

(19)



(11)

EP 3 251 858 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.12.2017 Bulletin 2017/49

(51) Int Cl.:
B41J 2/21 ^(2006.01) **B41J 25/34** ^(2006.01)

(21) Application number: **17173100.3**

(22) Date of filing: **26.05.2017**

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

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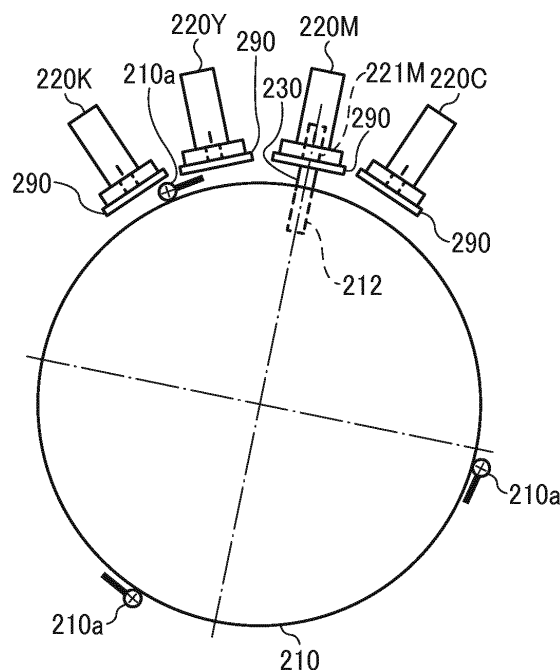
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(30) Priority: **31.05.2016 JP 2016108248**
27.03.2017 JP 2017061105

(54) **LIQUID DISCHARGE APPARATUS, METHOD OF MOUNTING LIQUID DISCHARGE HEADS, AND METHOD OF PRODUCING LIQUID DISCHARGE APPARATUS**

(57) A liquid discharge apparatus (1) includes a conveyor (210) to convey a medium; and a plurality of liquid discharge heads (220) arrayed in a conveyance direction of the medium. Each of the plurality of liquid discharge heads (220) includes head-side positioning portions (221) and the conveyor (210) includes conveyor-side positioning portions (212). The head-side positioning portions (221) and the conveyor-side positioning portions

(212) are positioning portions to define a positional relation between the conveyor (210) and each of the plurality of liquid discharge heads (220). The conveyor-side positioning portions (212) correspond to the head-side positioning portions (221) of each of the plurality of liquid discharge heads (220) by movement of the conveyor (210) in the conveyance direction.

FIG. 5

Description

BACKGROUND

Technical Field

[0001] Exemplary embodiments of the present disclosure relate to a liquid discharge apparatus, a method for mounting a plurality of liquid discharge heads, and a method for producing the liquid discharge apparatus.

Background Art

[0002] There is a liquid discharge apparatus that includes a conveyor to convey a medium and a plurality of liquid discharge heads arrayed in a conveyance direction of the medium.

[0003] For example, JP2010-173305A discloses an inkjet recording apparatus that includes a rotary drum and four line heads disposed opposite an outer peripheral surface of the rotary drum, in which ink is discharged from the four line heads onto a sheet medium wound on the outer peripheral surface of the rotary drum, to thereby form an image.

[0004] In this inkjet recording apparatus, each line head includes both ends fixed on a pair of pedestals, and the pair of pedestals is fixed to side plates of a body of the inkjet recording apparatus. When each line head is positioned in a normal direction relative to the drum surface and a peripheral direction of the drum, the positioning of each line head (relative to the drum) is performed by positioning the pair of pedestals relative to the side plates of the body of the inkjet recording apparatus.

[0005] The pair of pedestals is positioned by mounting a dummy head on the pair of pedestals, and a pair of positioning pins disposed at both ends of the dummy head is fitted in a pair of positioning holes formed at both ends of the outer peripheral surface of the drum.

[0006] More specifically, the pair of positioning pins each is formed of a stepped pin and has a small diameter portion and a large diameter portion. When the pair of pedestals approaches to the surface of the drum, the small diameter portion is engaged to the positioning hole on the drum until an edge of the large diameter portion contacts the outer peripheral surface of the drum. Then, the pair of pedestals is secured to the side plates of the body of the apparatus, and the dummy head is replaced with the line head relative to the pair of pedestals.

[0007] However, the method disclosed in JP2010-173305A is configured such that the positioning hole as a positioning reference portion disposed on the drum that serves as the conveyor is disposed individually to each line head or liquid discharge head.

[0008] As a result, the pair of pedestals supporting each line head is positioned by the positioning holes different from each other on the drum. Accordingly, because a positional relation between line heads depends on the positional accuracy of each positioning hole formed on

the drum, the relative positional accuracy between the line heads worsens if the positional accuracy of the positioning holes is low.

[0009] Accordingly, to improve the relative positional accuracy between the line heads according to the method disclosed in JP2010-173305A, it is necessary to improve the positional accuracy of each of the eight positional holes, and it is difficult to improve the relative positional accuracy between the line heads.

SUMMARY

[0010] In one embodiment of the disclosure, provided is an optimal liquid discharge apparatus including a conveyor to convey a medium; and a plurality of liquid discharge heads arrayed in a conveyance direction of the medium. Each of the plurality of liquid discharge heads includes head-side positioning portions and the conveyor includes conveyor-side positioning portions. The head-side positioning portions and the conveyor-side positioning portions are positioning portions to define a positional relation between the conveyor and each of the plurality of liquid discharge heads. The conveyor-side positioning portions correspond to the head-side positioning portions of each of the plurality of liquid discharge heads by movement of the conveyor in the conveyance direction.

[0011] In another embodiment of the disclosure, provided is an optimal method of mounting a plurality of liquid discharge heads to discharge liquid to a medium. The method includes a moving step to move a conveyor-side positioning portion disposed on a conveyor that conveys the medium, to a position corresponding to a head-side positioning portion on one of the plurality of liquid discharge heads; a securing step to position the conveyor and the one of the plurality of liquid discharge heads with a rod-shaped member or a laser beam to secure the one of the plurality of liquid discharge heads to a body of a liquid discharge apparatus; and a repeating step to perform the moving step and the securing step on each of the plurality of liquid discharge heads.

[0012] According to aspects of the present disclosure, an excellent effect is obtained in which the relative positional accuracy between the liquid discharge heads can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 schematically illustrates an inkjet recording apparatus according to an embodiment of the present disclosure;

FIG. 2 schematically illustrates an image forming section of the inkjet recording apparatus of FIG. 1;

FIG. 3 illustrates exemplary shapes of a pair of head-side positioning reference holes disposed to each liquid discharge head and a pair of drum-side positioning reference holes disposed on the sheet conveying drum according to a first embodiment;
 FIG. 4 illustrates a positioning process of a first liquid discharge head;
 FIG. 5 illustrates a positioning process of a second liquid discharge head;
 FIG. 6 is a plan view of a main part of the liquid discharge head viewed from above;
 FIG. 7 illustrates exemplary shapes of a pair of head-side positioning reference holes disposed to each liquid discharge head and a pair of drum-side positioning reference holes disposed on the sheet conveying drum according to a second embodiment;
 FIG. 8 illustrates other exemplary shapes of a pair of head-side positioning reference holes disposed to each liquid discharge head and a pair of drum-side positioning reference holes disposed on the sheet conveying drum according to the second embodiment; and
 FIG. 9 illustrates further other exemplary shapes of a pair of positioning reference holes of the head side disposed to each liquid discharge head and a pair of positioning reference holes of the drum side disposed on the sheet conveying drum according to the second embodiment.

DETAILED DESCRIPTION

[0014] Hereinafter, an embodiment of the present disclosure will be described with reference to accompanying drawings.

General Outline

[0015] FIG. 1 schematically illustrates a general structure of an inkjet recording apparatus 1 according to an embodiment of the present disclosure. The inkjet recording apparatus 1 according to the present embodiment includes, for example, a sheet supplier 100, an image forming section 200, a dryer 300, and a sheet ejector 400.

[0016] In the inkjet recording apparatus 1, the image forming section 200 forms an image with ink as a liquid for image formation, on a sheet P as a recording medium supplied and fed from the sheet supplier 100. The dryer 300 dries the ink adhered onto the sheet P, and the sheet ejector 400 ejects the sheet P.

Sheet Feeder

[0017] The sheet supplier 100 includes, for example, a sheet tray 110 on which a plurality of sheets P is stacked; a sheet feeder 120 to separate and feed each sheet from the sheet tray 110, and a pair of registration rollers 130 to send the sheet P into the image forming section 200.

[0018] The sheet feeder 120 may employ a device using rollers and rotary members, and a device using an air-suctioning unit, or any other suitable type of sheet feeder. The sheet P is sent out from the sheet tray 110 via the sheet feeder 120. When the leading end of the sheet P reaches the pair of registration roller 130, the pair of registration roller 130 starts to be driven at a pre-determined timing, so that the sheet P is supplied to the image forming section 200.

[0019] In the present embodiment, the structure of the sheet supplier 100 is not limited to a particular structure, and may be any structure as long as the sheet supplier 100 can send the sheet P to the image forming section 200.

Image Forming Section

[0020] The image forming section 200 includes, for example, a receiving body 201 to receive the sheet P or medium supplied; a cylindrical sheet conveying drum 210 as a conveyor, to carry the sheet P fed by the receiving body 201, on an outer peripheral surface of the sheet conveying drum 210; an ink discharge device 220 to discharge ink onto the sheet P conveyed by the sheet conveying drum 210; a transfer body 202 to transfer the sheet P conveyed by the sheet conveying drum 210 to the dryer 300.

[0021] The leading end of the sheet P fed from the sheet supplier 100 to the image forming section 200 is held by a sheet gripper 201a disposed on the surface of the receiving body 201, and the sheet P is fed along with a surface movement of the receiving body 201. The sheet P fed by the receiving body 201 is transferred to the sheet conveying drum 210 in which the receiving body 201 is disposed opposite the sheet conveying drum 210.

[0022] Sheet grippers 210a are also disposed on the surface of the sheet conveying drum 210, and the leading end of the sheet is held by the sheet grippers 210a. In addition, a plurality of suction holes is formed in a dispersed manner on the surface of the sheet conveying drum 210, so that suction air toward an inner side of the sheet conveying drum 210 is generated in each suction hole by a suction device 211.

[0023] When the sheet P reaches the sheet conveying drum 210 from the receiving body 201, the leading end of the sheet P is held by the sheet gripper 210a, and the sheet P is suctioned to the surface of the sheet conveying drum 210 due to the suction air, and is conveyed along the surface movement of the sheet conveying drum 210.

[0024] In the present embodiment, the ink discharge device 220 forms an image by discharging four colors of ink, that is, cyan (C), magenta (M), yellow (Y), and black (K), and includes liquid discharge heads 220C, 220M, 220Y, and 220K for each color.

[0025] The structure of the liquid discharge heads 220C, 220M, 220Y, and 220K is not limited to any particular structure, and may be any structure as long as the heads can discharge liquid. If necessary, the ink dis-

charge device 220 may include a liquid discharge head to discharge a special ink, such as white, gold, or silver, or a liquid discharge head to discharge a surface coating liquid or any other liquid that does not form an image.

[0026] A discharge operation of each of the liquid discharge heads 220C, 220M, 220Y, and 220K in the ink discharge device 220 is controlled by a driving signal corresponding to image information. When the sheet P fed by the sheet conveying drum 210 passes through an area opposite the ink discharge device 220, each color ink is discharged from each of the liquid discharge heads 220C, 220M, 220Y, and 220K, so that an image corresponding to the image information is formed.

[0027] In addition, the structure of the image forming section 200 is not limited to any particular structure as long as the image forming section 200 can discharge liquid onto the sheet P, to form an image on the sheet P.

Drier

[0028] The drier 300 includes, for example, a drying device 301 to dry the ink adhered on the sheet P in the image forming section 200; and a feed device 302 to convey the sheet P conveyed from the image forming section 200.

[0029] The sheet P fed from the image forming section 200 is received by the feed device 302, and is fed to pass the drying device 301, and is transferred to the sheet ejector 400. When the sheet P passes the drying device 301, a drying process is applied to the ink on the sheet P, so that an aqueous content, such as moisture, in the ink is evaporated, the ink is fixed on the sheet P, and a curl of the sheet P is improved.

Sheet Ejector

[0030] The sheet ejector 400 includes, for example, a plurality of sheet ejection trays 410 on which the plurality of sheets P is stacked. The sheet P fed from the dryer 300 is sequentially stacked and held on any of the sheet ejection trays 410.

[0031] In the present embodiment, the structure of the sheet ejector 400 is not limited to any particular structure, as long as the sheet ejector can eject the sheet P.

Other Functions

[0032] The inkjet recording apparatus 1 according to the present embodiment includes the sheet supplier 100, the image forming section 200, the dryer 300, and the sheet ejector 400; however, other functional units may be added optionally. For example, between the sheet supplier 100 and the image forming section 200, a pre-treatment device to perform a pretreatment process can be added. Otherwise, between the dryer 300 and the sheet ejector 400, a post-treatment device to perform a post-treatment process can be added.

[0033] As the pre-treatment device, for example, there

is a device to coat a treatment liquid onto the sheet P to suppress bleeding due to reaction with ink; however, details of the pre-treatment process are not limited, in particular.

[0034] As a post-treatment device, for example, there is a device to reverse and refeed a sheet on which the image is formed in the image forming section 200, form an image on both sides of the sheet, and bind the plurality of sheets on each of which the image is formed. However, the details of the post-treatment are not limited in particular.

[0035] In the present embodiment, the liquid discharge apparatus is illustrated with the example of the inkjet recording apparatus. However, the liquid discharge apparatus is not limited to an apparatus that includes a liquid discharge head to discharge liquid to a dried surface of a sheet medium and render a meaningful image, such as letters or a figure, visible by the discharged liquid. Instead, the liquid discharge apparatus may form a pattern or an image having no meaning in itself.

[0036] Materials for the sheet medium are not limited to any particular materials, and may be any materials onto which liquid can be adhered even temporarily, such as paper, thread, fiber, fabrics, leather, metals, plastics, glass, wood, and ceramics. The materials for the sheet medium may be materials used for, for example, film products, clothes for clothing, construction materials, such as wall paper and floor materials, and leather goods. In the present embodiment, the term "medium" includes any material on which liquid can be adhered even temporarily.

[0037] The liquid discharge apparatus may include devices for supplying, feeding, conveying, and ejecting the medium on which liquid can be adhered, a pre-treatment device, and a post-treatment device.

[0038] The term "liquid" may be any substance having a viscosity or surface tension dischargeable from the head, and is not limited to any particular substance; however, the liquid may preferably have a viscosity of 30 mPa·s or smaller at a normal temperature and pressure, or under heating or cooling.

[0039] More specifically, examples of the liquid include a solution, suspension liquid, or emulsion including solvent such as water or an organic solvent, colorant such as a dye or pigment polymerizable compounds, resins, functionality imparting material such as surfactant, biocompatible material such as DNA, amino acid, protein, and calcium, edible material such as a natural colorant. Those materials are used for, for example, inkjet ink or a surface treatment liquid.

[0040] Further, the liquid discharge apparatus may be an apparatus in which a liquid discharge head and a medium, on which liquid can adhere, move relatively, but is not limited to this. For example, the liquid discharge apparatus may be a serial-type apparatus in which the liquid discharge head is moved relative to the medium or a line-type device in which the liquid discharge head is not moved relative to the medium.

[0041] The liquid discharge head is a functional component to discharge or inject liquid from a discharge hole(s) or nozzle(s). Examples of discharging energy generator to discharge the liquid include a piezoelectric actuator (such as a layered-type piezoelectric element and thin-film type piezoelectric element); a thermal actuator using electro-thermal conversion element such as heat-generating resistor; and an electrostatic actuator including a diaphragm and opposed electrodes. However, the discharging energy generator for use is not limited to any particular type.

[0042] In the present embodiment, the plurality of liquid discharge heads is arrayed in a width direction of the sheet P, that is, a direction perpendicular to the conveyance direction of the sheet P, to thereby form a long liquid discharge head or a line head. If not specified otherwise, the liquid discharge head means the line head.

Positioning of Head

[0043] Next, how to position the liquid discharge heads 220C, 220M, 220Y, and 220K of the image forming section 200 in the first embodiment relative to the sheet conveying drum 210 that serves as a conveyor, will be described.

[0044] FIG. 2 schematically illustrates a structure of the image forming section 200.

[0045] As described above, when the sheet P is fed to the image forming section 200, the leading end of the sheet P is held by the sheet gripper 201a disposed on the surface of the receiving body 201. The sheet P is fed along with the surface movement of the receiving body 201 and is transferred to the sheet conveying drum 210.

[0046] The sheet P transferred to the sheet conveying drum 210 is carried on the surface of the sheet conveying drum 210 with the leading end held by the sheet gripper 201a disposed on the sheet conveying drum 210, and is conveyed along with a rotation of the sheet conveying drum 210.

[0047] Then, when the sheet P conveyed by the sheet conveying drum 210 passes through the area opposite the ink discharge device 220, the liquid discharge heads 220C, 220M, 220Y, and 220K discharge the different color inks, to thereby form an image corresponding to the image information on the sheet P.

[0048] In the present embodiment, each of the liquid discharge heads 220C, 220M, 220Y and 220K is a line-type liquid discharge head with a length covering the length of the sheet P in the width direction, that is, the length of the sheet P in the main scanning direction, and discharges ink onto the sheet P.

[0049] In the present embodiment, the liquid discharge heads 220C, 220M, 220Y, and 220K are disposed radially about the rotary axis of the sheet conveying drum 210. In this case, when the accuracy in the positional relation between the liquid discharge heads is low, the positional relation between the color inks discharged from the liquid discharge heads onto the sheet P wors-

ens, so that a problem, such as color shift, may occur.

[0050] Herein, examples of the relative positional relation between the liquid discharge heads include relative positions of the liquid discharge heads in the main scanning direction, relative positions of the liquid discharge heads in the sub-scanning direction, a distance of each liquid discharge head from the surface of the sheet conveying drum 210, and a parallelism of each liquid discharge head to the rotary axis of the sheet conveying drum 210.

[0051] In the present embodiment, the liquid discharge heads 220C, 220M, 220Y, and 220K are positioned relative to the sheet conveying drum 210 as follows, to thereby secure the relative positional accuracy between the liquid discharge heads.

[0052] In the inkjet recording apparatus according to the present embodiment, the sheet conveying drum 210 is provided with a plurality of common positioning references (or conveyor-side positioning portions) at different positions in the main scanning direction, that is, the direction perpendicular to the conveyance direction of the sheet conveying drum 210, and a direction of the rotary axis of the sheet conveying drum 210.

[0053] The plurality of common positioning references in the present embodiment is defined by a pair of drum-side positioning reference holes 212 formed of two positioning reference holes. The two positioning reference holes are aligned in the rotary axis direction of the sheet conveying drum 210 and disposed at both ends on the outer surface in the rotary axis direction of the sheet conveying drum 210.

[0054] More specifically, as illustrated in FIG. 3, each of the pair of drum-side positioning reference holes 212 is disposed near each end in the sheet width direction of the sheet conveying drum 210.

[0055] Each of the pair of drum-side positioning reference holes 212 includes an opening open upwards in a rotary position of the sheet conveying drum 210 illustrated in FIG. 2.

[0056] In each of the liquid discharge heads 220C, 220M, 220Y, and 220K, a plurality of head-side positioning references or head-side positioning portions is disposed at different positions in the main scanning direction.

[0057] The plurality of head-side positioning references in the present embodiment is formed of a pair of head-side positioning reference holes 221C, 221M, 221Y, and 221K, as two positioning reference holes. The two positioning reference holes are aligned in the rotary axis direction of the sheet conveying drum 210 and disposed at both end areas in the rotary axis direction of the sheet conveying drum 210 on the nozzle plate of each of the liquid discharge heads 220C, 220M, 220Y, and 220K.

[0058] More specifically, as illustrated in FIG. 3, each of the head-side positioning reference holes 221 is disposed near each end in the sheet width direction of the sheet conveying drum 210, that is, near each end in the longitudinal direction of each of the liquid discharge

heads 220C, 220M, 220Y, and 220K.

[0059] When each of the liquid discharge heads 220C, 220M, 220Y, and 220K is positioned relative to the sheet conveying drum 210 in the present embodiment, positioning of one of the liquid discharge heads 220C, 220M, 220Y, and 220K disposed most upstream in the rotary direction of the sheet conveying drum 210 is performed first, and positioning of the others is performed sequentially.

[0060] The order to perform positioning the liquid discharge heads 220C, 220M, 220Y, and 220K is arbitrary and is not limited to the above-described order in the present embodiment.

[0061] Before performing the positioning process, each of the liquid discharge heads 220C, 220M, 220Y, and 220K is temporarily held on a base 290. The base 290 includes through holes at positions corresponding to the head-side positioning reference holes 221.

[0062] As illustrated in FIG. 4, the sheet conveying drum 210 is rotated such that the pair of drum-side positioning reference holes 212 on the sheet conveying drum 210 are disposed at a predetermined rotary position (or a rotary angle position) to perform the positioning process of the first liquid discharge head 220C (i.e., moving step).

[0063] Then, an end of a reference pin 230 serving as a positioning reference is inserted through the drum-side positioning reference hole 212 on the sheet conveying drum 210, and with the reference pin 230 passing through the through-hole of the base 290, another end of the reference pin 230 is inserted through the head-side positioning reference hole 221C on the liquid discharge head 220C.

[0064] With this structure, the liquid discharge head 220C is positioned at a position regulated by the reference pins 230 engaged with the drum-side positioning reference holes 212 on the sheet conveying drum 210. As a result, the liquid discharge head 220C is positioned at a position defined by the drum-side positioning reference holes 212 and the reference pins 230 relative to the sheet conveying drum 210.

[0065] The thus-positioned liquid discharge head 220C is secured to the base 290 that supports the liquid discharge head 220C (i.e., securing step).

[0066] Next, as illustrated in FIG. 5, the sheet conveying drum 210 is rotated and stopped such that the pair of drum-side positioning reference holes 212 on the sheet conveying drum 210 is placed at a predetermined rotary position (or a rotary angle position) to perform the positioning process of the second liquid discharge head 220M.

[0067] Then, similarly, an end of the reference pin 230 serving as the positioning reference is inserted through the drum-side positioning reference hole 212 on the sheet conveying drum 210, and with the reference pin 230 passing through the through-hole of the base 290, another end of the reference pin 230 is inserted through the head-side positioning reference hole 221M on the

liquid discharge head 220M.

[0068] With this structure, the liquid discharge head 220M is positioned at a position regulated by the drum-side positioning reference holes 212 and the reference pins 230 on the sheet conveying drum 210. Then, the thus-positioned liquid discharge head 220M is secured relative to the base 290 that supports the liquid discharge head 220M.

[0069] By performing the above process with respect to the third liquid discharge head 220Y and the fourth liquid discharge head 220K, the positioning of each of the liquid discharge heads 220C, 220M, 220Y, and 220K relative to the sheet conveying drum 210 is completed.

[0070] More specifically, the position in the main scanning direction, the position in the sub-scanning direction, the distance from the surface of the sheet conveying drum 210, and the parallelism to the rotary axis of the sheet conveying drum 210 with respect to each of the liquid discharge heads 220C, 220M, 220Y, and 220K are defined by the common drum-side positioning reference holes 212 and the reference pins 230 on the sheet conveying drum 210.

[0071] FIG. 6 is a plan view of a main part of the liquid discharge head 220C viewed from above. The base 290 is omitted for explanation in FIG. 6.

[0072] In FIG. 6, the drum-side positioning reference holes 212 are placed at positions corresponding to the head-side positioning reference holes 221C. In this case, when the reference pin 230 is entered from above into the head-side positioning reference hole 221C, the liquid discharge head 220C is positioned with the drum-side positioning reference holes 212 set as a reference.

[0073] Then, the liquid discharge head 220C is mounted and secured to the base 290, and the sheet conveying drum 210 is rotated. The liquid discharge head 220M is also mounted and secured to the base 290 similarly.

[0074] In the present embodiment of the disclosure, the reference pin 230 is used, but the method is not limited to this. For example, the positioning of the drum-side positioning reference holes 212 and the head-side positioning reference holes 221 can be performed using a non-contact laser measuring device or by checking with eyes. Namely, as long as the drum-side positioning reference holes 212 can be viewed with eyes via the head-side positioning reference holes 221, an effect of the present embodiment can be obtained.

[0075] Specifically, the method of mounting the plurality of liquid discharge heads according to the present embodiment includes the moving step in which the pair of drum-side positioning reference holes 212 (or the conveyor-side positioning portions) disposed on the sheet conveying drum 210 (or the conveyor) to convey the sheet P (or the medium) is moved to a position corresponding to the pair of head-side positioning reference holes 221 (or the head-side positioning portions) disposed on each of the liquid discharge heads 220C, 220M, 220Y, and 220K; and the securing step to engage the reference pins 230 (rod-shaped members) into the drum-

side positioning reference holes 212 and the head-side positioning reference holes 221 to position the drum-side positioning reference holes 212 and the head-side positioning reference holes 221, so that the liquid discharge heads 220C, 220M, 220Y, and 220K are secured to a body of the inkjet recording apparatus 1 (the base 290 in the present embodiment). The moving step and the securing step are performed on each of the liquid discharge heads 220C, 220M, 220Y, and 220K.

[0076] Accordingly, the liquid discharge apparatus according to the present embodiment includes the sheet conveying drum 210 (the conveyor) to feed the sheet P (the medium); and the plurality of liquid discharge heads 220C, 220M, 220Y, and 220K disposed along the conveyance direction of the sheet P. Each liquid discharge head includes the head-side positioning reference holes 221 (the head-side positioning portions), and the sheet conveying drum 210 includes the drum-side positioning reference holes 212 (the conveyor-side positioning portions). The drum-side positioning reference holes 212 and the head-side positioning reference holes 221 are positioning members to define the positional relation between the liquid discharge heads 220C, 220M, 220Y, and 220K and the sheet conveying drum 210. The drum-side positioning reference holes 212 are placed at positions corresponding to the plurality of head-side positioning reference holes 221 of each of the liquid discharge heads 220C, 220M, 220Y, and 220K by movement of the sheet conveying drum 210 in the conveyance direction.

[0077] In the present embodiment, the positional relation means, for example, relative positions, distances, attitudes, and angles between the plurality of liquid discharge heads 220C, 220M, 220Y, and 220K and the sheet conveying drum 210. More specifically, distances between the liquid discharge heads 220C, 220M, 220Y, and 220K in the conveyance direction, relative positions of the liquid discharge heads 220C, 220M, 220Y, and 220K in the sheet width direction, and the parallelism between the liquid discharge heads 220C, 220M, 220Y, and 220K, the distance from each of the liquid discharge heads 220C, 220M, 220Y, and 220K and the surface of the sheet conveying drum 210, and the parallelism of each of the liquid discharge heads 220C, 220M, 220Y, and 220K relative to the rotary axis of the sheet conveying drum 210 are included, but not limited. In addition, the positioning member to define the positional relation may be a mark, dent, hole, groove, through-hole, and sensor used for defining at least one of the above positional relations, and a contact type or non-contact type may be used.

[0078] Also, the expression that the conveyor-side positioning portions are placed at positions corresponding to the head-side positioning portions does not necessarily mean that the conveyor-side positioning portions are disposed below the head-side positioning portions. The expression means that the conveyor-side positioning portions and the head-side positioning portions are in a state in which the conveyor-side positioning portions and

the head-side positioning portions can be referred or used to define the positional relation between the liquid discharge head 220 and the sheet conveying drum 210.

[0079] Next, with reference to FIG. 7, a second embodiment of the present disclosure will be described. FIG. 7 illustrates exemplary shapes of a pair of head-side positioning reference holes 221 disposed on each of the liquid discharge heads 220C, 220M, 220Y, and 220K, and of a pair of drum-side positioning reference holes 212 disposed on the sheet conveying drum 210 in the second embodiment.

[0080] In the present embodiment, any of the pair of head-side positioning reference holes 221 disposed on each of the liquid discharge heads 220C, 220M, 220Y, and 220K has a shape and dimensions matched with the shape and the outer diameter of the reference pin 230 that fits in the head-side positioning reference holes 221.

[0081] On the other hand, among the pair of drum-side positioning reference holes 212 on the sheet conveying drum 210, one drum-side positioning reference hole 212a includes a shape and dimensions matched with the shape of the outer diameter of the reference pin 230 that fits in the one drum-side positioning reference hole 212a. However, the other drum-side positioning reference hole 212b has a longer slit shape in the main scanning direction and the reference pin 230 inserted to the other drum-side positioning reference hole 212b is movable in the main scanning direction.

[0082] With this structure, even if there is any variation in the position in the main scanning direction of the pair of head-side positioning reference holes 221 disposed to each of the liquid discharge heads 220C, 220M, 220Y, and 220K, the head-side positioning reference holes 221 on the liquid discharge heads 220C, 220M, 220Y, and 220K can be positioned relative to the drum-side positioning reference holes 212 on the sheet conveying drum 210, with the drum-side positioning reference hole 212a on the sheet conveying drum 210 as a main reference and with the drum-side positioning reference hole 212b as an auxiliary reference.

[0083] The same is applied to a case in which the sheet conveying drum 210 and the liquid discharge head 220 are structured as illustrated in FIG. 8. Specifically, the pair of drum-side positioning reference holes 212 on the sheet conveying drum 210 has a shape and dimensions matched with the shape and the outer diameter of the reference pin 230 that fits in the head-side positioning reference holes 221. On the other hand, the pair of head-side positioning reference holes 221 disposed on each of the liquid discharge heads 220C, 220M, 220Y, and 220K includes one head-side positioning reference hole 221a having a shape and dimensions matched with the shape of the outer diameter of the reference pin 230 that fits in the one head-side positioning reference hole 221a. However, the other head-side positioning reference hole 221b has a longer slit shape in the main scanning direction and the reference pin 230 inserted to the other head-side positioning reference hole 221b is movable in the

main scanning direction.

[0084] Even with such a structure, although there is any variation in the position in the main scanning direction of the pair of head-side positioning reference holes 221 disposed on each of the liquid discharge heads 220, 220M, 220Y, and 220K, the head-side positioning reference holes 221 on each of the liquid discharge heads 220C, 220M, 220Y, and 220K can be positioned relative to the drum-side positioning reference holes 212 on the sheet conveying drum 210, with the drum-side positioning reference hole 212a on each of the liquid discharge heads 220C, 220M, 220Y, and 220K as a main reference and with the head-side positioning reference hole 212b as an auxiliary reference.

[0085] The same effect may be exerted even when a cutout 212c is used instead of the drum-side positioning reference hole 212b having a long hole shape, as illustrated in FIG. 9.

[0086] In addition, in any of the above embodiments, the drum-side positioning reference hole 212 may be a through-hole, a not-through-groove, or a dent, as long as the drum-side positioning reference hole 212 has a shape into which the rod-shaped reference pin 230 can be entered.

[0087] In addition, in any of the above embodiments, the head-side positioning reference hole 221 can be a through-hole, a not-through-groove, or a dent. However, the head-side positioning reference hole 221 is preferably a through-hole, such that the drum-side positioning reference hole 212 of the sheet conveying drum 210 can be viewed from above the liquid discharge heads 220C, 220M, 220Y, and 220K. In this case, operability is improved.

[0088] In any of the above embodiments, the rod-shaped reference pin 230 is not necessary for positioning. For example, the positioning may be performed by emitting a light beam of a laser measuring device from the head-side positioning reference hole 221 as a light transmissive portion to the drum-side positioning reference hole 212 and by measuring relative positions between the liquid discharge heads 220C, 220M, 220Y, and 220K and the sheet conveying drum 210. Otherwise, the positioning may be performed using any other different method.

[0089] As the light transmissive portion, a through-hole, glass, film, and mirror may be used, and as long as the positional relation can be finally defined, any structure and method may be used. If a mirror is used, a radiation position of the laser beam can be variable.

[0090] In the present embodiment, any of the head-side positioning reference holes 221C, 221M, 221Y, and 221K disposed on each of the liquid discharge heads 220C, 220M, 220Y, and 220K is positioned relative to the common drum-side positioning reference holes 212 on the sheet conveying drum 210.

[0091] In the former structure in which individual drum-side positioning reference holes are disposed on the sheet conveying drum 210 for each of the liquid discharge

heads 220C, 220M, 220Y, and 220K, the positional accuracy of the drum-side positional reference holes for each liquid discharge head affects the relative positional accuracy between the liquid discharge heads.

[0092] According to the present embodiment, because any pair of the head-side positioning reference holes 221C, 221 M, 221 Y, and 221 K of each of the liquid discharge heads is positioned relative to the common drum-side positioning reference holes 212 on the sheet conveying drum 210, the positional accuracy between the drum-side positioning reference holes for each of the liquid discharge heads does not affect the relative positional accuracy between the liquid discharge heads, contrary to the former structure.

[0093] As a result, in the present embodiment, even if the positional accuracy or processing accuracy of the pair of drum-side positioning reference holes 212 disposed on the sheet conveying drum 210 is low, a high degree of relative positional accuracy between the liquid discharge heads can be easily obtained, and a high degree of accuracy of relative adhesion positions of ink discharged from the liquid discharge heads may be easily obtained.

[0094] For example, when a direction connecting the positions of the pair of drum-side positioning reference holes disposed on the sheet conveying drum 210 is shifted from the rotary axis direction of the sheet conveying drum 210, the parallelism of each of the liquid discharge heads relative to the rotary axis of the sheet conveying drum 210 is shifted; however, there is no deviation in the relative parallelism between the liquid discharge heads.

[0095] In this case, an ink adhering position of each color ink discharged from each of the liquid discharge heads relative to the sheet P is deviated from a target position and a slight image distortion may occur; however, relative positions of inks discharged from the liquid discharge heads does not shift. Accordingly, color shift, which is more remarkable image degradation than the image distortion, can be prevented.

[0096] The above embodiments are examples, and particular effects may be exerted according to each of the following aspects.

Aspect A

[0097] A liquid discharge apparatus includes a conveyor to convey a medium and a plurality of liquid discharge heads arrayed in a conveyance direction of the medium. Each of the plurality of liquid discharge heads includes head-side positioning portions and the conveyor includes conveyor-side positioning portions. The head-side positioning portions and the conveyor-side positioning portions are positioning portions to define a positional relation between the liquid discharge heads and the conveyor. The conveyor-side positioning portions are placed at positions corresponding to the plurality of head-side positioning portions by movement of the conveyor in the conveyance direction.

[0098] According to the present aspect, the head-side positioning portions disposed on each of the liquid discharge heads are positioned relative to the conveyor-side positioning portions disposed on the conveyor, to position each liquid discharge head relative to the conveyor.

[0099] As a result, compared to a former case in which the head-side positioning portions disposed on each liquid discharge head are positioned relative to individual positioning portions for each of the liquid discharge heads disposed on the conveyor, the positional accuracy between the positioning portions for each of the liquid discharge heads disposed on the conveyor does not affect the relative positional accuracy between the liquid discharge heads.

[0100] Further, because the number of the conveyor-side positioning portions disposed on the conveyor is smaller than the former case in which the individual positioning portions for each of the liquid discharge heads are disposed on the conveyor, the high-accuracy positioning portions can be disposed on the conveyor relatively easily. Accordingly, a high degree of relative positional accuracy between the liquid discharge heads (i.e., the positional accuracy relative to the conveyor) can be easily obtained, and a high degree of relative adhesion positions of liquid discharged from the liquid discharge heads can be easily obtained.

[0101] Herein, the relative positional accuracy between the liquid discharge heads (i.e., the positional accuracy relative to the conveyor) means, concerning the positional accuracy at which the head-side positioning portions disposed on each of the liquid discharge heads are positioned relative to the conveyor-side positioning portions disposed on the conveyor, the positional accuracy between the liquid discharge heads on the position in the main scanning direction, the position in the sub-scanning direction, the distance to the surface of the conveyor, the parallelism relative to the surface of the conveyor, and the parallelism relative to the direction perpendicular to the conveyance direction of the conveyor.

[0102] For example, as to the positions of the liquid discharge heads in the main scanning direction, the distance between the surface of the conveyor and each of the liquid discharge heads, and the parallelism of each of the liquid discharge heads relative to the conveyor, a high degree of positioning accuracy can be obtained by positioning the liquid discharge heads relative to common positioning portions, that is, the conveyor-side positioning portions disposed on the conveyor.

[0103] Further, for example, as to the positions of the liquid discharge heads in the sub-scanning direction, and the parallelism of each liquid discharge head relative to the direction perpendicular to the feeding direction of the conveyor, a high degree of positioning accuracy can be obtained by controlling the conveyance position of the conveyor with a higher accuracy and by positioning the liquid discharge heads relative to the conveyor-side positioning portions common to the liquid discharge heads.

[0104] As a result, for example, when the accuracy of relative adhesion positions of liquid discharged from the liquid discharge heads is degraded, the accuracy of relative adhesion positions of liquid discharged from the liquid discharge heads can be improved by adjusting the relative positional accuracy between the liquid discharge heads or the positional accuracy relative to the conveyor. Accordingly, a liquid discharge apparatus can be achieved that is capable of improving the accuracy of relative adhesion positions of liquid discharged from the liquid discharge heads.

Aspect B

[0105] In the above aspect A, the conveyor is a cylindrical conveying drum, and the conveyor-side positioning portions are placed at the positions corresponding to the plurality of the head-side positioning portions by rotation of the conveying drum. With this structure, in the liquid discharge apparatus to discharge liquid from the plurality of liquid discharge heads to a medium carried on the surface of the drum-shaped member, the relative adhesion positions of liquid discharged from the liquid discharge heads can be easily obtained.

Aspect C

[0106] In the above aspect A or B, at least one of the conveyor-side positioning portions and the head-side positioning portions is a hole or cutout that is longer in a direction perpendicular to the conveyance direction of the conveyor.

[0107] With this structure, even when there is any variation in the position of the plurality of head-side positioning portions in the main scanning direction disposed on each liquid discharge head, the plurality of head-side positioning portions can be positioned relative to the conveyor-side positioning portions on the conveyor.

Aspect D

[0108] In any of the above aspects A to C, the head-side positioning portions are through-holes, and when the conveyor-side positioning portions are placed at positions corresponding to the through-holes, rod-shaped members are engageable with the conveyor-side positioning portions via the through-holes. With this structure, the relative positional accuracy between the liquid discharge heads can be improved by a simple work using the rod-shaped member.

Aspect E

[0109] In any of the above aspects A to C, the head-side positioning portions are light transmissive portions through which light permeates, and when the conveyor-side positioning portions are placed at positions corresponding to the light transmissive portions, the light

reaches the conveyor-side positioning portions through the light transmissive portions. With this structure, the positioning of the liquid discharge heads can be performed using, e.g., laser beams or the view by human eyes.

Aspect F

[0110] A method of mounting a plurality of liquid discharge heads includes a moving step to move conveyor-side positioning portions disposed on a conveyor that conveys a medium, to positions corresponding to head-side positioning portions disposed on each of the liquid discharge heads; and a securing step to engage rod-shaped members to the conveyor-side positioning portions and the head-side positioning portions to position the conveyor-side positioning portions and the head-side positioning portions to secure each of the liquid discharge heads with a body of a liquid discharge apparatus. The moving step and the securing step are performed on each of the plurality of liquid discharge heads.

[0111] According to the present aspect, by positioning the head-side positioning portions disposed on each liquid discharge head relative to the conveyor-side positioning portions disposed on the conveyor, each liquid discharge head can be positioned relative to the conveyor.

[0112] As a result, compared to a former case in which the head-side positioning portions disposed on each liquid discharge head are positioned relative to individual positioning portions for each of the liquid discharge head disposed on the conveyor, the positional accuracy between the individual positioning portions for each of the liquid discharge heads disposed on the conveyor does not affect the relative positional accuracy between the liquid discharge heads.

[0113] Further, because the number of the conveyor-side positioning portions disposed on the conveyor is smaller than a case in which the individual positioning portions for each of the liquid discharge heads are disposed on the conveyor, the high-accuracy positioning portions can be disposed on the conveyor relatively easily. Accordingly, a high degree of relative positional accuracy between the liquid discharge heads (i.e., the positional accuracy relative to the conveyor) can be easily obtained, and a high degree of relative adhesion positions of liquid discharged from the plurality of liquid discharge heads can be easily obtained.

[0114] Herein, the relative positional accuracy between the liquid discharge heads (i.e., the positional accuracy relative to the conveyor) means, concerning the positional accuracy when the head-side positioning portions disposed on each of the liquid discharge heads are positioned relative to the conveyor-side positioning portion disposed on the conveyor, the positional accuracy between the liquid discharge heads on the positions in the main scanning direction, the positions in the sub-scanning direction, the distance to the surface of the con-

veyor, the parallelism relative to the surface of the conveyor, and the parallelism relative to the direction perpendicular to the feeding direction of the conveyor.

[0115] For example, as to the positions of the liquid discharge heads in the main scanning direction, the distance between the surface of the conveyor and each liquid discharge head, and the parallelism of each liquid discharge head relative to the conveyor, a high degree of positioning accuracy can be obtained by positioning each liquid discharge head relative to the common positioning portions between the liquid discharge heads that are the conveyor-side positioning portions disposed on the conveyor.

[0116] Further, for example, as to the positions of the liquid discharge heads in the sub-scanning direction, and the parallelism of each liquid discharge head relative to the direction perpendicular to the conveyance direction of the conveyor, by controlling the feeding position of the conveyor with a higher accuracy and by positioning each of the liquid discharge heads relative to the conveyor-side positioning portions common to the liquid discharge heads.

Aspect G

[0117] A method of mounting a plurality of liquid discharge heads includes a moving step to move conveyor-side positioning portions disposed on a conveyor that conveys a medium, to positions corresponding to head-side positioning portions disposed on each of the liquid discharge heads; and a securing step to match the conveyor-side positioning portion with the head-side positioning portion using a laser beam to secure each of the liquid discharge heads with a body of a liquid discharge device. The moving step and the securing step are performed on each of the plurality of liquid discharge heads. Similarly to the aspect F, a high degree of relative positional accuracy between the liquid discharge heads (i.e., the positional accuracy relative to the conveyor) can be easily obtained, and a high degree of accuracy of relative adhesion positions of the liquid discharged from the liquid discharge heads can be easily obtained.

Aspect H

[0118] A method of producing a liquid discharge apparatus includes the method of mounting the plurality of liquid discharge heads as described in any of the aspects F and G. With this structure, a high degree of relative positional accuracy between the liquid discharge heads (i.e., the positional accuracy relative to the conveyor), can be easily obtained, and a high degree of accuracy of relative adhesion positions of the liquid discharged from the liquid discharge heads can be easily obtained. As a result, the liquid discharge apparatus capable of discharging the liquid from the liquid discharge heads with a high degree of accuracy of relative adhesion positions, can be produced.

Claims**1.** A liquid discharge apparatus (1) comprising:

a conveyor (210) to convey a medium (P); and
a plurality of liquid discharge heads (220) arrayed in a conveyance direction of the medium (P),
wherein:

each of the plurality of liquid discharge heads (220) includes head-side positioning portions (221) and the conveyor (210) includes conveyor-side positioning portions (212);

the head-side positioning portions (221) and the conveyor-side positioning portions (212) are positioning portions to define a positional relation between the conveyor (210) and each of the plurality of liquid discharge heads (220); and

the conveyor-side positioning portions (212) correspond to the head-side positioning portions (221) of each of the plurality of liquid discharge heads (220) by movement of the conveyor (210) in the conveyance direction.

2. The liquid discharge apparatus (1) according to claim 1, wherein the conveyor (210) is a cylindrical conveying drum, and the conveyor-side positioning portions (212) correspond to the head-side positioning portions (221) of each of the plurality of liquid discharge heads (220) by rotation of the conveying drum.**3.** The liquid discharge apparatus (1) according to claim 1 or 2, wherein at least one of the conveyor-side positioning portions (212) and the head-side positioning portions (221) is a hole or cutout that is longer in a direction perpendicular to the conveyance direction.**4.** The liquid discharge apparatus (1) according to any one of claims 1 to 3, wherein the head-side positioning portions (221) are through-holes, and when the conveyor-side positioning portions (212) are placed at positions corresponding to the through-holes, rod-shaped members (230) are engageable with the conveyor-side positioning portions (212) via the through-holes.**5.** The liquid discharge apparatus (1) according to any one of claims 1 to 3, wherein the head-side positioning portions (221) are light transmissive portions through which light permeates, and when the conveyor-side positioning portions (212) are placed at positions corresponding to the light transmissive portions,

the light is permeable to the conveyor-side positioning portions (212) through the light transmissive portions.

6. A method of mounting a plurality of liquid discharge heads (220) to discharge liquid to a medium (P), the method comprising:

a moving step to move a conveyor-side positioning portion (212) disposed on a conveyor that conveys the medium (P), to a position corresponding to a head-side positioning portion on one of the plurality of liquid discharge heads (220);

a securing step to position the conveyor and the one of the plurality of liquid discharge heads (220) with a rod-shaped member (230) or a laser beam to secure the one of the plurality of liquid discharge heads (220) to a body of a liquid discharge apparatus (1); and

a repeating step to perform the moving step and the securing step on each of the plurality of liquid discharge heads (220).

7. A method of producing the liquid discharge apparatus (1) using the method of mounting the plurality of liquid discharge heads (220) according to claim 6.

FIG. 1

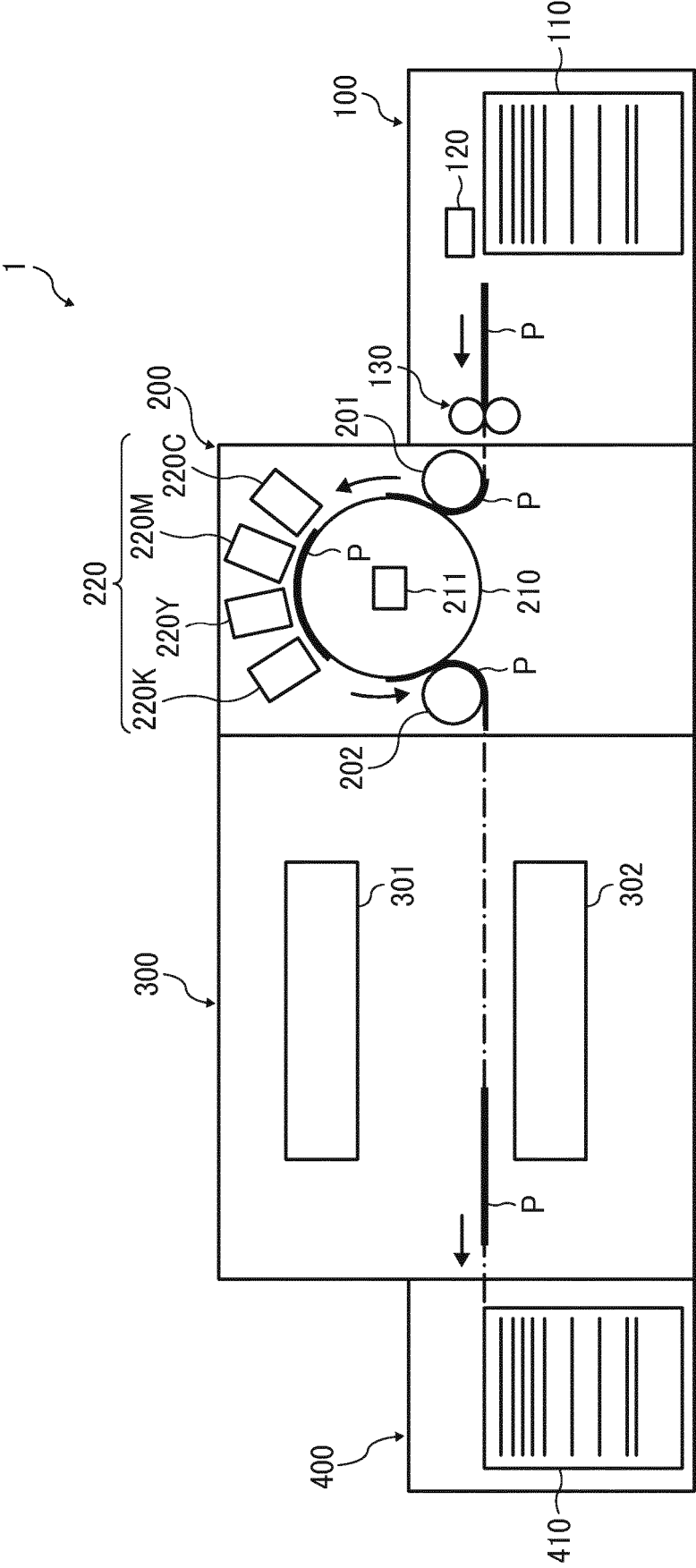


FIG. 2

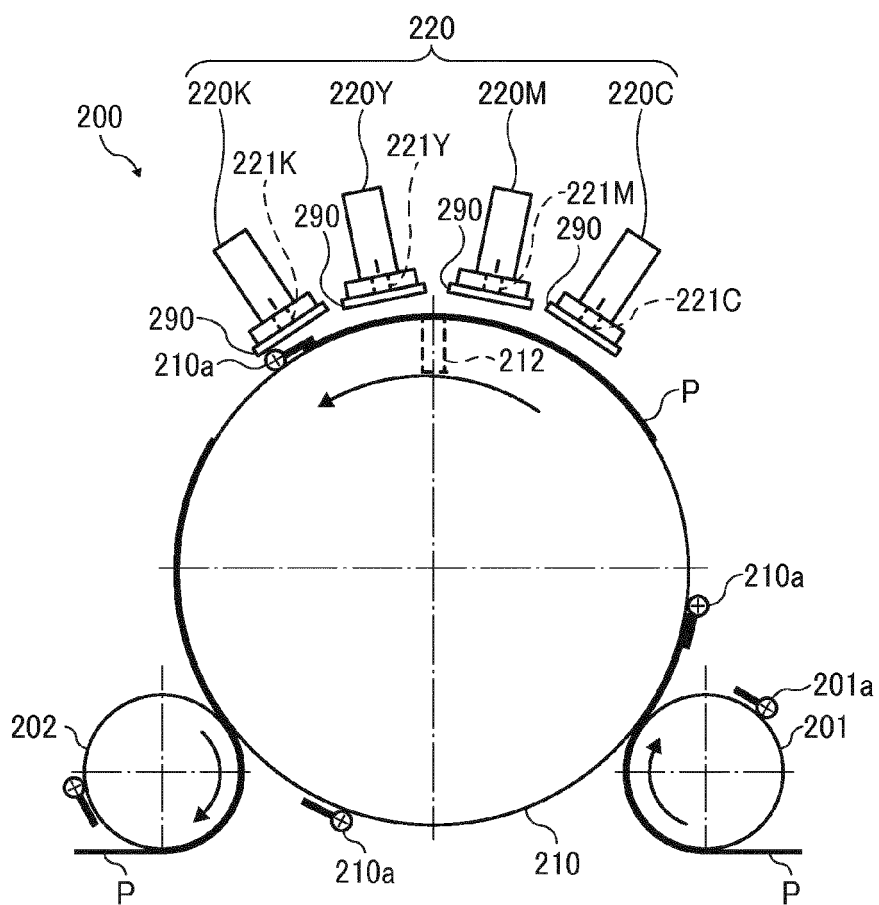


FIG. 3

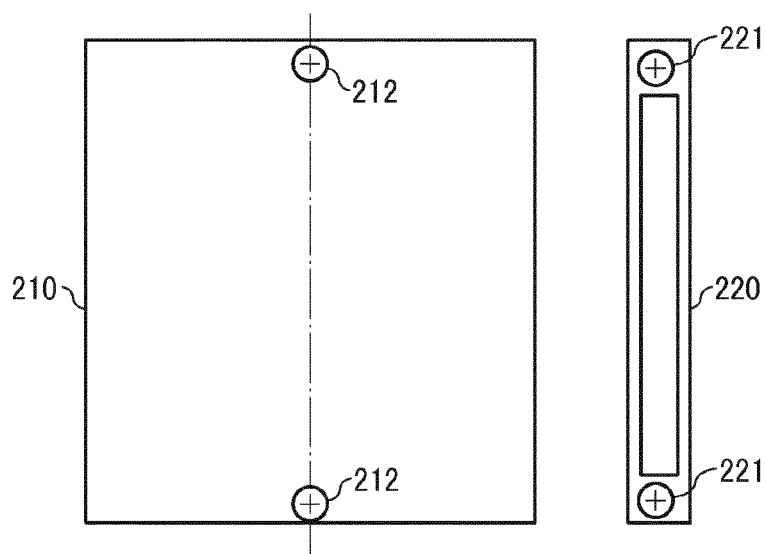


FIG. 4

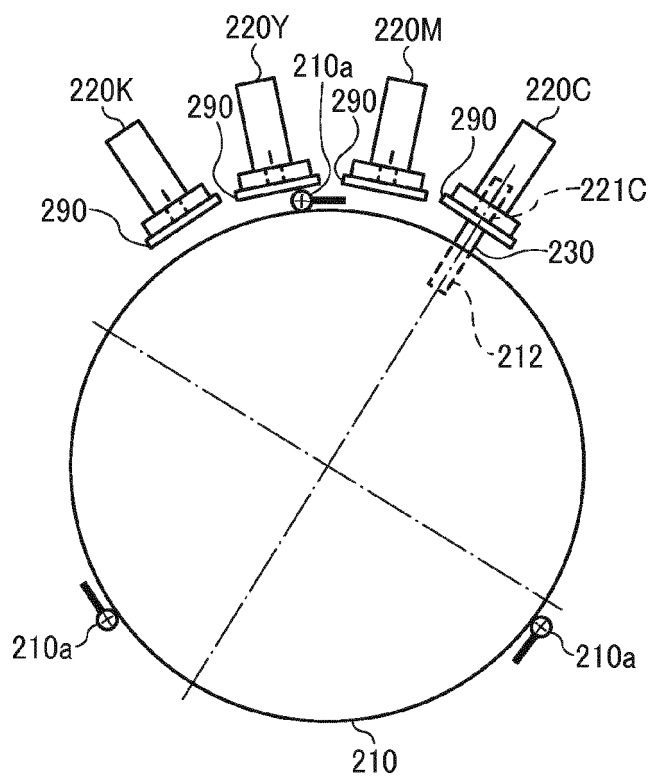


FIG. 5

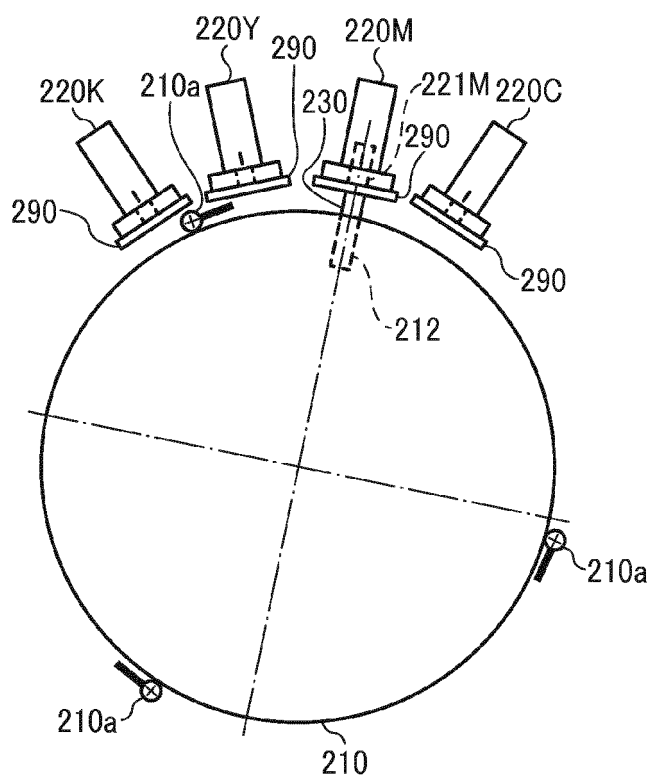


FIG. 6

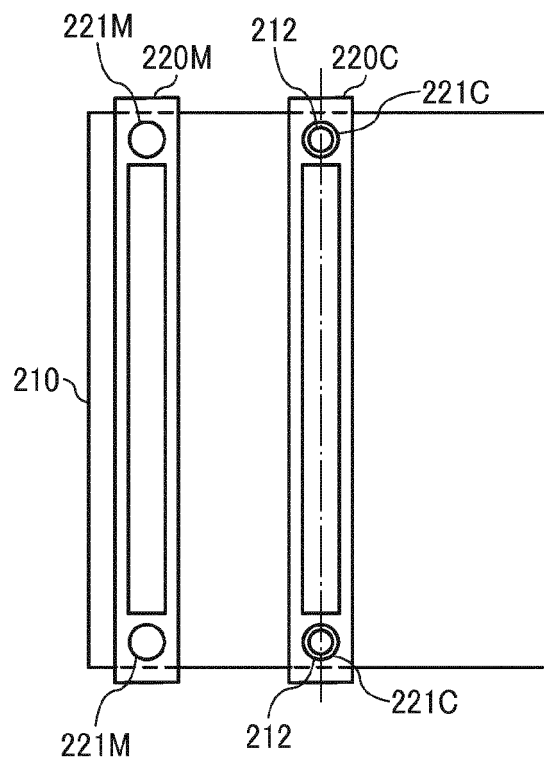


FIG. 7

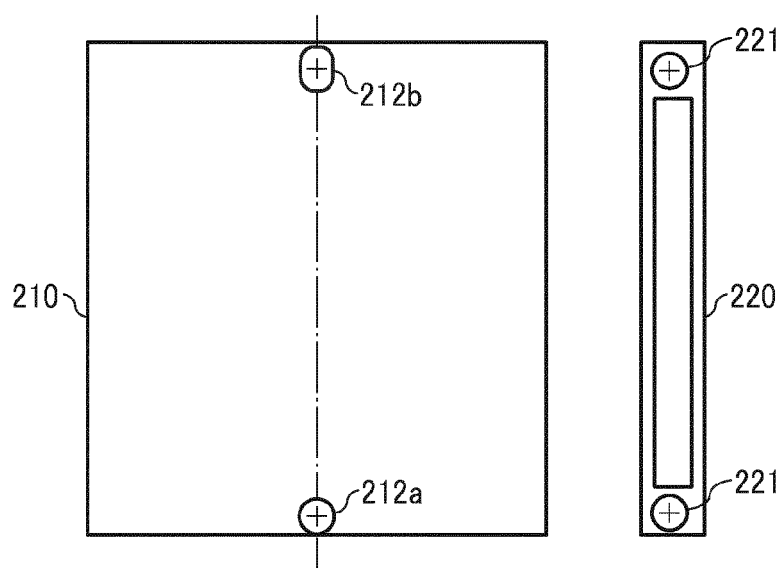


FIG. 8

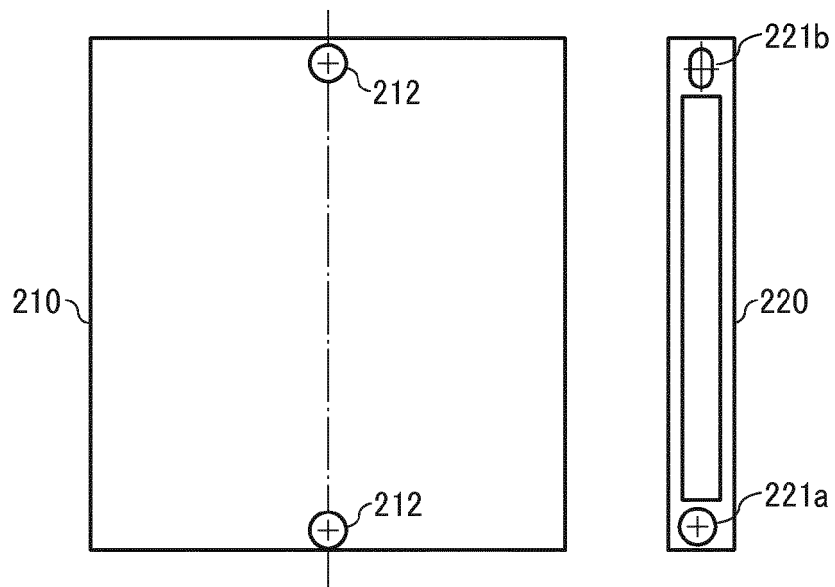
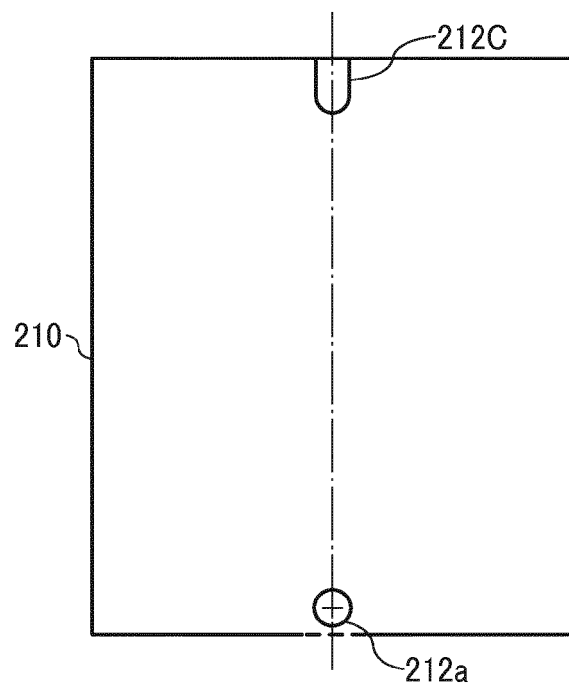


FIG. 9





EUROPEAN SEARCH REPORT

Application Number
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			B41J
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 October 2017	Examiner Hartmann, Mathias
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