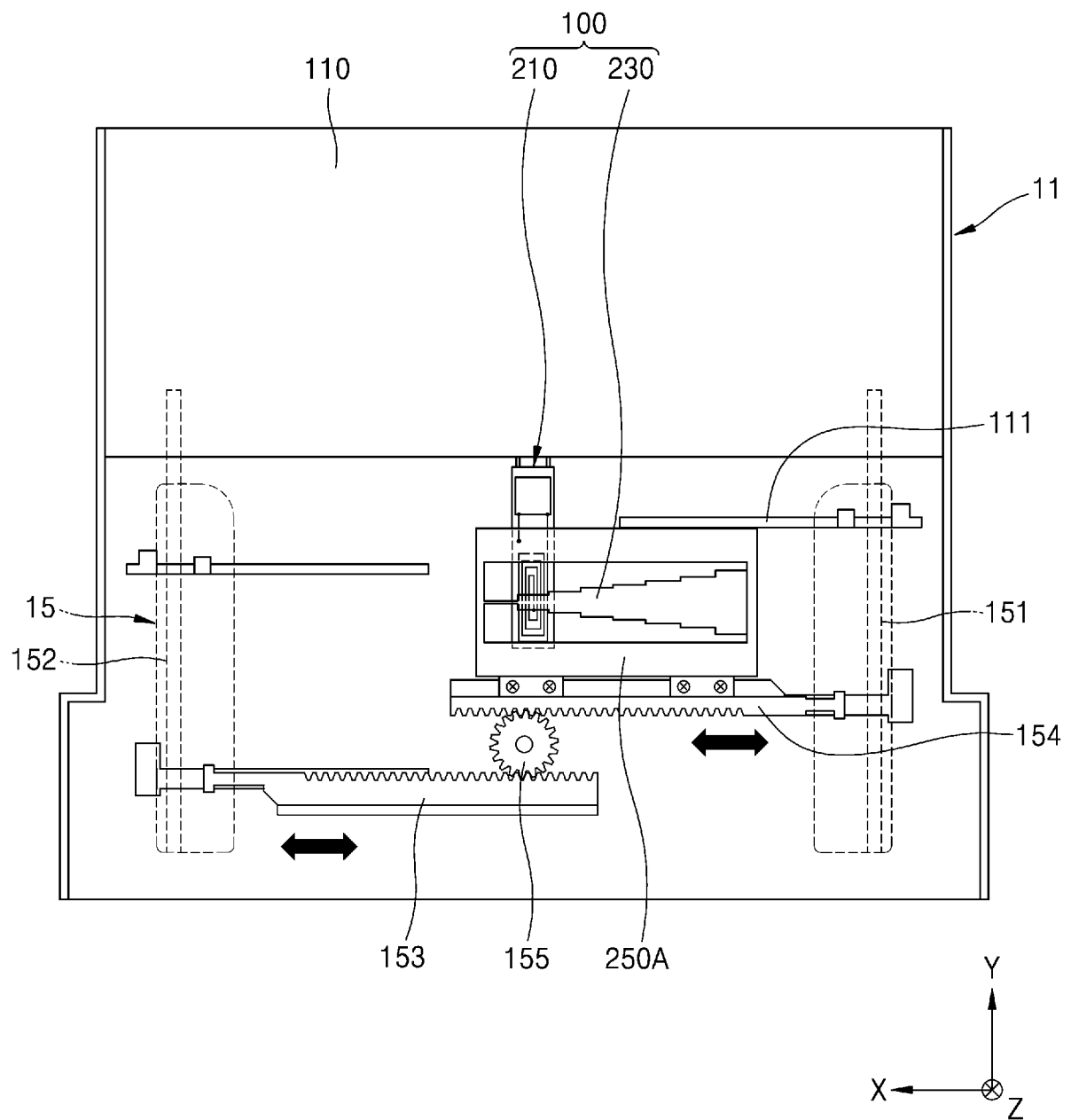


FIG. 4

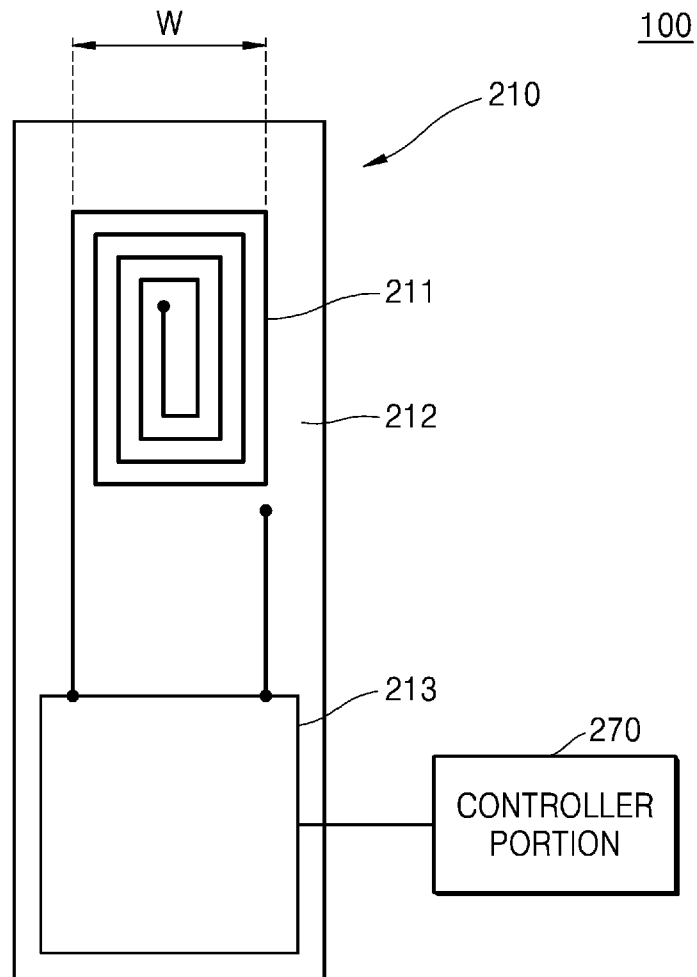


FIG. 5

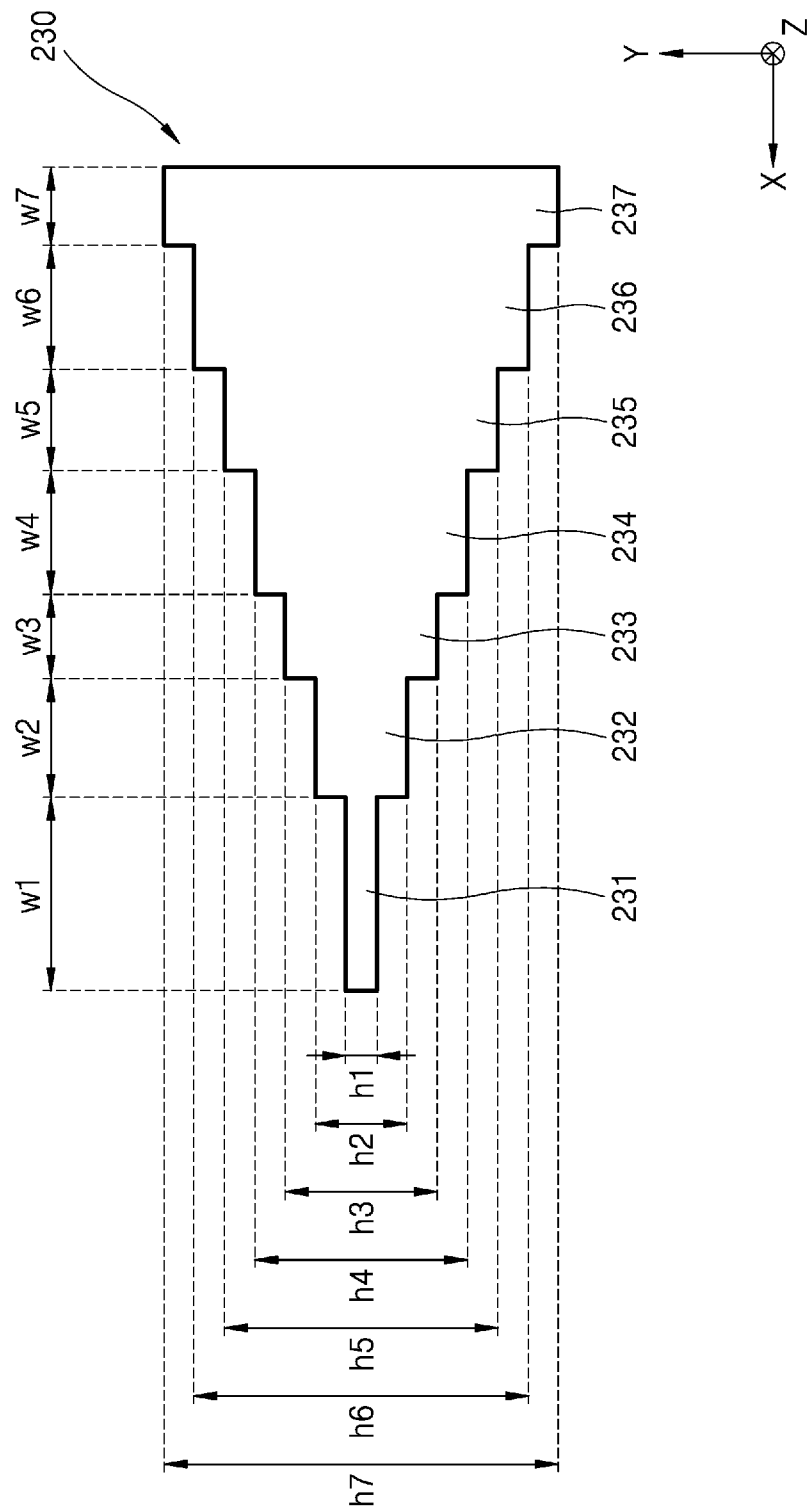


FIG. 6

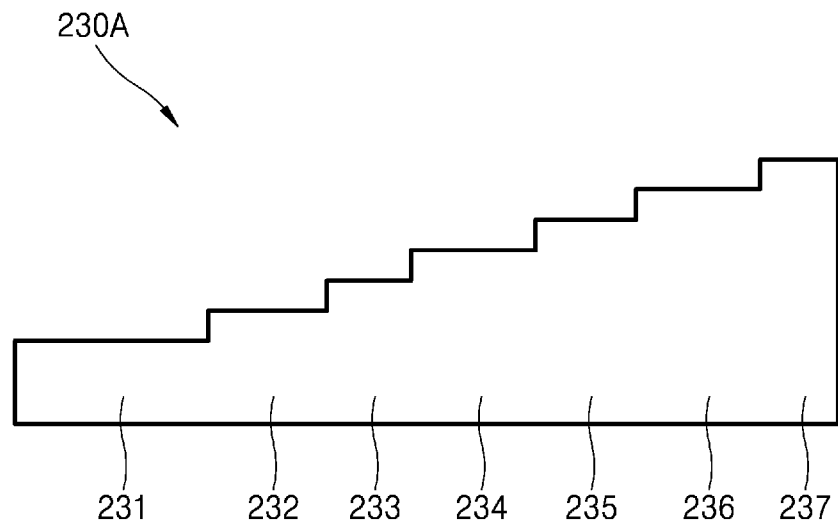


FIG. 7

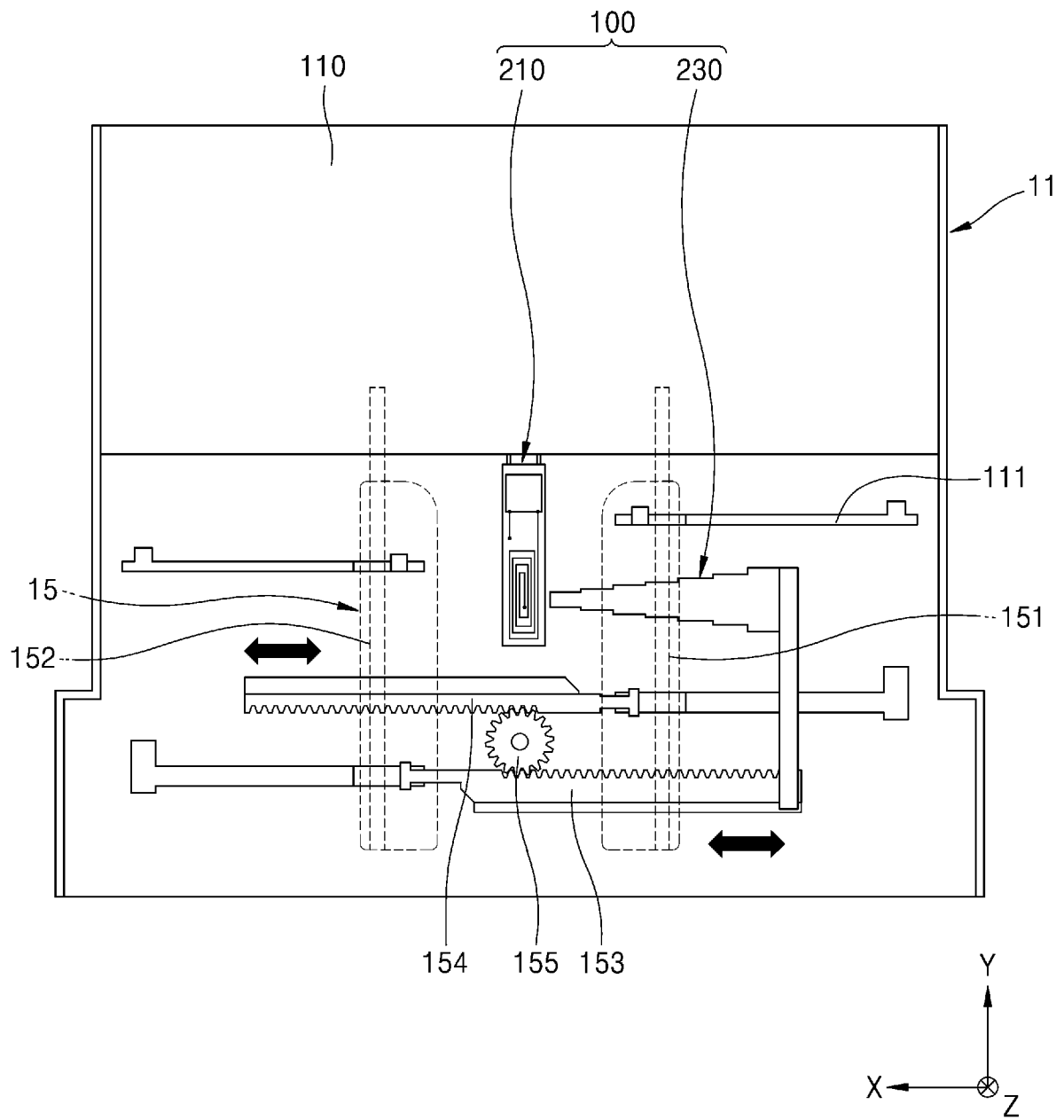


FIG. 8A

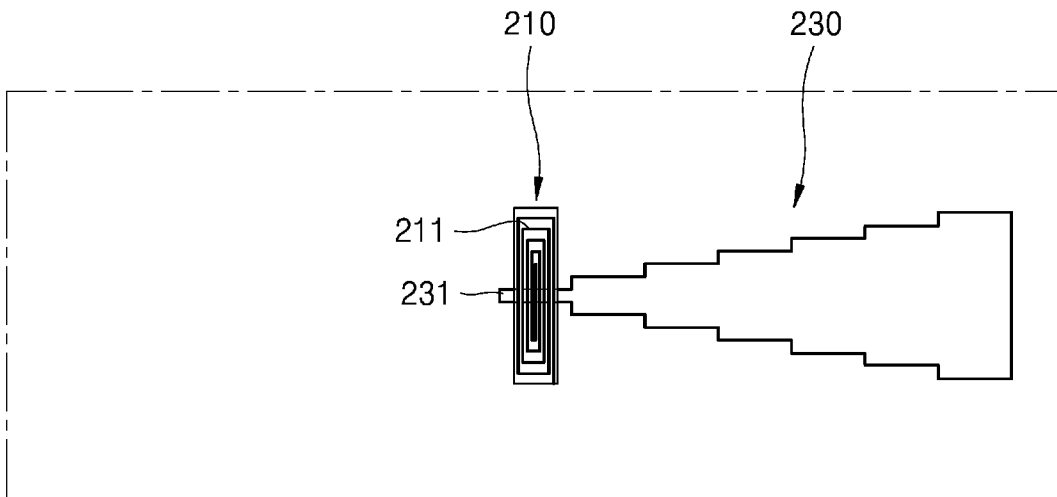


FIG. 8B

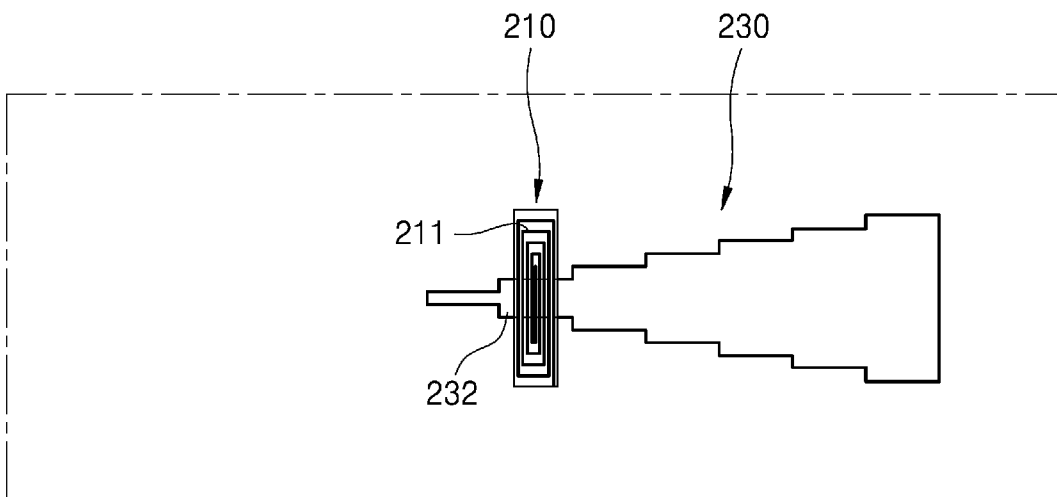


FIG. 8C

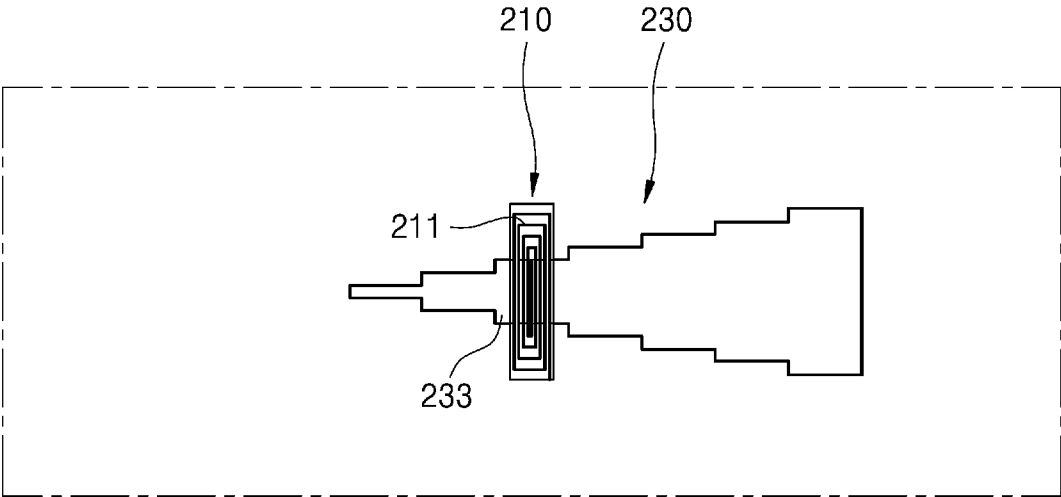


FIG. 8D

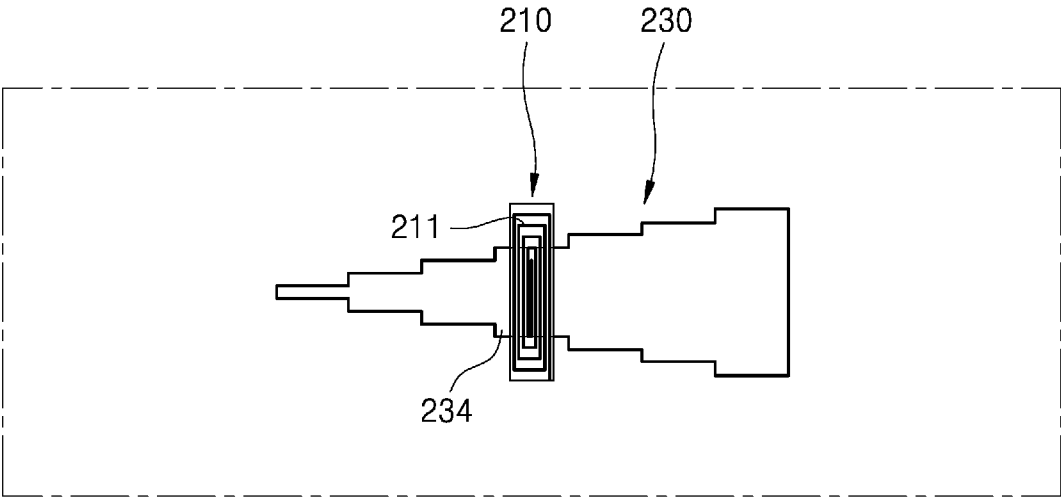


FIG. 8E

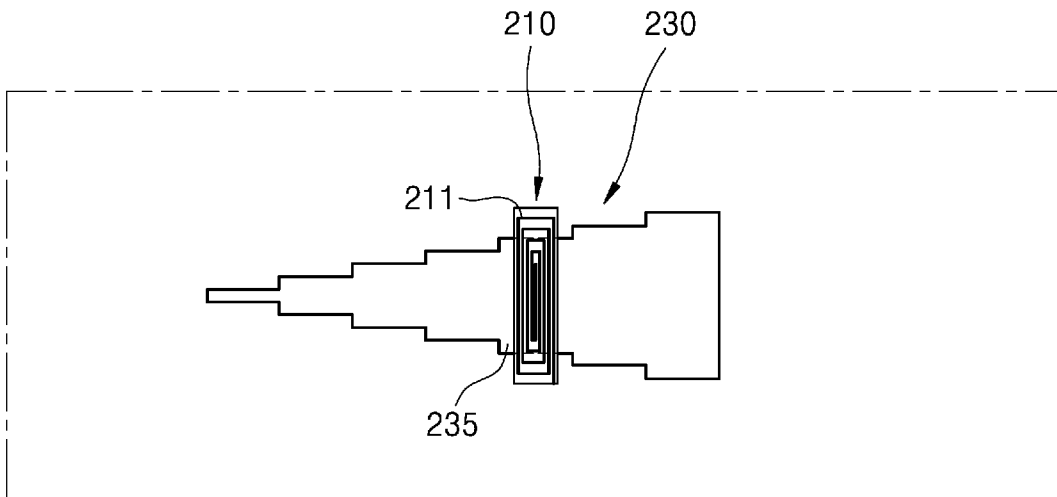


FIG. 8F

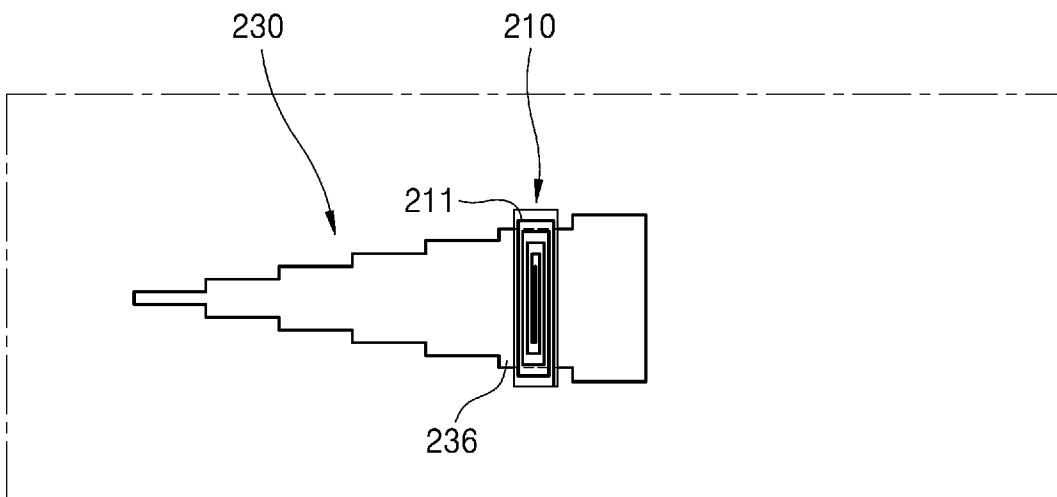


FIG. 9

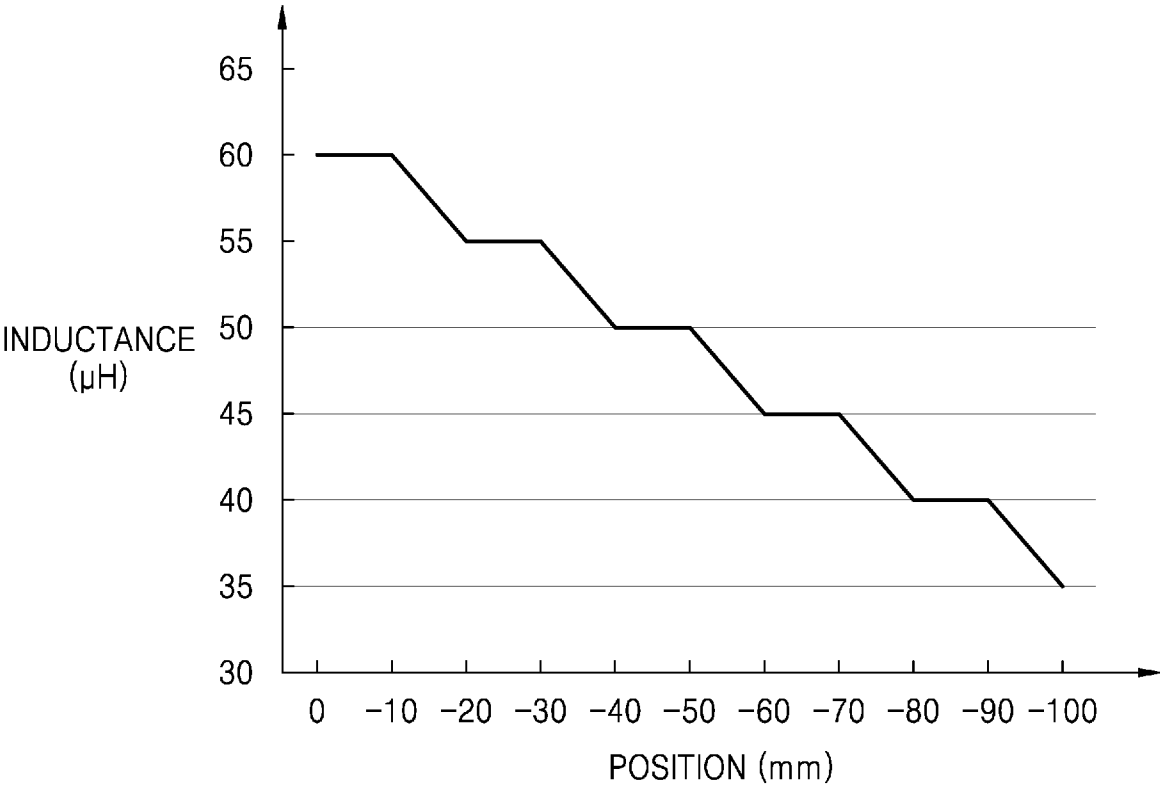


FIG. 10

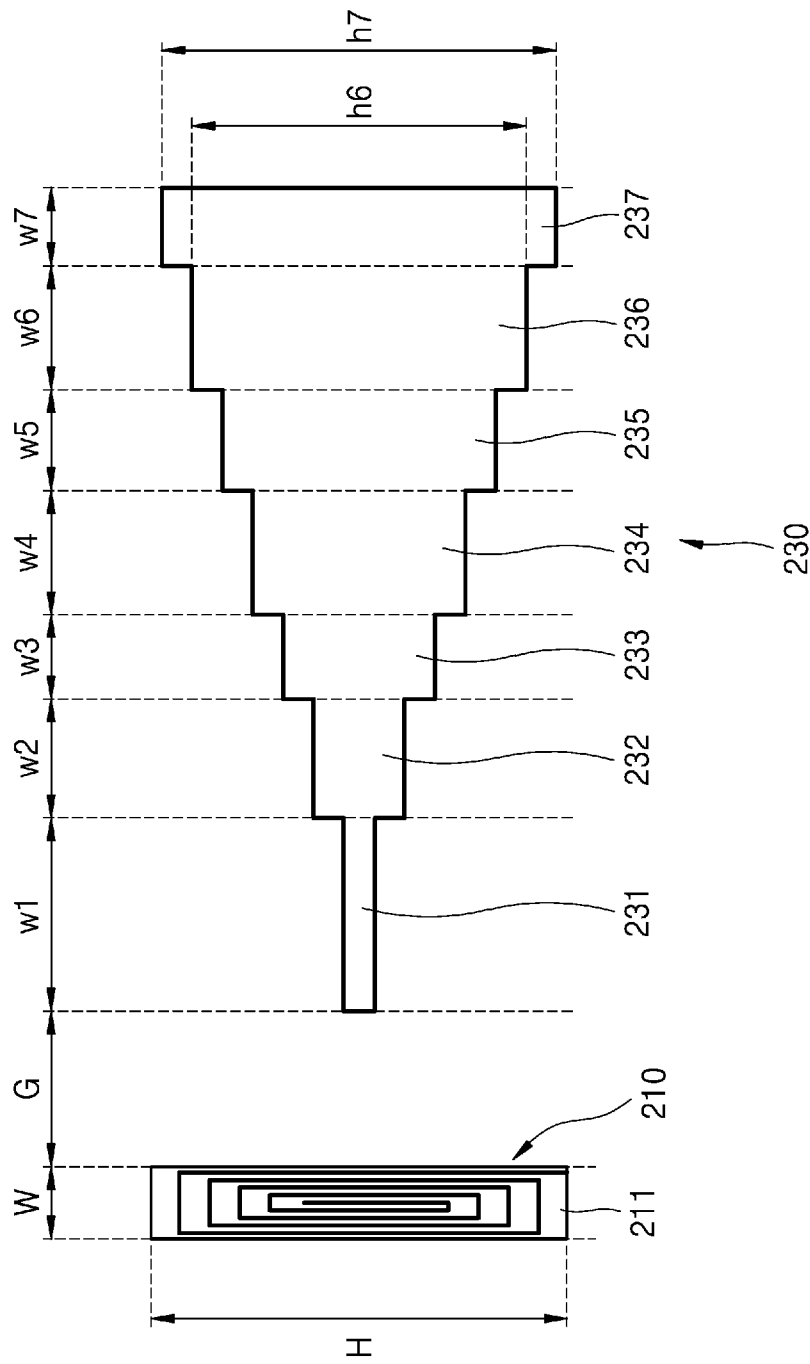


FIG. 11

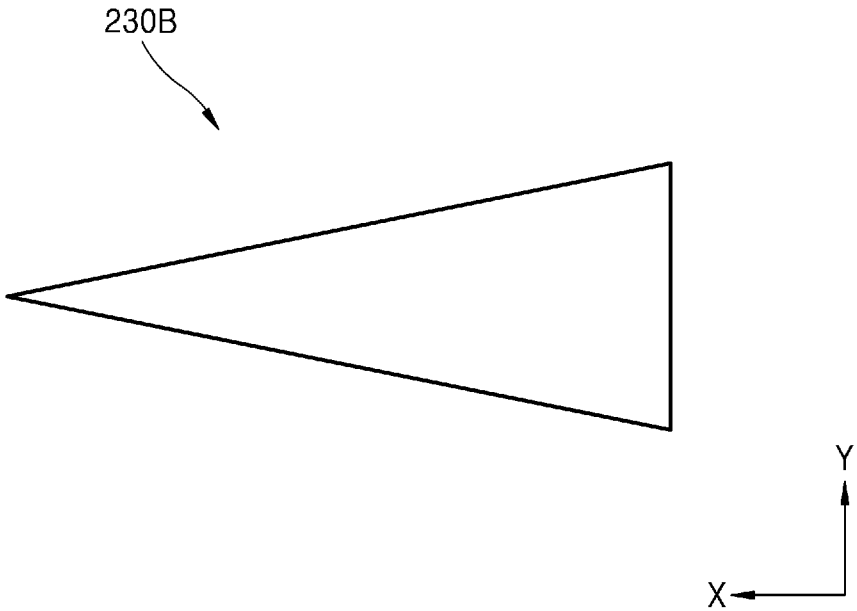


FIG. 12

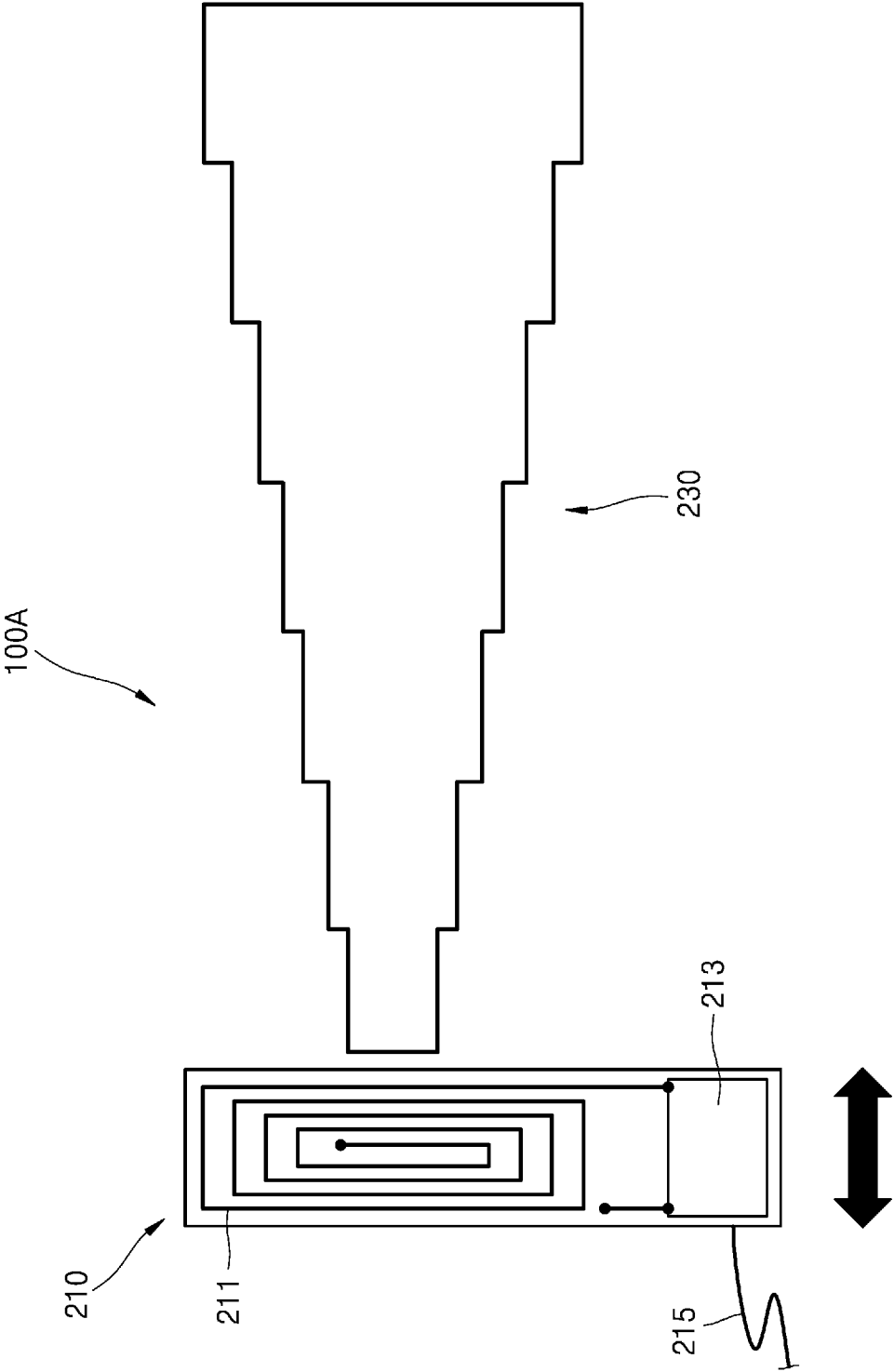
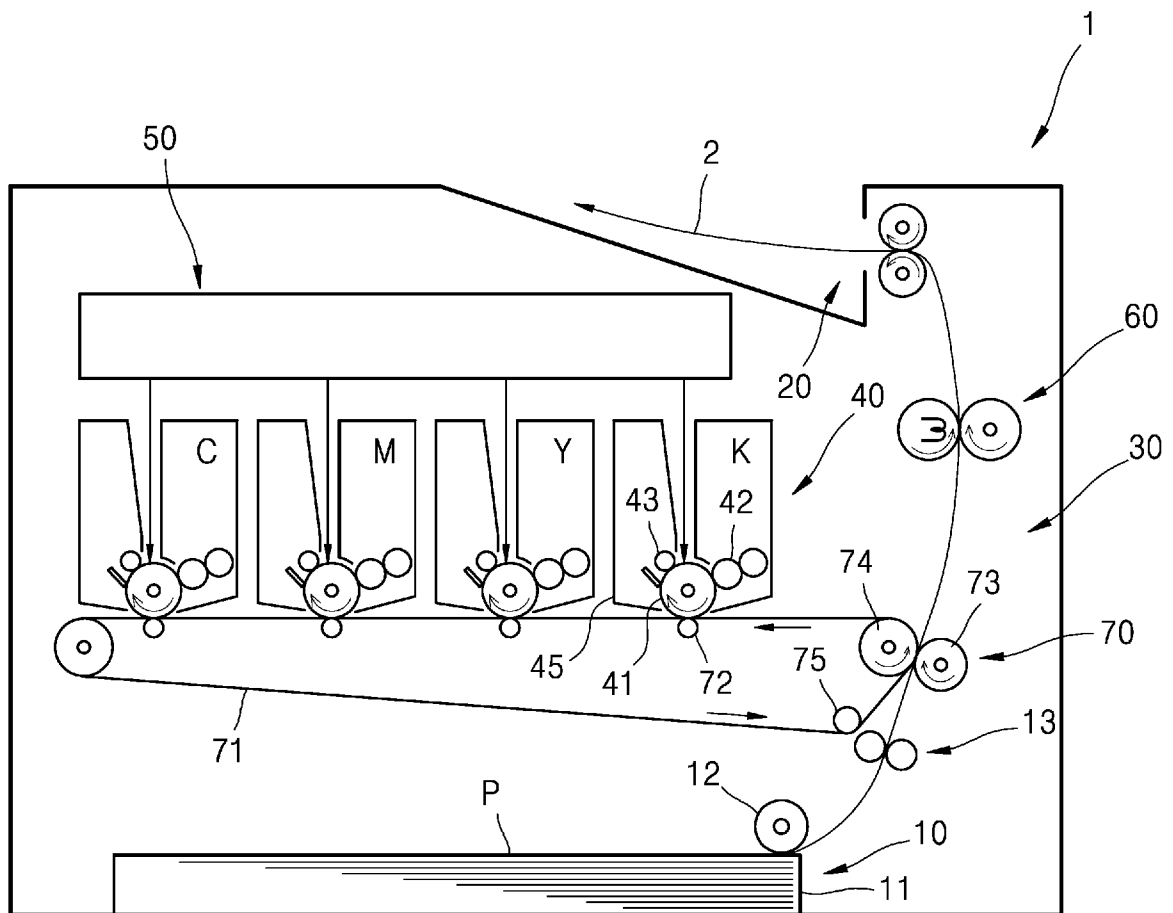


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2021/037367

A. CLASSIFICATION OF SUBJECT MATTER		
B41J 13/32 (2006.01) B41J 13/16 (2006.01) G01B 7/04 (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
B41F 21/00, B41L 43/14, G01R 33/02, B41J 13/32, 13/16, G01B 7/04		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
PatSearch (RUPTO internal), USPTO, PAJ, Esp@cenet, DWPI, EAPATIS, PATENTSCOPE		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7992862 B2 (PRIMAX ELECTRONICS, LTD.) 09.08.2011	1-15
A	US 7918452 B2 (KYOCERA MITA CORPORATION) 05.04.2011	1-15
A	US 6073925 A (TOHOKU RICOH CO., LTD.) 13.0	1-15
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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"P" document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search	Date of mailing of the international search report	
02 September 2021 (02.09.2021)	09 September 2021 (09.09.2021)	
Name and mailing address of the ISA/RU: Federal Institute of Industrial Property, Berezhkovskaya nab., 30-1, Moscow, G-59, GSP-3, Russia, 125993 Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37	Authorized officer T. Plotnikov Telephone No. (499) 240-25-91	