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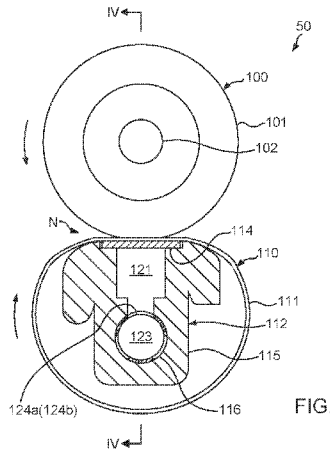


FIG. 2

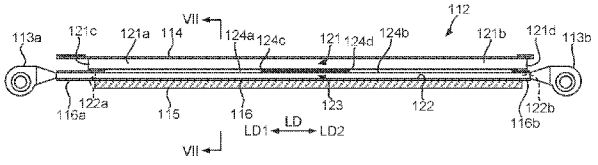


FIG. 4

(57) Abstract: A fixing device includes a pressing device and a heating device. The heating device includes a rotatable heating body, a heat source disposed inside the heating body, a cooling passage disposed inside the heating body to guide an air flow to the heat source, and a supply passage disposed inside the heating body to supply the air flow to the cooling passage through an opening formed between the supply passage and the cooling passage.

[Continued on next page]

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FIXING DEVICE WITH COOLING PASSAGE

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This application claims priority to Japanese Patent Application No. 2022-129097, filed on August 12, 2022 the entirety of which is incorporated by reference herein.

BACKGROUND

[0002] An image forming apparatus includes a fixing device which fixes a toner image to a print medium. The fixing device fixes the toner image to the print medium by heating and pressing the print medium onto which the toner image has been transferred.

BRIEF DESCRIPTION OF DRAWINGS

[0003] FIG. 1 is a schematic view of an example image forming apparatus.

[0004] FIG. 2 is a schematic cross-sectional view of an example fixing device.

[0005] FIG. 3 is a schematic diagram illustrating various widths of a print medium relative to a fixing nip region formed by the fixing device.

[0006] FIG. 4 is a schematic cross-sectional view of a heat source device taken along line IV-IV shown in FIG. 2.

[0007] FIG. 5 is an enlarged view of a first end portion of the heat source device shown in FIG. 4.

[0008] FIG. 6 is an enlarged view of a second end portion of the heat source device shown in FIG. 4.

[0009] FIG. 7 is a schematic cross-sectional view of the heat source device shown in FIG. 4, taken along line VII-VII.

[0010] FIG. 8 is a schematic cross-sectional view of a duct in an example heat source device.

[0011] FIG. 9 is a schematic diagram showing side views of the duct, corresponding to different rotation regions of the duct.

[0012] FIG. 10 is a schematic diagram showing side views of a duct according to another example, corresponding to different rotation regions of the duct.

[0013] FIG. 11 is a schematic diagram showing side views of a duct according to another example, corresponding to different rotation regions of the duct.

[0014] FIG. 12 is a schematic drawing illustrating a planar development view of another example duct, developed in a circumferential direction.

[0015] FIG. 13 is a schematic cross-sectional view taken longitudinally, of another example heat source device.

DETAILED DESCRIPTION

[0016] An example fixing device includes: a pressing device which extends in a longitudinal direction; and a heating device which extends adjacent to the pressing device, wherein the heating device includes a rotatable heating body (or heating element), a heat source which is disposed inside the heating body, a cooling passage which is disposed inside the heating body and guides an air flow to the heat source, and a supply passage which is disposed inside the heating body and supplies the air flow to the cooling passage through an opening formed between the supply passage and the cooling passage.

[0017] An example image forming apparatus includes: a fixing device which includes a heating device and a pressing device and fixes a toner image to a print medium, wherein the heating device includes a rotatable heating body which extends in a longitudinal direction of the heating device, a heat source which is disposed inside the heating body, a cooling passage which extends in the longitudinal direction inside the heating body and guides an air flow to the heat source, a supply passage which extends in the longitudinal direction inside the heating body and sends the air flow to the cooling passage through an opening, and a control unit (or control device) which changes an end position of the opening in the longitudinal direction based on a width of the print medium in the longitudinal direction.

[0018] In a fixing device, a print medium to which a toner image has been transferred, is heated and pressed at a fixing nip region between a pressing device and a heating device so that the toner image is fixed to the print medium. In the heating device, a heat source is disposed inside a heating body such as an endless belt and heat generated from the heat source is transferred to the print medium through the heating body. At this time, the temperature of the heat source may rise excessively depending on the usage condition or the like. The heat source may be cooled indirectly through the heating body by blowing air toward the heating body using a fan positioned to face the heating body. However, in this indirect cooling system, the heat source may not be efficiently cooled. Further, the fan is disposed outside the heating body to face the heating body, thereby increasing the size of the apparatus.

[0019] On the other hand, in the example fixing device and the example image forming apparatus described herein, the cooling passage which guides the air flow to the heat source and the supply passage which supplies the air flow to the cooling passage through the opening formed between the supply passage and the cooling passage are arranged inside the heating body in which the heat source is disposed. Therefore, when the supply passage generates the air flow, this air flow is supplied to the cooling passage through the opening and is guided to the heat source through the cooling passage. Accordingly, since the heat source can be directly cooled, the heat source can be more efficiently cooled. Further, since the fan has a high degree of freedom in arrangement even when the fan is adopted to generate the air flow in the supply passage, it is possible to suppress any increase in the size of the apparatus.

[0020] Hereinafter, examples of the image forming apparatus will be described with reference to the drawings. Additionally, in the description based on the drawings, the same reference numerals are given to the same elements or similar elements having the same function, and redundant description is omitted.

[0021] FIG. 1 is a schematic view of an example image forming apparatus 1. The image forming apparatus 1 may form a color image by using four color toners of magenta, yellow, cyan, and black. The image forming apparatus 1 includes a conveying device (or

conveyance device) 10, a plurality of photosensitive drums 20, a plurality of developing devices 30, a transfer device 40, a fixing device 50, and a discharge device 60.

[0022] The conveying device 10 conveys a sheet M as a print medium on which an image is to be formed. The plurality of photosensitive drums 20 include four photosensitive drums 20M, 20Y, 20C, and 20K. The four photosensitive drums 20M, 20Y, 20C, and 20K form electrostatic latent images for forming toner images of magenta, yellow, cyan, and black, respectively. Since the photosensitive drums 20M, 20Y, 20C, and 20K have substantially the same configurations, the photosensitive drum 20 described herein may be understood as a representative one of each of the four photosensitive drums 20M, 20Y, 20C, and 20K.

[0023] A developing device 30, a charging device 22, an exposure device 23, and a cleaning unit 24 are provided around the photosensitive drum 20. The charging device 22 may charge the surface of the photosensitive drum 20 to a predetermined potential. The exposure device 23 directs a light to the surface of the photosensitive drum 20 having been charged by the charging device 22 according to the image to be formed on the sheet M. Accordingly, an electrostatic latent image corresponding to the image to be formed on the sheet M is formed on the surface of the photosensitive drum 20. The cleaning unit 24 collects the toner remaining on the photosensitive drum 20.

[0024] The plurality of developing devices 30 include four developing devices 30M, 30Y, 30C, and 30K. The four developing devices 30M, 30Y, 30C, and 30K are respectively arranged adjacent to the respective photosensitive drums 20M, 20Y, 20C, and 20K to develop the electrostatic latent images respectively formed on the surfaces of the photosensitive drums 20M, 20Y, 20C, and 20K so as to form four respective toner images. Since the developing devices 30M, 30Y, 30C, and 30K have substantially the same configuration, the developing device 30 described herein may be understood as a representative one of each of the four developing devices 30M, 30Y, 30C, and 30K.

[0025] The developing device 30 includes a developing roller 31 which supplies a toner to the surface of the photosensitive drum 20. When the developing roller 31 supplies the toner to the surface of the photosensitive drum 20, the electrostatic latent image formed on

the surface of the photosensitive drum 20 is developed. Accordingly, the toner image corresponding to the electrostatic latent image, that is, the toner image based on the image to be formed on the sheet M is formed on the surface of the photosensitive drum 20.

[0026] The transfer device 40 conveys the toner image developed by the developing device 30 and transfers the toner image onto the sheet M. The transfer device 40 includes an intermediate transfer belt 41 to which the toner image formed on the surface of the photosensitive drum 20 is primarily transferred and which secondarily transfers the primarily transferred toner image to the sheet M.

[0027] The fixing device 50 fixes the toner image on the sheet M to the sheet M by heating and pressing the sheet M onto which the toner image has been transferred. The discharge device 60 discharges the sheet M with the toner image fixed thereon, to the outside of the apparatus.

[0028] The image forming apparatus further includes an electronic control unit (or control device or controller) 70 which includes a CPU (Central Processing Unit), a ROM (Read Only Memory), a RAM (Random Access Memory), and the like. Various controls may be executed by the control unit 70, for example, in such a manner that a program stored in the ROM is loaded into the RAM and is executed by the CPU. The control unit 70 may be composed of a plurality of electronic control units (or controllers) or may be composed of a single electronic control unit (or single controller). The control unit 70 executes various controls of the image forming apparatus 1.

[0029] FIG. 2 is a schematic cross-sectional view of the example fixing device 50. As shown in FIG. 2, the fixing device 50 includes a pressing device 100 which extends in a longitudinal direction LD (cf. FIG. 4) and a heating device 110 which extends adjacent to the pressing device 100. Additionally, a first longitudinal direction LD1 points toward a first end of the fixing device 50 in the longitudinal direction LD and a second longitudinal direction LD2 points toward a second end of the fixing device 50 in the longitudinal direction LD.

[0030] The pressing device 100 is pressed against the heating device 110 to form a fixing nip region N between the pressing device and the heating device 110where the sheet

M is conveyed to fix the toner image to the sheet M. The pressing device 100 includes a rotatable pressing roller 101 and a support portion 102 which rotatably supports the pressing roller 101 so that the pressing roller 101 is pressed against the heating device 110. The pressing roller 101 has, for example, an elastically deformable outer peripheral portion.

[0031] FIG. 3 is a schematic view illustrating an example of a relationship between the width of the sheet M and the fixing nip region N. As shown in FIG. 3, the sheet M that is conveyed does not occupy the entire length of the fixing nip region N in the longitudinal direction LD, but instead occupies a partial region of the fixing nip region N in the longitudinal direction LD (e.g., the sheet M contacts a partial length of the fixing nip region N). Here, in the fixing nip region N, a region through which the sheet M is conveyed is referred to as a sheet passing region (or sheet conveyance region) N1, regions on either side of the sheet passing region N1 where the sheet M does not pass, are referred to as sheet non-passing regions N2, and respective boundaries between the sheet passing region N1 and the sheet non-passing regions N2 include a first boundary B1 and a second boundary B2. The first boundary B1 is located between the sheet passing region N1 and the sheet non-passing region N2 extending from a first end of the fixing nip region N in the longitudinal direction LD, and the boundary B2 is the boundary between the sheet passing region N1 and the sheet non-passing region N2 extending from a second end of the fixing nip region N. The first sheet non-passing region N2 adjacent to the first boundary B1 is located at a first end portion of the heating device 110 (toward the first longitudinal direction LD1) and extends in the longitudinal direction LD. The second sheet non-passing region N2 adjacent to the second boundary B2 is located at a second end portion of the heating device 110 (toward the second longitudinal direction LD2) and extends in the longitudinal direction LD. During a fixing operation of the fixing device 50, the pressing device 100 and the heating device 110 remain in contact with each other while the sheet M is conveyed through the fixing nip region N.

[0032] Depending on the width of the sheet M, the ratio of the sheet passing region N1 and the sheet non-passing regions N2 may vary and the respective positions of the first boundary B1 and of the second boundary B2 may vary accordingly. The width of the sheet M extends in the longitudinal direction LD when the sheet M is conveyed through the fixing

nip region N. For example, FIG. 3 illustrates example widths of a first sheet M1, a second sheet M2, and a third sheet M3 with respect to the fixing nip region N. Given a predetermined width of the first sheet M1, the second sheet M2 has a width that is narrower than the width of the first sheet M1, and the third sheet M3 has a width narrower than the width of the second sheet M2. Accordingly, the sheet passing region N1, as well as a distance (or gap) between the boundaries B1 and B2, is narrower (while the sheet non-passing region N2 is wider) in a case in which the second sheet M2 is conveyed through the fixing nip region N in comparison to a case in which the first sheet M1 is conveyed through the fixing nip region N. Further, the sheet passing region N1, as well as the distance (or gap) between the boundaries B1 and B2, is narrower (while the sheet non-passing region N2 is wider) in a case in which the third sheet M3 is conveyed through the fixing nip region N in comparison to a case in which the second sheet M2 is conveyed through the fixing nip region N.

[0033] The heating device 110 heats the sheet M conveyed through the fixing nip region N. FIG. 4 is a schematic cross-sectional view of a heat source unit (or heat source device) 112 taken along a line IV-IV shown in FIG. 2. FIG. 5 is an enlarged schematic cross-sectional view of a first end portion of the heat source unit (or heat source device) 112 shown in FIG. 4. FIG. 6 is an enlarged schematic cross-sectional view of a second end portion of the heat source unit (or heat source device) 112 shown in FIG. 4. FIG. 7 is a schematic cross-sectional view taken along a line VII-VII shown in FIG. 4. With reference to FIG. 2 and FIGS. 4 to 7, the heating device 110 includes the heating body 111, the heat source unit (or heat source device) 112, and fans 113a and 113b.

[0034] The heating body 111 is a rotatable member. The heating body 111 is, for example, an endless belt (fixing belt) and rotates around an axis extending in the longitudinal direction LD. The heating body 111 forms the fixing nip region N between the heating body 111 and the pressing roller 101. Then, the heating body 111 contacts the sheet M conveyed through the fixing nip region N and heats the sheet M conveyed to the fixing nip region N.

[0035] The heat source unit (or heat source device) 112 is disposed inside the heating body 111 and extends in the longitudinal direction LD, with reference to FIG. 2. The

recitation that the heat source unit 112 is disposed inside the heating body 111 refers to the heat source unit 112 extending inside the heating body 111 so that at least a part of the heat source unit 112 is disposed inside the heating body 111 in the longitudinal direction LD. Therefore, for example, the end portions of the heat source unit 112 may protrude out from the heating body 111 in the longitudinal direction LD. The heat source unit 112 includes a heat source 114, a casing 115, and a duct 116.

[0036] The heat source 114 is a heater which radiates heat to heat the sheet M conveyed to the fixing nip region N. The heat source 114 is disposed inside the heating body 111 and extends in the longitudinal direction LD. That is, the heat source 114 extends inside the heating body 111 so that at least a part of the heat source 114 is disposed inside the heating body 111 in the longitudinal direction LD. For example, the heat source 114 may be disposed at a position adjacent to the heating body 111 inside the heating body 111, so as to contact an inner surface of the heating body 111, for example. Then, the heat source 114 indirectly heats the sheet M conveyed to the fixing nip region N by heating the heating body 111. The heat source 114 is, for example, a planar heating element such as a ceramic heater or a tubular heating element such as a halogen heater. The planar heating element may be formed in a substantially flat plate shape. The tubular heating element may be formed in a substantially tubular shape. The drawing shows an example in which a ceramic heater, which is a planar heating element, is used as the heat source 114.

[0037] The casing 115 is a member that supports the heat source 114. The casing 115 is disposed inside the heating body 111 and extends in the longitudinal direction LD. That is, the casing 115 extends inside the heating body 111 so that at least a part of the casing 115 is disposed inside the heating body 111 in the longitudinal direction LD. The casing 115 supports the heat source 114, for example, so that the heat source 114 is disposed at a position adjacent to the heating body 111. The casing 115 is provided with a cooling passage 121 and a duct hole 122.

[0038] The cooling passage 121 is disposed inside the heating body 111 similarly to the casing 115 to guide the air flow to the heat source 114. The cooling passage 121 extends in the longitudinal direction LD along the heat source 114 so as to expose the heat source 114 to the cooling passage 121. The cooling passage 121 includes a first longitudinal portion

121a which substantially extends along the first end portion of the heating device 110 located at the first sheet non-passing region N2, a second longitudinal portion 121b which substantially extends along the second end portion of the heating device 110 located at the second sheet non-passing region N2, an outlet 121c which is disposed at a first longitudinal end of the cooling passage 121 (in the first longitudinal direction LD1), and an outlet 121d which is disposed at a second longitudinal end of the cooling passage 121 (in the second longitudinal direction LD2), in the longitudinal direction LD. The outlet 121c and the outlet 121d open the cooling passage 121 to the outside of the casing 115.

[0039] The duct hole 122 accommodates the duct 116. The duct hole 122 extends in the longitudinal direction LD adjacent to the cooling passage 121 so as to communicate with the cooling passage 121. A transverse cross-section of the duct hole 122 in a direction orthogonal to the longitudinal direction LD forms a circular shape. The duct hole 122 includes an opening 122a which is disposed at a first longitudinal end of the duct hole 122 and an opening 122b which is disposed at a second longitudinal end of the duct hole 122, in the longitudinal direction LD. The opening 122a and the opening 122b open the duct hole 122 to the outside of the casing 115.

[0040] The duct 116 is inserted into the duct hole 122 of the casing 115 and forms a supply passage 123. The duct 116 is formed in a cylindrical shape and the supply passage 123 is formed inside the duct 116. The supply passage 123 supplies the air flow to the cooling passage 121 through a first opening 124a and a second opening 124b formed between the supply passage and the cooling passage 121. The first opening 124a is located at a first end portion of the supply passage 123 and extends in the longitudinal direction LD. The second opening 124b is located at a second end portion of the supply passage 123 and extends in the longitudinal direction LD. The first opening 124a and the second opening 124b extend in the longitudinal direction LD so that the air flow is directed along the first longitudinal portion 121a and the second longitudinal portion 121b of the cooling passage 121. Additionally, the first and second end portions of the supply passage 123 in the longitudinal direction LD correspond to regions located on opposite sides of a longitudinal center portion of the supply passage 123, in the longitudinal direction LD.

[0041] The first opening 124a and the second opening 124b are formed by the duct 116. The duct 116 extends in the longitudinal direction LD and is rotatable around an axis extending in the longitudinal direction LD inside the duct hole 122. The duct 116 may be rotationally driven inside the duct hole 122 by a rotational drive source such as a motor. A first end 116a of the duct 116 and a second end 116b of the duct 116 protrude out from the duct hole 122 in the longitudinal direction LD.

[0042] FIG. 8 is a schematic cross-sectional view of the duct 116. FIG. 9 is a schematic diagram showing three side views taken from different rotational positions of the duct, so as to illustrate rotation regions of the duct 116. With reference to FIGS. 8 and 9, the duct 116 has a first rotation region R1, a second rotation region R2, a third rotation region R3, a fourth rotation region R4, a fifth rotation region R5, and a sixth rotation region R6 which are offset in the rotation direction RD of the duct 116. The rotation direction RD of the duct 116 is also the circumferential direction of the duct 116. Each of the first rotation region R1, the second rotation region R2, the third rotation region R3, the fourth rotation region R4, the fifth rotation region R5, and the sixth rotation region R6 is a region extending in the longitudinal direction LD and do not overlap in the rotation direction RD of the duct 116.

[0043] With reference to FIGS. 4 to 6 and FIG. 9, a pair of first holes 125a and 125b are formed in the first rotation region R1 of the duct 116. The pair of first holes 125a and 125b open the supply passage 123 to the outside of the duct 116 in the first rotation region R1. The pair of first holes 125a and 125b have the same length in the longitudinal direction LD, and are separated from each other in the longitudinal direction LD. The first hole 125a is located at a first end portion of the duct 116 and extends in the longitudinal direction LD. The first hole 125b is located at a second end portion of the duct 116 and extends in the longitudinal direction LD. Additionally, the end portions of the duct 116 refers to regions located on opposite sides of a longitudinal center portion of the duct 116, in the longitudinal direction LD.

[0044] The pair of first holes 124a and 125b respectively form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116 is rotated to a position in which the first rotation region R1 faces the cooling passage 121. That is, when the first rotation region R1 faces the cooling passage

121, the first hole 125a is disposed at a position corresponding to the first opening 124a and the first hole 125b is disposed at a position corresponding to the second opening 124b. In this position, an inner end 125c of the first hole 125a in the second longitudinal direction LD2 is an inner end position 124c of the first opening 124a in the second longitudinal direction LD2 and an inner end 125d of the first hole 125b in the first longitudinal direction LD1 is an inner end position 124d of the second opening 124b in the first longitudinal direction LD1.

[0045] A pair of second holes 126a and 126b are formed in the third rotation region R3 of the duct 116. The pair of second holes 126a and 126b open the supply passage 123 to the outside of the duct 116 in the third rotation region R3. The pair of second holes 126a and 126b have a same length in the longitudinal direction LD, which is longer than the length of the pair of first holes 125a and 125b in the longitudinal direction LD. The pair of second holes 126a and 126b are separated from each other in the longitudinal direction LD. The second hole 126a is located at the first end portion of the duct 116 and extends in the longitudinal direction LD. The second hole 126b is located at the second end portion of the duct 116 and extends in the longitudinal direction LD.

[0046] The pair of second holes 126a and 126b respectively form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116 is rotated to a position in which the third rotation region R3 faces the cooling passage 121. That is, when the third rotation region R3 faces the cooling passage 121, the second hole 126a is disposed at a position corresponding to the first opening 124a and the second hole 126b is disposed at a position corresponding to the second opening 124b. In this position, an inner end 126c of the second hole 126a in the second longitudinal direction LD2 is an inner end position 124c of the first opening 124a, and an inner end 126d of the second hole 126b in the first longitudinal direction LD1 is an inner end position 124d of the second opening 124b.

[0047] A pair of third holes 127a and 127b are formed in the fifth rotation region R5 of the duct 116. The pair of third holes 127a and 127b are holes which open the supply passage 123 to the outside of the duct 116 in the third rotation region R3. The pair of third holes 127a and 127b have a same length in the longitudinal direction LD, that is longer than

the length of the pair of second holes 126a and 126b in the longitudinal direction LD. The pair of third holes 127a and 127b are separated from each other in the longitudinal direction LD. The third hole 127a is located at the first end portion of the duct 116 and extends in the longitudinal direction LD. The third hole 127b is located at the second end portion of the duct 116 and extends in the longitudinal direction LD.

[0048] The pair of third holes 127a and 127b respectively form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116 is rotated to a position in which the fifth rotation region R5 faces the cooling passage 121. That is, when the fifth rotation region R5 faces the cooling passage 121, the third hole 127a is disposed at a position corresponding to the first opening 124a and the third hole 127b is disposed at a position corresponding to the second opening 124b. In this position, an inner end 127c of the third hole 127a in the second longitudinal direction LD2 is an inner end position 124c of the first opening 124a, and an inner end 127d of the third hole 127b in the first longitudinal direction LD1 is an inner end position 124d of the second opening 124b.

[0049] With reference to FIG. 9, the inner end 125c of the first hole 125a, the inner end 126c of the second hole 126a, and the inner end 127c of the third hole 127a are located at different positions in the longitudinal direction LD. That is, the inner end 125c of the first hole 125a, the inner end 126c of the second hole 126a, and the inner end 127c of the third hole 127a are offset from each other in the longitudinal direction LD in order to set the inner end position 124c of the first opening 124a by selecting the first hole 125a, the second hole 126a, or the third hole 127a as the first opening 124a. Further, a center position 125g of the first hole 125a, a center position 126g of the second hole 126a, and a center position 127g of the third hole 127a are offset from each other in the longitudinal direction LD.

[0050] Similarly, the inner end 125d of the first hole 125b, the inner end 126d of the second hole 126b, and the inner end 127d of the third hole 127b are located at different positions in the longitudinal direction LD. That is, the inner end 125d of the first hole 125b, the inner end 126d of the second hole 126b, and the inner end 127d of the third hole 127b are offset from each other in the longitudinal direction LD in order to set the inner end position 124d of the second opening 124b by selecting the first hole 125b, the second hole

126b, or the third hole 127b as the second opening 124b. Further, a center position 125h of the first hole 125b, a center position 126h of the second hole 126b, and a center position 127h of the third hole 127b are offset from each other in the longitudinal direction LD.

[0051] Therefore, the inner end position 124d of the second opening 124b in the first longitudinal direction LD1 may be changed or varied as the rotation region of the duct 116 facing the cooling passage 121 is changed among the first rotation region R1, the third rotation region R3, and the fifth rotation region R5, for example by rotating the duct 116.

[0052] On the other hand, an outer end 125e of the first hole 125a in the first longitudinal direction LD1, an outer end 126e of the second hole 126a in the first longitudinal direction LD1, and an outer end 127e of the third hole 127a in the first longitudinal direction LD1 are located at a same position in the longitudinal direction LD. Further, an outer end 125f of the first hole 125b in the second longitudinal direction LD2, an outer end 126f of the second hole 126b in the second longitudinal direction LD2, and an outer end 127f of the third hole 127b in the second longitudinal direction LD2 are located at a same position in the longitudinal direction LD.

[0053] The second rotation region R2, the fourth rotation region R4, and the sixth rotation region R6 of the duct 116 are wall regions that are not provided with any hole opening the supply passage 123 to the outside of the duct 116. When the second rotation region R2, the fourth rotation region R4, or the sixth rotation region R6 faces the cooling passage 121, the duct 116 does not form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121, so as to separate the supply passage 123 from the cooling passage 121.

[0054] The pair of first holes 125a and 125b, the pair of second holes 126a and 126b, and the pair of third holes 127a and 127b are offset from each other in the rotation direction RD of the duct 116. Further, the second rotation region R2, the fourth rotation region R4, or the sixth rotation region R6 which correspond to the wall regions are formed between the pair of first holes 125a and 125b, the pair of second holes 126a and 126b, and the pair of third holes 127a and 127b in the rotation direction RD of the duct 116.

[0055] With reference to FIGS. 3 and 9, the inner end 125c of the first hole 125a and the inner end 125d of the first hole 125b are located at respective positions corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 with the sheet non-passing regions N2 when the first sheet M1 is conveyed through the fixing nip region N. Further, the inner end 126c of the second hole 126a and the inner end 126d of the second hole 126b are located at respective positions corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 with the sheet non-passing regions N2 when the second sheet M2 is conveyed through the fixing nip region N. Further, the inner end 127c of the third hole 127a and the inner end 127d of the third hole 127b are located at respective positions corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 with the sheet non-passing regions N2 when the third sheet M3 is conveyed through the fixing nip region N. The position correspondences described above may refer to a same position or to neighboring or adjacent positions in the longitudinal direction LD.

[0056] With reference to FIGS. 4 to 6, the fan 113a and the fan 113b are blowing devices which generate an air flow inside the supply passage 123.

[0057] The fan 113a is disposed at the first end of the heating device 110, namely at the first end of the heat source unit (or heat source device) 112, so as to be connected to the first end 116a of the duct 116. The fan 113a generates a first air flow F1 directed in the second longitudinal direction LD2 inside the supply passage 123. The first air flow F1 which is generated by the fan 113a is introduced from the supply passage 123 to the first longitudinal portion 121a of the cooling passage 121 through the first opening 124a. Then, the first air flow F1 which is introduced to the first longitudinal portion 121a of the cooling passage 121 is discharged (or directed out) from the outlet 121c of the cooling passage 121 in the first longitudinal direction LD1.

[0058] The fan 113b is disposed at the second end of the heating device 110, namely at the second end of the heat source unit 112, so as to be connected to the second end 116b of the duct 116. The fan 113b generates the second air flow F2 directed in the first longitudinal direction LD1 inside the supply passage 123. The second air flow F2 generated by the fan 113b is introduced from the supply passage 123 to the second longitudinal

portion 121b of the cooling passage 121 through the second opening 124b. Then, the second air flow F2 introduced to the second longitudinal portion 121b of the cooling passage 121 is discharged (or directed out) from the outlet 121d of the cooling passage 121 in the second longitudinal direction LD2.

[0059] With reference to FIGS. 5 and 6, the casing 115 is provided with a pair of first guide portions 117a and 117b, a pair of second guide portions 118a and 118b, and a pair of third guide portions 119a and 119b. Additionally, the pair of first guide portions 117a and 117b, the pair of second guide portions 118a and 118b, and the pair of third guide portions 119a and 119b are omitted in the schematic representation of FIG. 4 for ease of understanding.

[0060] The first guide portion 117a, the second guide portion 118a, and the third guide portion 119a are guide portions which guide the first air flow F1, supplied from the supply passage 123 to the first longitudinal portion 121a of the cooling passage 121 through the first opening 124a, to the outlet 121c of the cooling passage 121 to be directed in the first longitudinal direction LD1. The first guide portion 117a, the second guide portion 118a, and the third guide portion 119a extend from the vicinity of the first opening 124a toward the outlet 121c of the cooling passage 121.

[0061] The first guide portion 117b, the second guide portion 118b, and the third guide portion 119b are guide portions which guide the second air flow F2, supplied from the supply passage 123 to the second longitudinal portion 121b of the cooling passage 121 through the second opening 124b, to the outlet 121d of the cooling passage 121 to be directed in the second longitudinal direction LD2. The first guide portion 117b, the second guide portion 118b, and the third guide portion 119b extend from the vicinity of the second opening 124b toward the outlet 121d of the cooling passage 121.

[0062] With reference to FIGS. 5 and 9, the first guide portion 117a is located at the position corresponding to the inner end 125c of the first hole 125a of the duct 116. Therefore, the first guide portion 117a can guide the first air flow F1, supplied from the supply passage 123 to the first longitudinal portion 121a of the cooling passage 121 through the first hole 125a corresponding to (e.g., forming) the first opening 124a, to the outlet 121c

of the cooling passage 121 from the position corresponding to the inner end 125c of the first hole 125a when the first rotation region R1 faces the cooling passage 121 so that the first hole 125a forms the first opening 124a.

[0063] With reference to FIGS. 6 and 9, the first guide portion 117b is located at the position corresponding to the inner end 125d of the first hole 125b of the duct 116. Therefore, the first guide portion 117b can guide the second air flow F2, supplied from the supply passage 123 to the second longitudinal portion 121b of the cooling passage 121 through the first hole 125b forming the second opening 124b, to the outlet 121d of the cooling passage 121 from the position corresponding to the inner end 125d of the first hole 125b when the first rotation region R1 faces the cooling passage 121 so that the first hole 125b forms the second opening 124b.

[0064] With reference back to FIGS. 5 and 9, the second guide portion 118a is located at the position corresponding to the inner end 126c of the second hole 126a of the duct 116. Therefore, the second guide portion 118a can guide the first air flow F1, supplied from the supply passage 123 to the first longitudinal portion 121a of the cooling passage 121 through the second hole 126a forming the first opening 124a, to the outlet 121c of the cooling passage 121 from the position corresponding to the inner end 126c of the second hole 126a when the third rotation region R3 faces the cooling passage 121 so that the second hole 126a forms the first opening 124a.

[0065] With reference back to FIGS. 6 and 9, the second guide portion 118b is located at the position corresponding to the inner end 126d of the second hole 126b of the duct 116. Therefore, the second guide portion 118b can guide the second air flow F2, supplied from the supply passage 123 to the second longitudinal portion 121b of the cooling passage 121 through the second hole 126b forming the second opening 124b, to the outlet 121d of the cooling passage 121 from the position corresponding to the inner end 126d of the second hole 126b when the third rotation region R3 faces the cooling passage 121 so that the second hole 126b forms the second opening 124b.

[0066] Reference again to FIGS. 5 and 9, the third guide portion 119a is located at the position corresponding to the inner end 127c of the third hole 127a of the duct 116.

Therefore, the third guide portion 119a can guide the first air flow F1, supplied from the supply passage 123 to the first longitudinal portion 121a of the cooling passage 121 through the third hole 127a forming the first opening 124a, to the outlet 121c of the cooling passage 121 from the position corresponding to the inner end 127c of the third hole 127a when the fifth rotation region R5 faces the cooling passage 121 so that the third hole 127a forms the first opening 124a.

[0067] Reference again to FIGS. 6 and 9, the third guide portion 119b is located at the position corresponding to the inner end 127d of the third hole 127b of the duct 116. Therefore, the third guide portion 119b can guide the second air flow F2, supplied from the supply passage 123 to the second longitudinal portion 121b of the cooling passage 121 through the third hole 127b forming the second opening 124b, to the outlet 121d of the cooling passage 121 from the position corresponding to the inner end 127d of the third hole 127b when the fifth rotation region R5 faces the cooling passage 121 so that the third hole 127b forms the second opening 124b.

[0068] As shown in FIGS. 1, 3, and 4, the controller 70 sets the inner end position 124c of the first opening 124a and the inner end position 124d of the second opening 124b based on the width taken in the longitudinal direction LD, of the sheet M to be conveyed through the fixing nip region N of the fixing device 50.

[0069] The fixing device 50 may fix the toner image onto the sheet M by heating and pressing the sheet M conveyed through the fixing nip region N between the pressing device 100 and the heating device 110. At this time, the heat source 114 is likely to be cooled in the sheet passing region N1 as the heat generated by the heat source 114 is transferred from the heating body 111 to the sheet M within the sheet passing region N1 through which the sheet M is conveyed. On the other hand, the heat source 114 is less likely to be cooled in the sheet non-passing region N2 since the heat generated by the heat source 114 is not transferred from the heating body 111 to the sheet M in the sheet non-passing region N2 where the sheet M does not pass (e.g., does not contact the heating body 111). Further, the positions of the boundary B1 and the boundary B2 are changed depending on the width of the sheet M.

[0070] Here, the controller 70 rotates the duct 116 to position one among the first rotation region R1, the third rotation region R3, and the fifth rotation region R5 to face the cooling passage 121 based on the width of the sheet M in the longitudinal direction LD in order to cool the heat source 114 in the sheet non-passing region N2. That is, the controller 70 rotates the duct 116 so that the inner end position 124c of the first opening 124a and the inner end position 124d of the second opening 124b correspond substantially to the boundary B1 and the boundary B2 of the sheet passing region N1 with the sheet non-passing regions N2.

[0071] For example, with reference to FIGS. 3 and 9, when the first sheet M1 is to be conveyed through the fixing nip region N, the controller 70 rotates the duct 116 so that the first rotation region R1 faces the cooling passage 121. In this position of the duct 116, the first hole 125a and the first hole 125b formed in the first rotation region R1 form the first openings 124a and 124b. Further, the inner end 125c of the first hole 125a and the inner end 125d of the first hole 125b are the inner end position 124c of the first opening 124a and the inner end position 124d of the second opening 124b. Further, the inner end position 124c of the first opening 124a and the inner end position 124d of the second opening 124b correspond substantially to the boundary B1 and the boundary B2 of the sheet passing region N1 with the sheet non-passing regions N2. Accordingly, a portion corresponding to the sheet non-passing region N2 of the heat source 114 may be cooled by the first air flow F1 and the second air flow F2 supplied from the first opening 124a and the second opening 124b that are respectively formed by the first hole 125a and the first hole 125b to the first longitudinal portion 121a and the second longitudinal portion 121b, respectively, of the cooling passage 121.

[0072] Further, when the second sheet M2 is to be conveyed through the fixing nip region N, the controller 70 rotates the duct 116 so that the third rotation region R3 faces the cooling passage 121. In this position of the duct 116, the second hole 126a and the second hole 126b formed in the third rotation region R3 form the first openings 124a and 124b. Further, the inner end 126c of the second hole 126a and the inner end 126d of the second hole 126b are the inner end position 124c of the first opening 124a and the inner end position 124d of the second opening 124b. Further, the inner end position 124c of the first

opening 124a and the inner end position 124d of the second opening 124b correspond substantially to the boundary B1 and the boundary B2 of the sheet passing region N1 with the sheet non-passing regions N2. Accordingly, a portion corresponding to the sheet non-passing region N2 of the heat source 114 may be cooled by the first air flow F1 and the second air flow F2 supplied from the first opening 124a and the second opening 124b that are respectively formed by the second hole 126a and the second hole 126b to the first longitudinal portion 121a and the second longitudinal portion 121b, respectively, of the cooling passage 121.

[0073] Further, when the third sheet M3 is to be conveyed through the fixing nip region N, the controller 70 rotates the duct 116 so that the fifth rotation region R5 faces the cooling passage 121. In this position of the duct 116, the third hole 127a and the third hole 127b formed in the fifth rotation region R5 form the first openings 124a and 124b. Further, the inner end 127c of the third hole 127a and the inner end 127d of the third hole 127b are the inner end position 124c of the first opening 124a and the inner end position 124d of the second opening 124b. Further, the inner end position 124c of the first opening 124a and the inner end position 124d of the second opening 124b correspond substantially to the boundary B1 and the boundary B2 of the sheet passing region N1 with the sheet non-passing regions N2. Accordingly, a portion corresponding to the sheet non-passing region N2 of the heat source 114 may be cooled by the first air flow F1 and the second air flow F2 supplied from the first opening 124a and the second opening 124b that are respectively formed by the third hole 127a and the third hole 127b to the first longitudinal portion 121a and the second longitudinal portion 121b, respectively, of the cooling passage 121.

[0074] Additionally, when it is not necessary to cool a portion corresponding to the sheet non-passing regions N2 of the heat source 114, such as when no sheet is not conveyed to the fixing nip region N, the controller 70 may rotate the duct 116 so that the wall region of any one of the second rotation region R2, the fourth rotation region R4, and the sixth rotation region R6 faces the cooling passage 121.

[0075] In the image forming apparatus 1 and the fixing device 50 with such a configuration, the cooling passage 121 guiding the air flow to the heat source 114 and the supply passage 123 supplying the air flow to the cooling passage 121 through the first

opening 124a and the second opening 124b formed between the supply passage and the cooling passage 121 are arranged inside the heating body 111 in which the heat source 114 is disposed. Therefore, when the supply passage 123 generates the air flow, this air flow is supplied to the cooling passage 121 through the first opening 124a and the second opening 124b and is guided to the heat source 114 through the cooling passage 121. Accordingly, it is possible to cool the heat source 114 directly, and therefore more efficiently. Further, the fan 113a and the fan 113b for generating the air flow in the supply passage 123 have a high degree of freedom in arrangement, so as to suppress an increase in size of the apparatus.

[0076] Further, the duct 116 forming the supply passage 123 includes the pair of first holes 125a and 125b which are formed in the first rotation region R1, the pair of second holes 126a and 126b which are formed in the third rotation region R3, and the pair of third holes 127a and 127b which are formed in the fifth rotation region R5. Then, the inner end 125e of the first hole 125a, the inner end 126e of the second hole 126a, and the inner end 127e of the third hole 127a are located at different positions in the longitudinal direction LD. Further, the inner end 125f of the first hole 125b, the inner end 126f of the second hole 126b, and the inner end 127f of the third hole 127b are located at different positions in the longitudinal direction LD. Therefore, it is possible to change the inner end position 124c of the first opening 124a and the inner end position 124d of the second opening 124b in the longitudinal direction LD based on the rotation position of the duct 116. Accordingly, it is possible to vary a portion to be cooled that corresponds to the sheet non-passing regions N2 of the heat source 114 according to the width of the sheet M that is conveyed through the sheet passing region N1.

[0077] Although various examples have been described and illustrated herein, other examples may be modified in arrangement and details.

[0078] For example, the shape of each hole formed in the duct can be appropriately changed. The shape of each hole formed in the duct may be the same shape. FIG. 10 is a schematic view illustrating rotation regions of another example duct. A duct 116A shown in FIG. 10 has the first rotation region R1, the second rotation region R2, the third rotation region R3, the fourth rotation region R4, the fifth rotation region R5, and the sixth rotation

region R6 arranged in the circumferential direction (or rotation direction RD), similarly to those of the duct 116 of the above-described example (cf. FIG. 8).

[0079] With reference to FIGS. 4 to 6 and FIG. 10, a pair of first holes 125aA and 125bA are formed in the first rotation region R1 of the duct 116A instead of the pair of first holes 125a and 125b of the above example. The pair of first holes 125aA and 125bA have the same length in the longitudinal direction LD. The pair of first holes 125aA and 125bA are separated from each other in the longitudinal direction LD.

[0080] The pair of first holes 125aA and 125bA respectively form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116A is rotated to a position in which the first rotation region R1 faces the cooling passage 121. In this position, an inner end 125cA of the first hole 125aA in the second longitudinal direction LD2 is the inner end position 124c of the first opening 124a and an inner end 125dA of the first hole 125bA in the first longitudinal direction LD1 is the inner end position 124d of the second opening 124b.

[0081] A pair of second holes 126aA and 126bA are formed in the third rotation region R3 of the duct 116A instead of the pair of second holes 126a and 126b of the above example. The pair of second holes 126aA and 126bA have the same length in the longitudinal direction LD, and respectively have the same lengths as those of the pair of first holes 125aA and 125bA in the longitudinal direction LD. The pair of second holes 126aA and 126bA are separated from each other in the longitudinal direction LD.

[0082] The pair of second holes 126aA and 126bA respectively form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116A is rotated to a position in which the third rotation region R3 faces the cooling passage 121. In this position, an inner end 126cA of the second hole 126aA in the second longitudinal direction LD2 is the inner end position 124c of the first opening 124a and an inner end 126dA of the second hole 126bA in the first longitudinal direction LD1 is the inner end position 124d of the second opening 124b.

[0083] A pair of third holes 127aA and 127bA are formed in the fifth rotation region R5 of the duct 116A instead of the pair of third holes 127a and 127b of the above example. The

pair of third holes 127aA and 127bA have the same length in the longitudinal direction LD. The pair of third holes 127aA and 127bA respectively have the same lengths as those of the pair of first holes 125aA and 125bA in the longitudinal direction LD. The pair of third holes 127aA and 127bA are separated from each other in the longitudinal direction LD.

[0084] The pair of third holes 127aA and 127bA respectively form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116A is rotated to a position in which the fifth rotation region R5 faces the cooling passage 121. In this position, an inner end 127cA of the third hole 127aA in the second longitudinal direction LD2 is the inner end position 124c of the first opening 124a and an inner end 127dA of the third hole 127bA in the first longitudinal direction LD1 is the inner end position 124d of the second opening 124b.

[0085] The inner end 125cA of the first hole 125aA, the inner end 126cA of the second hole 126aA, and the inner end 127cA of the third hole 127aA are located at different positions in the longitudinal direction LD. Similarly, the inner end 125dA of the first hole 125bA, the inner end 126dA of the second hole 126bA, and the inner end 127dA of the third hole 127bA are located at different positions in the longitudinal direction LD. Therefore, the end position 124d of the second opening 124b in the first longitudinal direction LD1 may be changed or varied as the rotation region of the duct 116A facing the cooling passage 121 is changed among the first rotation region R1, the third rotation region R3, and the fifth rotation region R5, for example by rotating the duct 116A.

[0086] Further, an outer end 125eA of the first hole 125aA in the first longitudinal direction LD1, an outer end 126eA of the second hole 126aA in the first longitudinal direction LD1, and an outer end 127eA of the third hole 127aA in the first longitudinal direction LD1 are located at different positions in the longitudinal direction LD. Similarly, an outer end 125fA of the first hole 125bA in the second longitudinal direction LD2, an outer end 126fA of the second hole 126bA in the second longitudinal direction LD2, and an outer end 127fA of the third hole 127bA in the second longitudinal direction LD2 are located at different positions in the longitudinal direction LD.

[0087] For example, with reference to FIGS. 3 and 10, the inner end 125cA of the first hole 125aA and the inner end 125dA of the first hole 125bA are located at the respective positions corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 with the sheet non-passing regions N2 when the first sheet M1 is conveyed through the fixing nip region N. Further, the inner end 126cA of the second hole 126aA and the inner end 126dA of the second hole 126bA are located at the respective positions corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 with the sheet non-passing regions N2 when the second sheet M2 is conveyed through the fixing nip region N. Further, the inner end 127cA of the third hole 127aA and the inner end 127dA of the third hole 127bA are located at the respective positions corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 with the sheet non-passing regions N2 when the third sheet M3 is conveyed through the fixing nip region N. The position correspondences described above may refer to a same position or to neighboring or adjacent positions in the longitudinal direction LD.

[0088] In this way, even in the duct 116A shown in FIG. 10, the inner end position 124c of the first opening 124a (cf. FIGS. 4 and 5) and the inner end position 124d of the second opening 124b (cf. FIGS. 4 and 6) in the longitudinal direction LD can be changed based on the rotation position of the duct 116A. Accordingly, it is possible to vary a portion to be cooled that corresponds to the sheet non-passing regions N2 of the heat source 114 according to the width of the sheet M to be conveyed through the sheet passing region N1.

[0089] Further, for example, the number of the holes formed in the duct can be changed as appropriate. The number of the holes formed to correspond to each opening 124a and 124b between the cooling passage121 and the supply passage 123 for each rotation region of the duct may be two or more. Further, the number of the holes formed in the duct may be one.

[0090] FIG. 11 is a schematic view illustrating rotation regions of another example duct 116B. The duct 116B shown in FIG. 11 has the first rotation region R1, the second rotation region R2, the third rotation region R3, the fourth rotation region R4, the fifth rotation region R5, and the sixth rotation region R6 arranged in the circumferential direction (or

rotation direction RD), similarly to those of the duct 116 of the above-described example (cf. FIG. 8).

[0091] With reference to FIGS. 4 to 6 and FIG. 11, in the first rotation region R1 of the duct 116B, a pair of first holes 125aB and 125bB are formed instead of the pair of first holes 125a and 125b, respectively, of the example illustrated in FIG. 9. The pair of first holes 125aB and 125bB have the same length in the longitudinal direction LD, and are further are separated from each other in the longitudinal direction LD.

[0092] The pair of first holes 125aB and 125bB respectively form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116B is rotated to a position in which the first rotation region R1 faces the cooling passage 121. In this position, an inner end 125cB of the first hole 125aB in the second longitudinal direction LD2 is the inner end position 124c of the first opening 124a and an inner end 125dB of the first hole 125bB in the first longitudinal direction LD1 is the inner end position 124d of the second opening 124b.

[0093] In the third rotation region R3 of the duct 116B, a first set of two second holes 126aB and 126bB are formed instead of the second hole 126a of the example of FIG. 9, and a second set of two second holes 126cB and 126dB are formed instead of the second hole 126b of the example of FIG. 9. The second holes 126aB, 126bB, 126cB, and 126dB have the same length in the longitudinal direction LD, each also having the same length as the first holes 125aB and 125bB in the longitudinal direction LD. The first set of two second holes 126aB and 126bB are separated from each other in the longitudinal direction LD and the second hole 126aB is offset in the second longitudinal direction LD2 relative the second hole 126bB. The second set of two second holes 126cB and 126dB are separated from each other in the longitudinal direction LD and the second hole 126cB is offset in the first longitudinal direction LD1 relative to the second hole 126dB. Further, the second hole 126aB and the second hole 126cB are separated from each other in the longitudinal direction LD.

[0094] The first set of two second holes 126aB and 126bB form the first opening 124a between the supply passage 123 and the cooling passage 121 when the duct 116B is rotated

to a position in which the third rotation region R3 faces the cooling passage 121. Further, the second set of two second holes 126cB and 126dB form the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116B is rotated to a position in which the third rotation region R3 faces the cooling passage 121. In this position, an inner end 126eB of the second hole 126aB in the second longitudinal direction LD2 is the inner end position 124c of the first opening 124a and an inner end 126fB of the second hole 126cB in the first longitudinal direction LD1 is the inner end position 124d of the second opening 124b.

[0095] In the fifth rotation region R5 of the duct 116B, a first set of three third holes 127aB, 127bB, and 127cB are formed instead of the third hole 127a of the example of FIG. 9, and a second set of three third holes 127dB, 127eB, and 127fB are formed instead of the third hole 127b of the example of FIG. 9. The third holes 127aB, 127bB, 127cB, 127dB, 127eB, and 127fB have the same length in the longitudinal direction LD, each also having the same length as the first holes 125aB and 125bB in the longitudinal direction LD.

[0096] The first set of three third holes 127aB, 127bB, and 127cB are separated from one another in the longitudinal direction LD. The third hole 127aB is offset in the second longitudinal direction LD2 relative to the third hole 127bB and the third hole 127cB is offset in the first longitudinal direction LD1 relative to the third hole 127bB. The second set of three third holes 127dB, 127eB, and 127fB are separated from one another in the longitudinal direction LD. The third hole 127dB is offset in the first longitudinal direction LD1 relative to the third hole 127eB, and the third hole 127fB is offset in the second longitudinal direction LD2 of the third hole 127eB. Further, the third hole 127aB and the third hole 127dB are separated from each other in the longitudinal direction LD.

[0097] The first set of third holes 127aB, 127bB, and 127cB form the first opening 124a between the supply passage 123 and the cooling passage 121 when the duct 116B is rotated to a position in which the fifth rotation region R5 faces the cooling passage 121. Further, the second set of third holes 127dB, 127eB, and 127fB form the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116B is rotated to a position in which the fifth rotation region R5 faces the cooling passage 121. In this position, an inner end 127gB of the third hole 127aB in the second longitudinal direction

LD2 is the inner end position 124c of the first opening 124a and an inner end 127hB of the third hole 127dB in the first longitudinal direction LD1 is the inner end position 124d of the second opening 124b.

[0098] The inner end 125cB of the first hole 125aB, the inner end 126eB of the second hole 126aB, and the inner end 127gB of the third hole 127aB are located at different positions in the longitudinal direction LD. Similarly, the inner end 125dB of the first hole 125bB, the inner end 126fB of the second hole 126cB, and the inner end 127hB of the third hole 127dB are located at different positions in the longitudinal direction LD. Therefore, the inner end position 124d of the second opening 124b in the first longitudinal direction LD1 may be changed or varied as the rotation region of the duct 116B facing the cooling passage 121 is changed among the first rotation region R1, the third rotation region R3, and the fifth rotation region R5, for example by rotating the duct 116B.

[0099] On the other hand, an outer end 125eB of the first hole 125aB in the first longitudinal direction LD1, an outer end 126gB of the second hole 126bB in the first longitudinal direction LD1, and an outer end 127iB of the third hole 127cB in the first longitudinal direction LD1 are located at the same position in the longitudinal direction LD. Similarly, an outer end 125fB of the first hole 125bB in the second longitudinal direction LD2, an outer end 126hB of the second hole 126dB in the second longitudinal direction LD2, and an outer end 127jB of the third hole 127fB in the second longitudinal direction LD2 are located at the same position in the longitudinal direction LD.

[0100] With reference to FIGS. 3 and 11, the inner end 125cB of the first hole 125aB and the inner end 125dB of the first hole 125bB are located at the respective positions corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 with the sheet non-passing regions N2 when the first sheet M1 is conveyed through the fixing nip region N. Further, the inner end 126eB of the second hole 126aB and the inner end 126fB of the second hole 126cB are located at the respective positions corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 with the sheet non-passing regions N2 when the second sheet M2 is conveyed through the fixing nip region N. Further, the inner end 127gB of the third hole 127aB and the inner end 127hB of the third hole 127dB are located at the respective positions

corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 with the sheet non-passing region N2 when the third sheet M3 is conveyed through the fixing nip region N. The position correspondences described above may refer to a same position or to neighboring or adjacent positions in the longitudinal direction LD.

[0101] In this way, even in the duct 116B shown in FIG. 11, it is possible to change the inner end position 124c of the first opening 124a (cf. FIGS. 4 and 5) and the inner end position 124d of the second opening 124b (cf. FIGS. 4 and 6) in the longitudinal direction LD based on the rotation position of the duct 116B. Accordingly, it is possible to vary a portion to be cooled that corresponds to the sheet non-passing regions N2 of the heat source 114 according to the width of the sheet M to be conveyed through the sheet passing region N1.

[0102] FIG. 12 is a schematic developed view in which another example duct 116C is developed in the rotation direction RD. The duct 116C shown in FIG. 12 has a seventh rotation region R7, an eighth rotation region R8, a ninth rotation region R9, and a tenth rotation region R10 which are offset from each other in the rotation direction (or circumferential direction) RD of the duct 116C. The seventh rotation region R7, the eighth rotation region R8, the ninth rotation region R9, and the tenth rotation region R10 are regions extending in the longitudinal direction LD and do not overlap each other in the rotation direction RD of the duct 116C. The seventh rotation region R7, the eighth rotation region R8, the ninth rotation region R9, and the tenth rotation region R10 are adjacent to each other in this order in the rotation direction RD.

[0103] The duct 116C is provided with a hole 125aC and a hole 125bC which are formed across the seventh rotation region R7, the eighth rotation region R8, and the ninth rotation region R9. The hole 125aC and the hole 125bC are holes which open the supply passage 123 to the outside of the duct 116C in the seventh rotation region R7, the eighth rotation region R8, and the ninth rotation region R9. The hole 125aC and the hole 125bC are separated from each other in the longitudinal direction LD. The hole 125aC is located at a first end portion of the duct 116C in the first longitudinal direction LD1 and extends in the longitudinal direction LD. The hole 125bC is located at a second end portion of the duct 116C in the second longitudinal direction LD2 and extends in the longitudinal direction LD.

[0104] A portion of the hole 125aC located at the seventh rotation region R7 is referred to as a hole portion 125cC, a portion of the hole 125aC located at the eighth rotation region R8 is referred to as the hole portion 125dC, and a portion of the hole 125aC located at the ninth rotation region R9 is referred to as a hole portion 125eC. Further, a portion of the hole 125bC located at the seventh rotation region R7 is referred to as a hole portion 125fC, a portion of the hole 125bC located at the eighth rotation region R8 is referred to as a hole portion 125gC, and a portion of the hole 125bC located at the ninth rotation region R9 is referred to as a hole portion 125hC.

[0105] With reference to FIGS. 4 to 6 and FIG. 12, the hole portion 125cC and the hole portion 125fC of the seventh rotation region R7 respectively form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116C is rotated to a position in which the seventh rotation region R7 faces the cooling passage 121. In this position, an inner end 125iC of the hole portion 125cC of the seventh rotation region R7 in the second longitudinal direction LD2 is the inner end position 124c of the first opening 124a and an inner end 125jC of the hole portion 125fC of the seventh rotation region R7 in the first longitudinal direction LD1 is the inner end position 124d of the second opening 124b.

[0106] The hole portion 125dC and the hole portion 125gC of the eighth rotation region R8 respectively form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct 116C is rotated to a position in which the eighth rotation region R8 faces the cooling passage 121. In this position, an inner end 125kC of the hole portion 125dC of the eighth rotation region R8 in the second longitudinal direction LD2 is the inner end position 124c of the first opening 124a and an inner end 125mC of the hole portion 125gC of the eighth rotation region R8 in the first longitudinal direction LD1 is the inner end position 124d of the second opening 124b.

[0107] The hole portion 125eC and the hole portion 125hC of the ninth rotation region R9 respectively form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 when the duct is rotated to a position in which the ninth rotation region R9 faces the cooling passage 121. In this position, an inner end 125nC of the hole portion 125eC of the ninth rotation region R9 in the second

longitudinal direction LD2 is the inner end position 124c of the first opening 124a and an inner end 125oC of the hole portion 125hC of the ninth rotation region R9 in the first longitudinal direction LD1 is the inner end position 124d of the second opening 124b.

[0108] The hole portion 125cC of the seventh rotation region R7 is shorter than the hole portion 125dC of the eighth rotation region R8 in the longitudinal direction LD and the hole portion 125dC of the eighth rotation region R8 is shorter than the hole portion 125eC of the ninth rotation region R9 in the longitudinal direction LD. Further, the inner end 125iC of the hole portion 125cC of the seventh rotation region R7, the inner end 125kC of the hole portion 125dC of the eighth rotation region R8, and the inner end 125nC of the hole portion 125eC of the ninth rotation region R9 are located at different positions in the longitudinal direction LD. Similarly, the inner end 125jC of the hole portion 125fC of the seventh rotation region R7, the inner end 125mC of the hole portion 125gC of the eighth rotation region R8, and the inner end 125oC of the hole portion 125hC of the ninth rotation region R9 are located at different positions in the longitudinal direction LD. Therefore, the inner end position 124d of the second opening 124b in the first longitudinal direction LD1 may be changed or varied as the rotation region of the duct 116C facing the cooling passage 121 is changed among the seventh rotation region R7, the eighth rotation region R8, and the ninth rotation region R9, for example by rotating the duct 116C.

[0109] The tenth rotation region R10 of the duct 116C is a wall region not provided with any hole opening the supply passage 123 to the outside of the duct 116C. When the tenth rotation region R10 faces the cooling passage 121, the duct 116C does not form the first opening 124a and the second opening 124b between the supply passage 123 and the cooling passage 121 so as to separate the supply passage 123 from the cooling passage 121.

[0110] With reference to FIGS. 3 and 12, the inner end 125iC of the hole portion 125cC and the inner end 125jC of the hole portion 125fC of the seventh rotation region R7 are located at the respective positions corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 with the sheet non-passing regions N2 when the first sheet M1 is conveyed through the fixing nip region N. Further, the inner end 125kC of the hole portion 125dC and the inner end 125mC of the hole portion 125gC of the eighth rotation region R8 are located at the respective positions corresponding to the boundary B1

and the boundary B2, respectively, of the sheet passing region N1 and the sheet non-passing regions N2 when the second sheet M2 is conveyed through the fixing nip region N. Further, the inner end 125nC of the hole portion 125eC and the inner end 125oC of the hole portion 125hC of the ninth rotation region R9 are located at the respective positions corresponding to the boundary B1 and the boundary B2, respectively, of the sheet passing region N1 and the sheet non-passing regions N2 when the third sheet M3 is conveyed through the fixing nip region N. The position correspondences described above may refer to a same position or to neighboring or adjacent positions in the longitudinal direction LD.

[0111] In this way, even in the duct 116C shown in FIG. 12, it is possible to change the inner end position 124c of the first opening 124a (cf. FIGS. 4 and 5) and the inner end position 124d of the second opening 124b (cf. FIGS. 4 and 6) in the longitudinal direction LD based on the rotation position of the duct 116C. Accordingly, it is possible to vary a portion to be cooled that corresponds to the sheet non-passing region N2 of the heat source 114 according to the width of the sheet M to be conveyed through the sheet passing region N1.

[0112] In other examples, the duct may not be provided and the end position of the opening formed between the cooling passage and the supply passage may not be changeable. FIG. 13 is a schematic cross-sectional view similar to the view of FIG. 4, illustrating another example heat source unit (or heat source device) 112D. The heat source unit 112D shown in FIG. 13 includes the heat source 114 and a casing 115D and does not include the example duct 116 of FIG. 4. Then, the duct hole 122 of the casing 115D forms a supply passage 123D and the fan 113a and the fan 113b are connected to both end portions of the duct hole 122 in the longitudinal direction LD. Further, a first opening 124aD and a second opening 124bD are formed between the cooling passage 121 and the supply passage 123D by the casing 115D and the air flow is supplied from the supply passage 123D to the cooling passage 121 through the first opening 124aD and the second opening 124bD.

[0113] In this way, even in the heat source unit 112D shown in FIG. 13, when the supply passage 123D generates the air flow, this air flow is supplied to the cooling passage 121 through the first opening 124aD and the second opening 124bD and is guided to the

heat source 114 through the cooling passage 121. Accordingly, since the heat source 114 can be directly cooled, the heat source 114 can be efficiently cooled.

[0114] Further, a shutter capable of adjusting the opening degrees of the first opening 124aD and the second opening 124bD is provided in the heat source unit 112D shown in FIG. 13, to change the inner end positions of the first opening 124aD and the second opening 124bD in the longitudinal direction LD. Accordingly, it is possible to vary a portion to be cooled that corresponds to the sheet non-passing region N2 of the heat source 114 according to the width of the sheet M to be conveyed through the sheet passing region N1.

[0115] Further, in some examples, the sheet passing region N1 through which the sheet M is conveyed in the fixing nip region N may be off-center (e.g., not in the center portion) in the longitudinal direction LD and may for example extend from an end portion in the longitudinal direction LD. In this case, there may be a single boundary between the sheet passing region N1 and the sheet non-passing region N2, for any given sheet width. In addition, there may be a single opening between the supply passage and the cooling passage. Depending on examples, there may be one or more boundary of the sheet passing region N1 with the sheet non-passing region N2, one or more opening between the supply passage and the cooling passage, and the like.

[0116] It is to be understood that not all aspects, advantages, and features described herein may necessarily be achieved by, or included in any one particular example. Indeed, having described and illustrated various examples herein, it should be apparent that other examples can be modified in arrangement and detail may be omitted. All suitable correction and modification included in the spirit and scope of the claimed subject matter are claimed.

WHAT IS CLAIMED IS:

1. A fixing device comprising:

a pressing device extending in a longitudinal direction; and

a heating device extending adjacent to the pressing device, wherein the heating device includes:

a rotatable heating body;

a heat source disposed inside the heating body;

a cooling passage disposed inside the heating body to guide an air flow to the heat source; and

a supply passage disposed inside the heating body to feed the air flow to the cooling passage through an opening formed between the supply passage and the cooling passage.

2. The fixing device according to claim 1,

wherein the heating device includes a casing which extends in the longitudinal direction to accommodate the heat source and a duct which forms the supply passage,

wherein the cooling passage extends between the duct and the heat source inside the casing, and

wherein the opening is formed in the duct to supply the air flow from the duct to the cooling passage.

3. The fixing device according to claim 2,

wherein the duct is rotatable to vary in the longitudinal direction, an end position of the opening to be formed between the duct and the cooling passage, based on a rotation position of the duct.

4. The fixing device according to claim 2,

wherein the duct includes a first hole and a second hole that is offset from the first hole in a rotation direction of the duct to selectively set the first hole or the second hole as the opening between the supply passage and the cooling passage via a rotation of the duct, and

wherein an end of the first hole is offset with respect to an end of the second hole in the longitudinal direction to vary an end position of the opening based on a rotation position

of the duct.

5. The fixing device according to claim 4,

wherein the second hole is longer than the first hole in the longitudinal direction.

6. The fixing device according to claim 4,

wherein a center position of the second hole is offset with respect to a center position of the first hole in the longitudinal direction.

7. The fixing device according to claim 4,

wherein the duct has a wall region between the first hole and the second hole in the rotation direction of the duct so as to separate the supply passage formed inside the duct from the cooling passage when the wall region of the duct is positioned to face the cooling passage.

8. The fixing device according to claim 1,

wherein the cooling passage has an outlet located at a longitudinal end of the cooling passage to draw the air flow to flow from the opening to the outlet of the cooling passage.

9. The fixing device according to claim 8, comprising:

a guide portion extending adjacent the opening to guide the air flow from the opening to the outlet.

10. The fixing device according to claim 1, comprising:

a fan which generates the air flow inside the supply passage.

11. The fixing device according to claim 1, comprising:

a pair of fans disposed at opposite ends of the heating device to generate a first air flow and a second air flow respectively, inside the supply passage,

wherein the opening is a first opening formed between the supply passage and the cooling passage to guide the first air flow to the cooling passage,

wherein a second opening is formed between the supply passage and the cooling passage to guide the second air flow into the cooling passage, and

wherein opposite ends of the cooling passage form respective outlets to direct the first air flow and the second air flow, respectively, out from the cooling passage.

12. The fixing device according to claim 1,

wherein the heating device is to contact the pressing device along an end portion when a print medium is conveyed between the heating device and the pressing device, and

wherein the opening is positioned in the longitudinal direction to direct the air flow along a longitudinal portion of the cooling passage that substantially corresponds to the end portion of the heating device.

13. An image forming apparatus comprising:

a fixing device including a heating device and a pressing device to fix a toner image to a print medium, wherein the heating device includes:

a rotatable heating body extending in a longitudinal direction of the heating device;

a heat source disposed inside the heating body;

a cooling passage extending in the longitudinal direction inside the heating body to guide an air flow to the heat source;

a supply passage extending in the longitudinal direction inside the heating body to feed the air flow to the cooling passage through an opening; and

a controller to vary an end position of the opening in the longitudinal direction based on a width of the print medium in the longitudinal direction.

14. The image forming apparatus according to claim 13, comprising:

a duct which extends in the longitudinal direction of the heating device to form the supply passage,

wherein the duct includes a first hole and a second hole that is offset in a rotation direction of the duct with respect to the first hole to position the first hole or the second hole as the opening between the supply passage and the cooling passage via a rotation of the duct, and

wherein an end of the first hole is offset with respect to an end of the second hole in the longitudinal direction in order to set the end position of the opening via a selective positioning of the first hole or the second hole as the opening.

15. The image forming apparatus according to claim 14, comprising:

a pair of fans disposed at opposite ends of the duct to generate a first air flow and a second air flow respectively,

wherein the opening is included in a pair of openings located at respective end portions

of the duct to guide the first air flow and the second air flow respectively, to the cooling passage, and

wherein opposite ends of the cooling passage form respective outlets to direct the first air flow and the second air flow, respectively, out from the cooling passage.

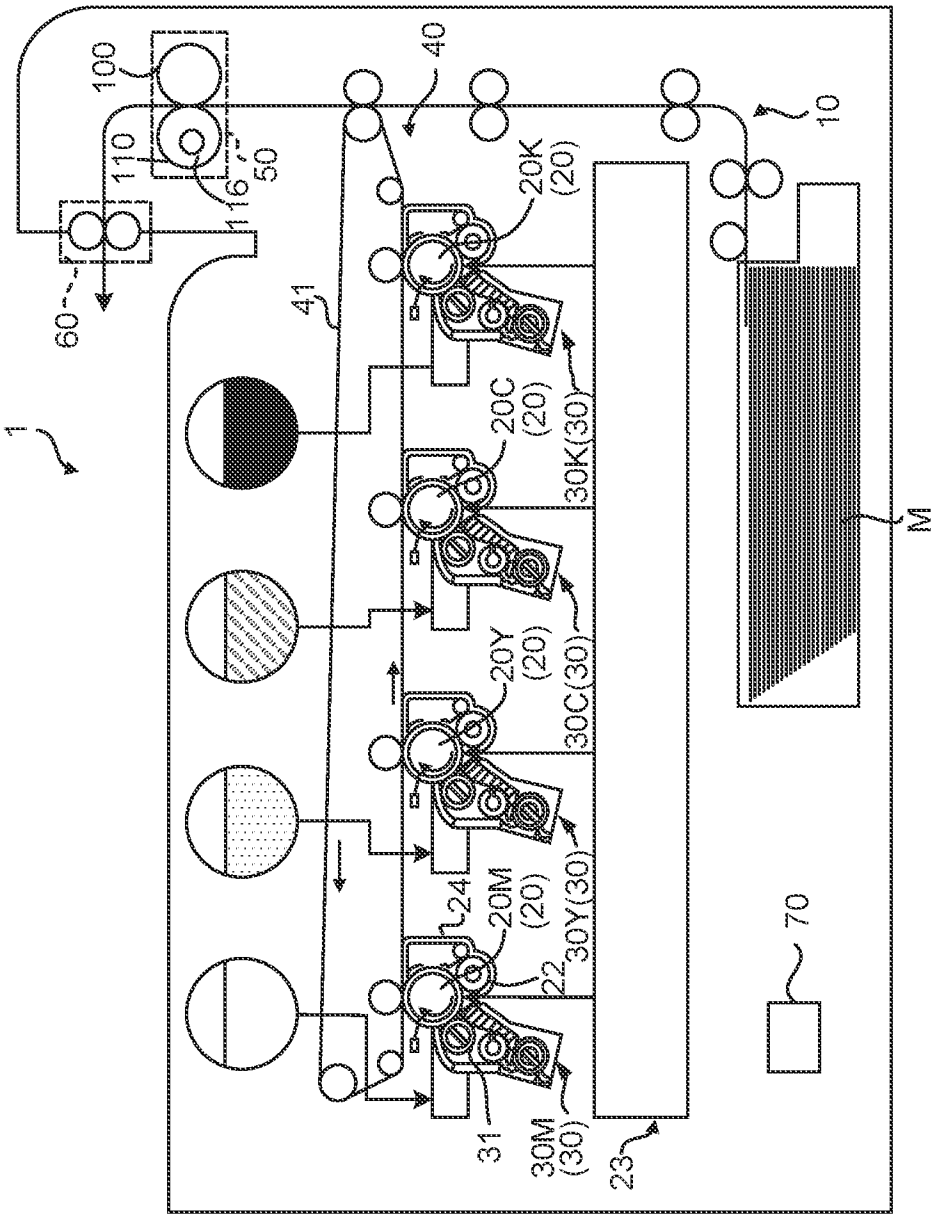

100
40
10
110
50
116
20K
(20)
60
41
1
20C
(20)
30K(30)
M
20Y
(20)
30C(30)
24
20M
(20)
30Y(30)
70
22
31
30M
(30)
23

FIG. 1

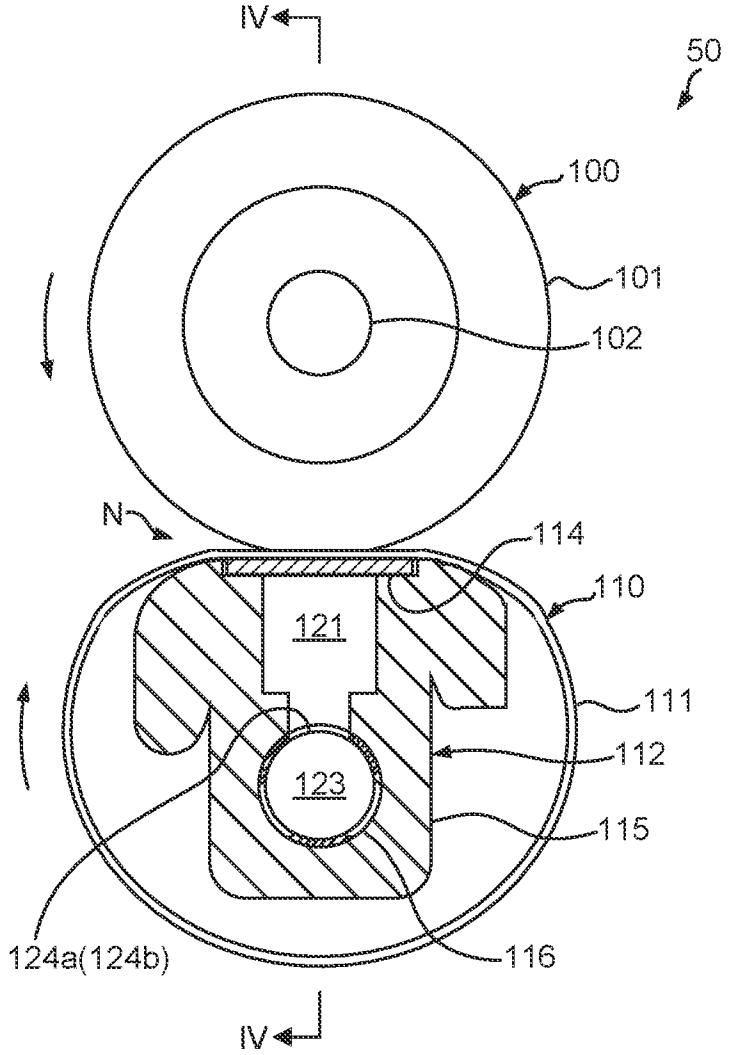


FIG. 2

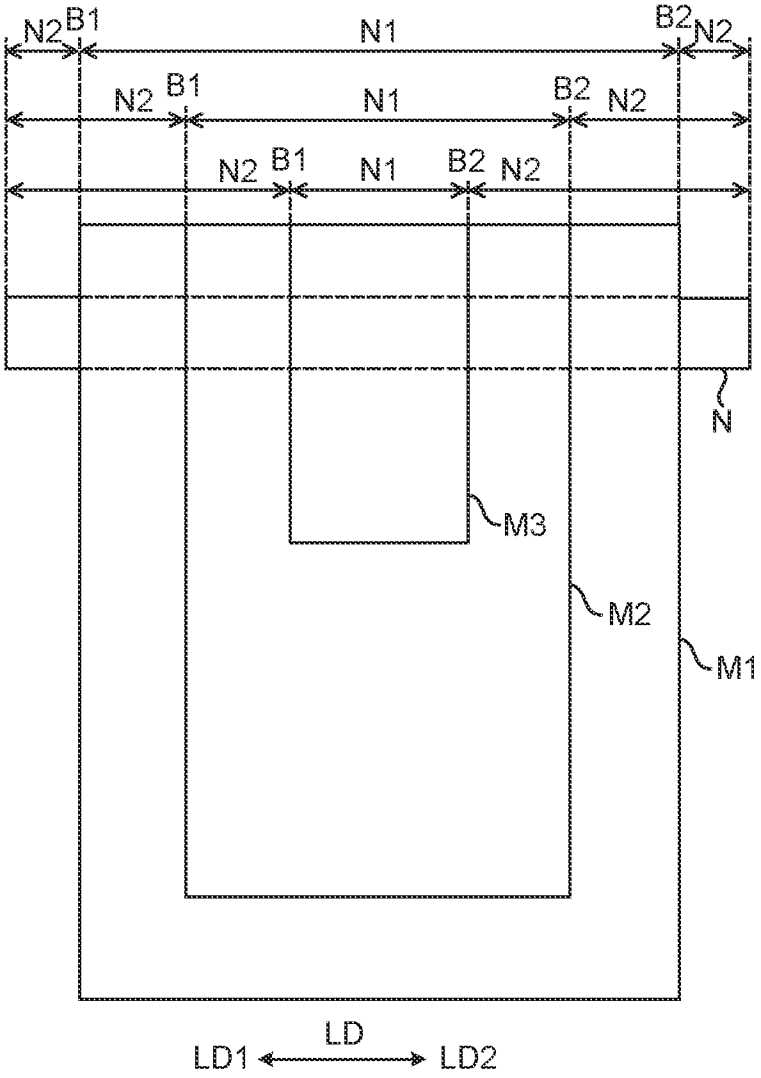


FIG. 3

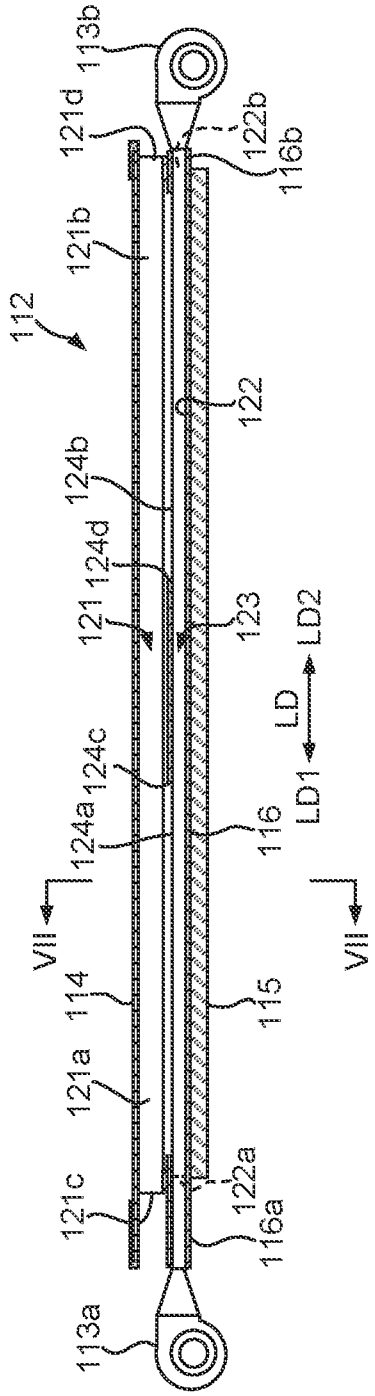

113b
121d
122b
116b
121b
112
122
124b
124d
121
123
LD2
LD
LD1
124c
124a
116
VII
VII
114
115
121a
121c
122a
116a
113a

FIG. 4

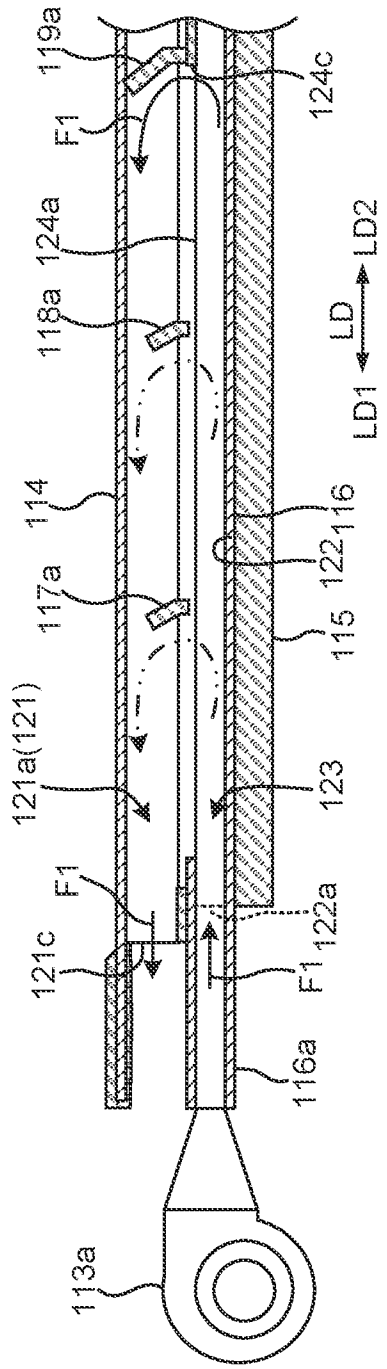

119a
F1
124c
124a
118a
LD
LD2
LD1
114
116
122
117a
115
121a(121)
123
F1
122a
121c
F1
116a
113a

FIG. 5

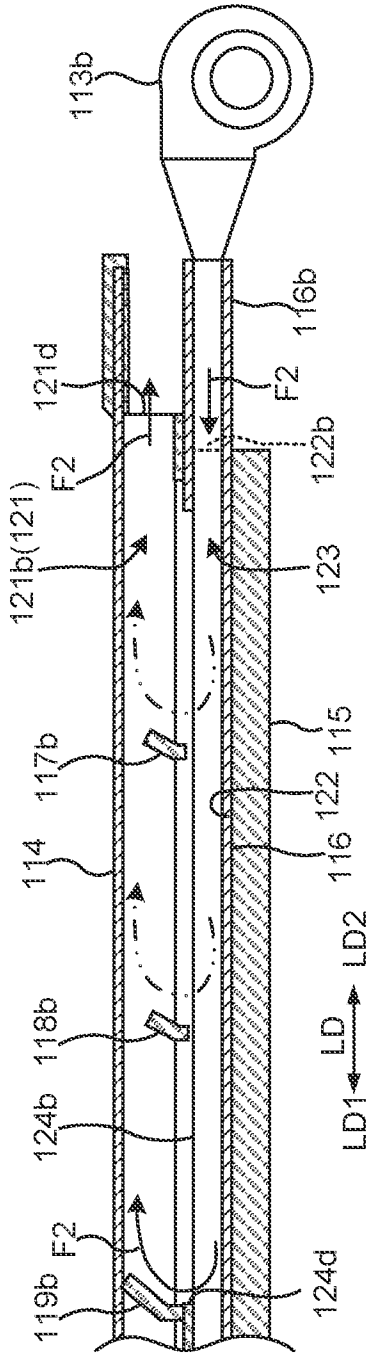

113b
116b
121d
F2
122b
F2
121b(121)
123
115
117b
122
114
116
LD2
LD
118b
LD1
124b
F2
119b
124d

FIG. 6

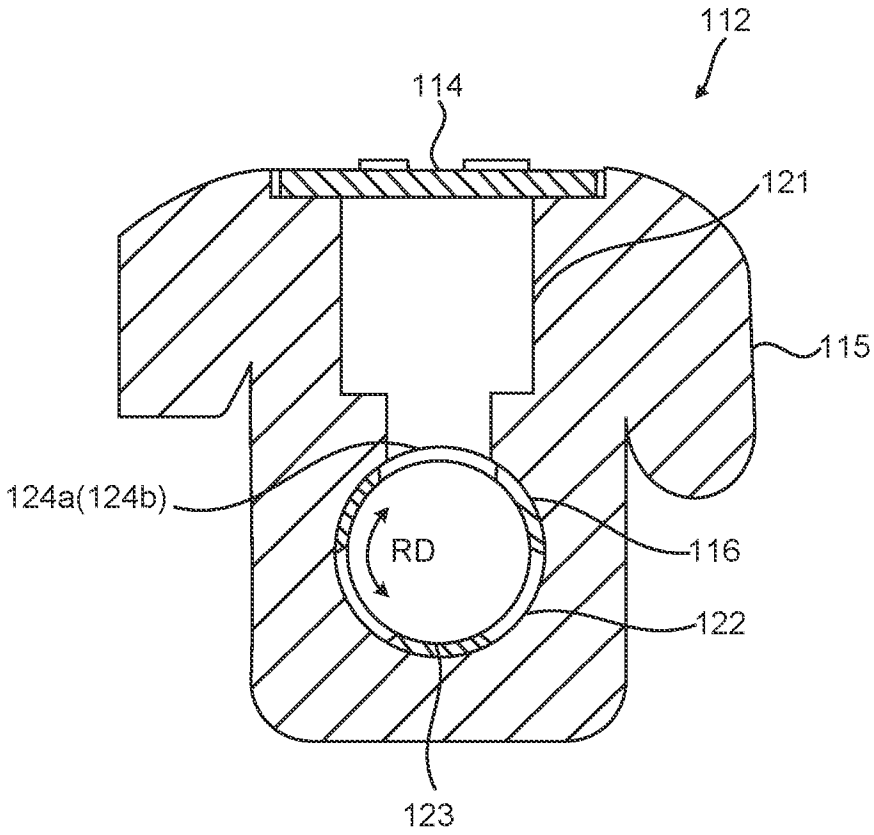


FIG. 7

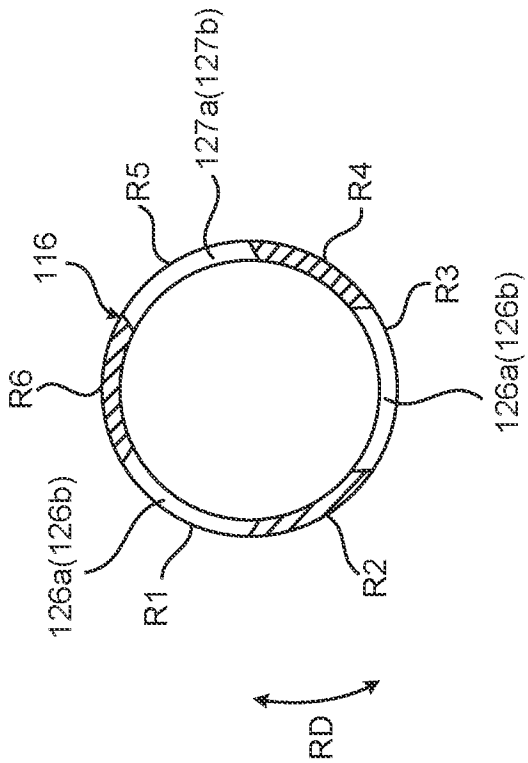


FIG. 8

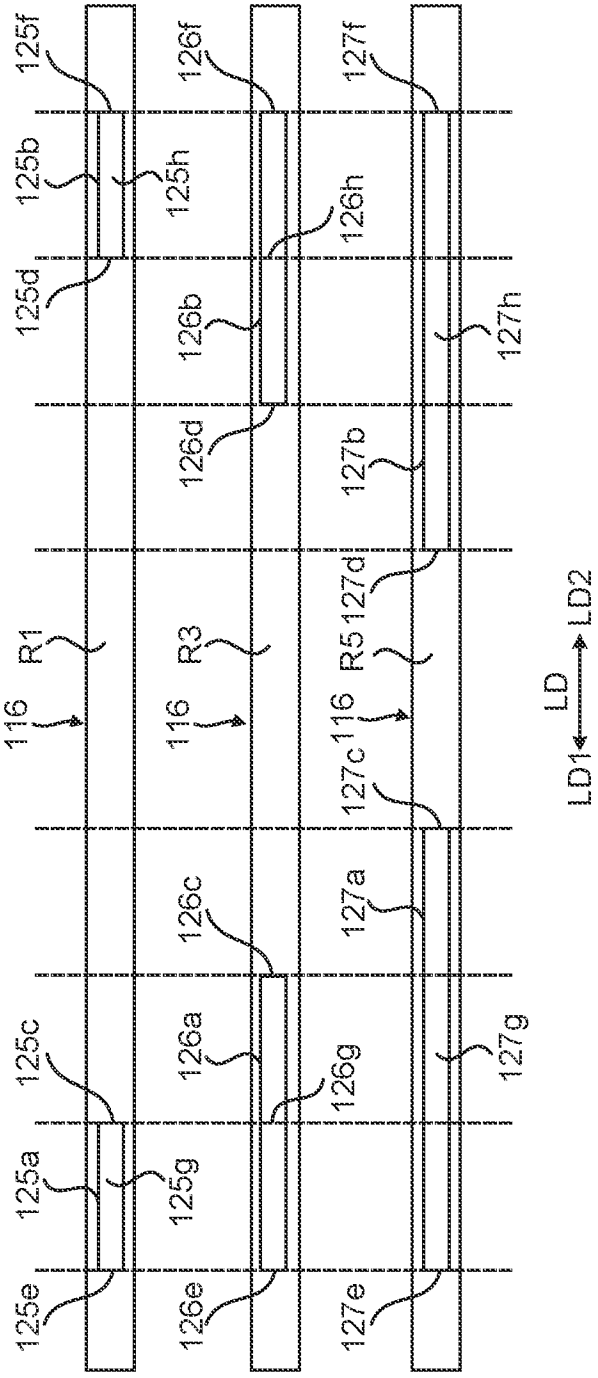

125f
126f
127f
125b
125h
126h
125d
126b
127h
126d
127b
R1
R3
R5
127d
116
116
116
127c
LD
LD1
LD2
126c
127a
125c
126a
126g
127g
125a
125g
125e
126e
127e

FIG. 9

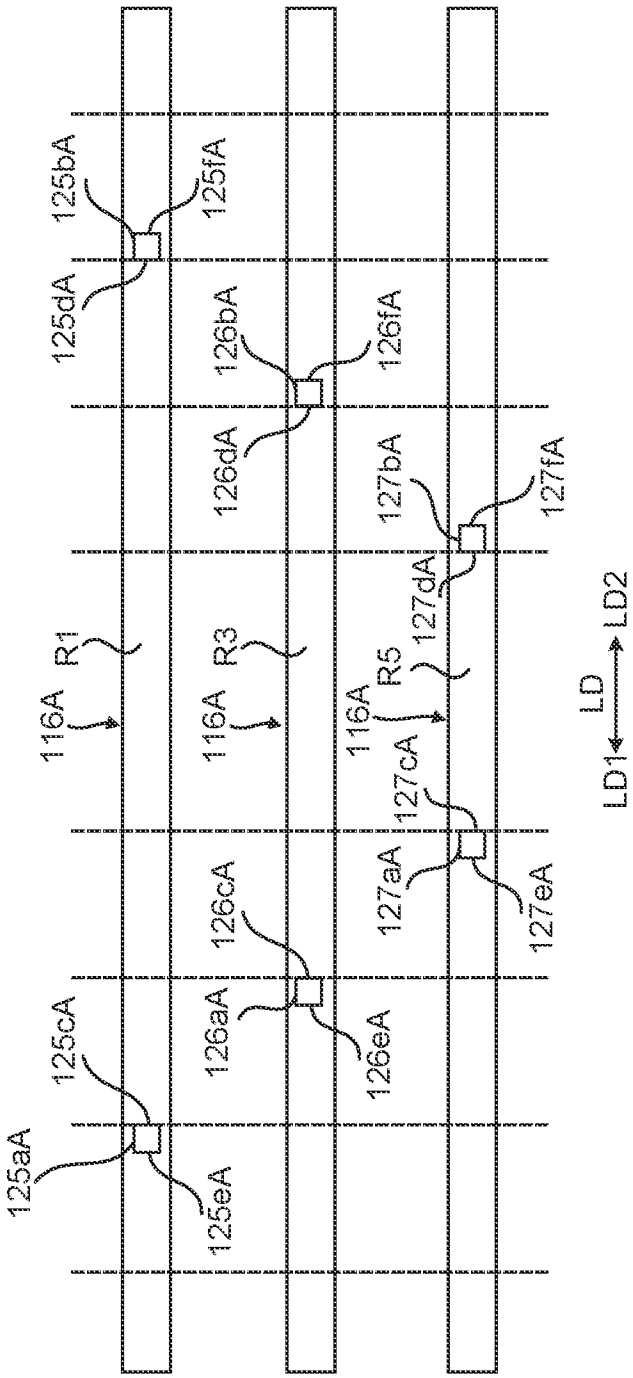

125bA
125fA
125dA
126bA
126fA
126dA
127bA
127fA
127dA
R1
R3
R5
116A
116A
116A
127cA
LD
LD1
LD2
125aA
125cA
125eA
126cA
126aA
126eA
127aA
127eA

FIG. 10

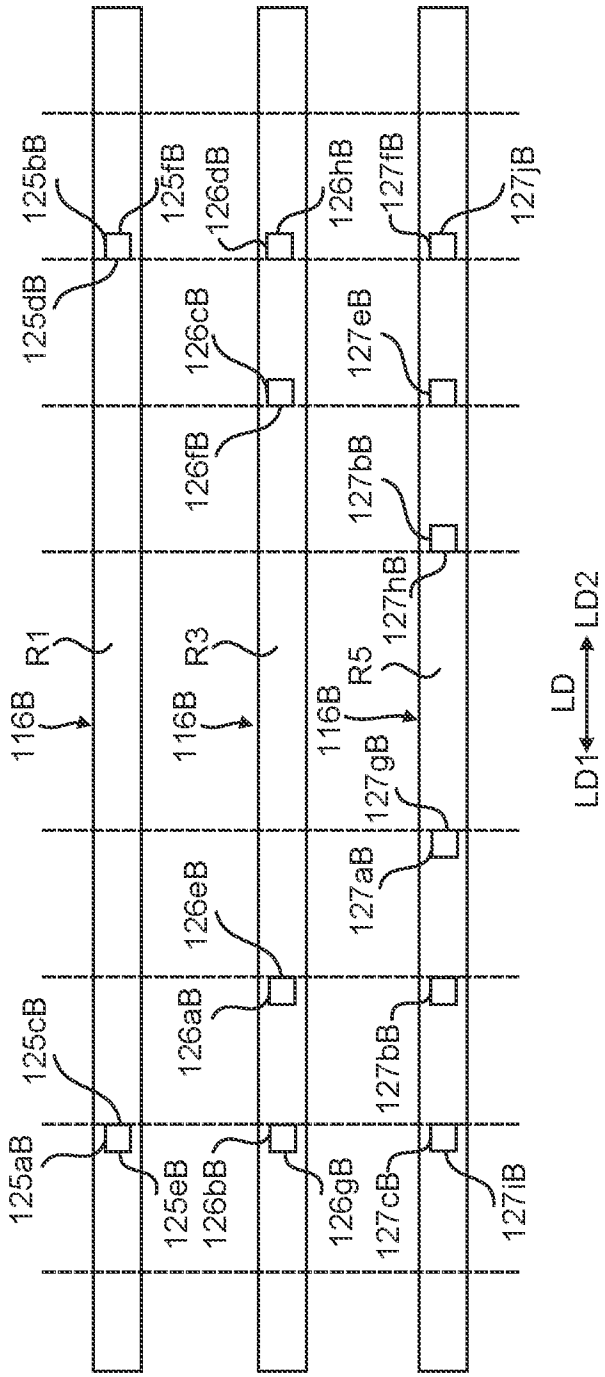

125bB
125fB
126dB
126hB
127fB
127jB
125dB
126cB
127eB
126fB
127bB
127hB
R1
R3
R5
116B
116B
116B
127gB
LD
LD1
LD2
127aB
126eB
125cB
126aB
127bB
125aB
125eB
126bB
126gB
127cB
127iB

FIG. 11

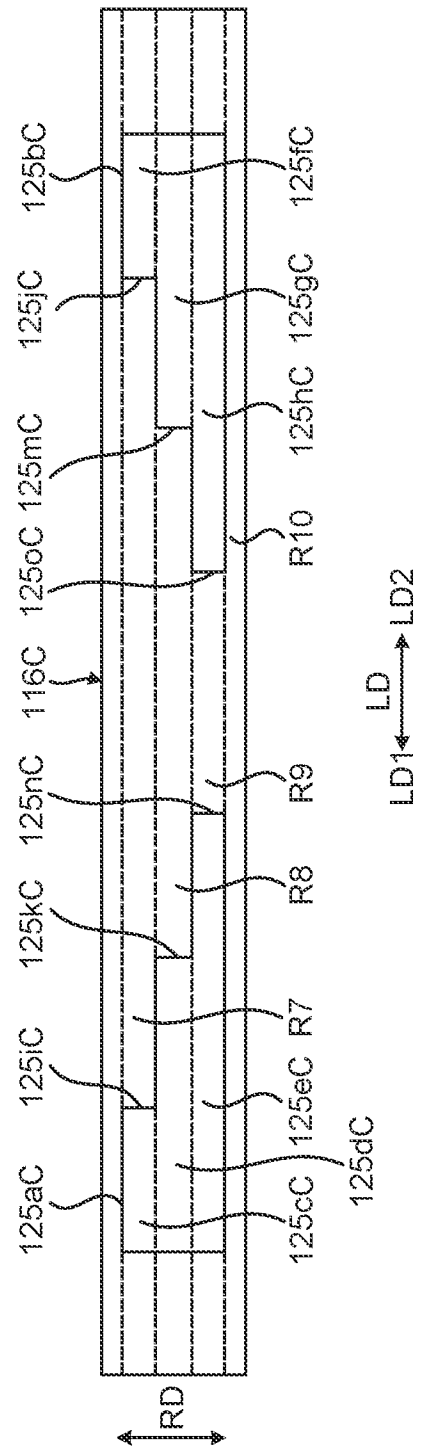

125bC
125fC
125jC
125gC
125mC
125hC
125oC
R10
116C
LD
LD1
LD2
125nC
R9
125kC
R8
125iC
R7
125eC
125dC
125aC
125cC
RD

FIG. 12

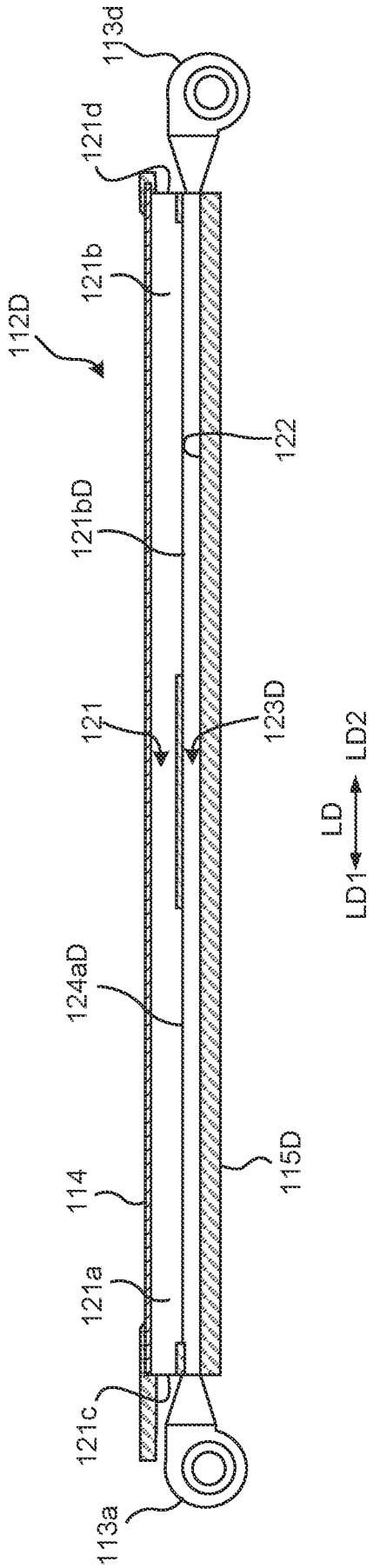

113d
121d
121b
112D
122
121bD
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123D
LD
LD1
LD2
124aD
114
115D
121a
121c
113a

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2023/015480

A. CLASSIFICATION OF SUBJECT MATTER
INV. G03G15/20 G03G21/20
ADD.

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)
G03G

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2021/364986 A1 (OKAMOTO JUN [JP]) 25 November 2021 (2021-11-25)	1,2, 8-10,12, 13
Y	the whole document	1-15

X	WO 2020/096649 A1 (HEWLETT PACKARD DEVELOPMENT CO [US]) 14 May 2020 (2020-05-14)	1,2,10, 12
A	1-65, Fig. 1-15	3-9,11, 13-15

Y	US 2011/305492 A1 (TAMAKI KENJI [JP] ET AL) 15 December 2011 (2011-12-15) 3-120, Fig. 1-11	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 June 2023	29/06/2023

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Scarpa, Giuseppe

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2023/015480

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		WO 2020096649 A1	14-05-2020
US 2011305492 A1	15-12-2011	JP 2012002909 A	05-01-2012
		US 2011305492 A1	15-12-2011