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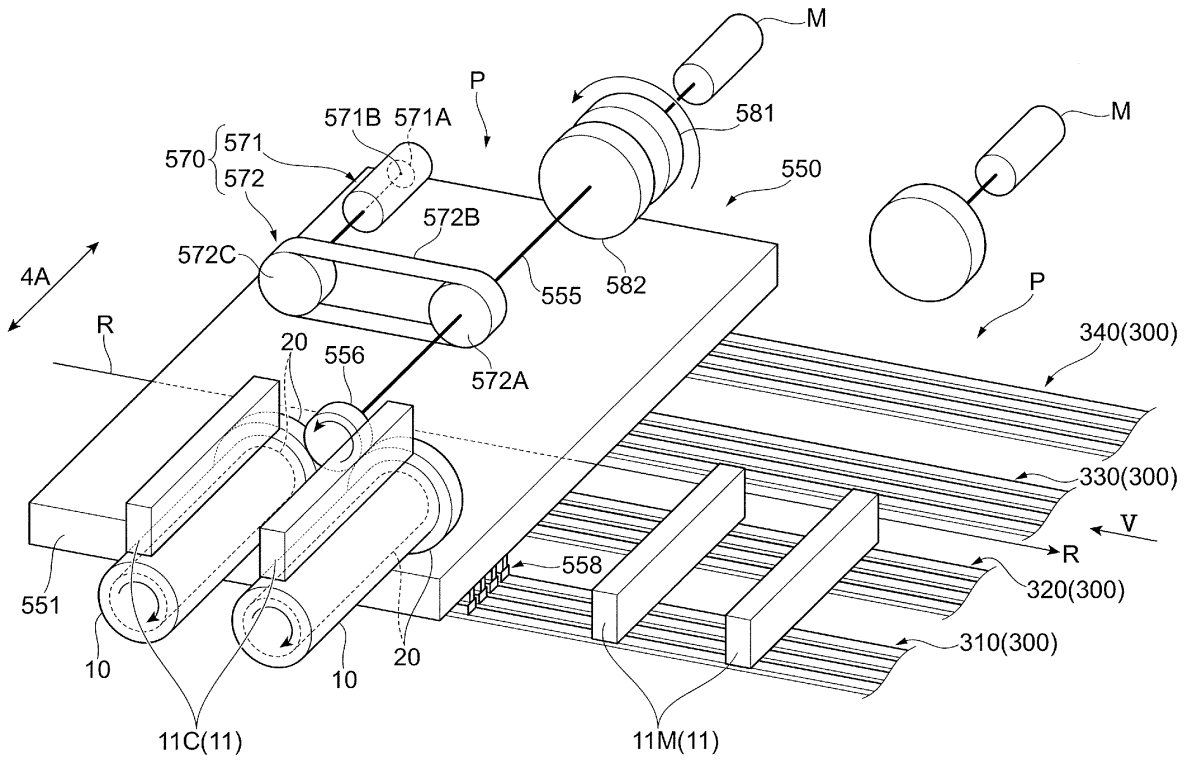
(54) **PRINTING DEVICE**

(57) A printing apparatus includes: an image forming unit performing image formation onto a can body; plural moving bodies each of which supports the can body in a rotatable state and moves toward the image forming unit; and a detection unit provided to each of the moving bodies to detect a phase of the can body.

FIG.4



EP 3 851 288 A1

Description

Technical Field

[0001] The present invention relates to a printing apparatus.

Background Art

[0002] Patent Document 1 discloses a method of manufacturing a can body including a basic molding step molding a material into a cylindrical unprocessed can body and a printing step performing printing processing on an outer circumferential surface of the unprocessed can body molded in the basic molding step.

Citation List

Patent Literature

[0003] Patent Document 1: Japanese Patent Application Laid-Open Publication No. 2008-183613

Summary of Invention

Technical Problem

[0004] When printing onto a can body is performed, to prevent displacements of the image to be formed, a mode for detecting a phase of the can body and starting printing onto the can body can be considered.

[0005] Here, for example, a mode in which a detection unit to detect a phase of a can body is provided at an installation location of an image forming unit and the phase of the can body is detected after the can body reaches the image forming unit can be considered. By the way, in this case, the time required to start image formation after the can body has reached the image forming unit becomes longer, and therefore printing efficiency for the can bodies is likely to be deteriorated.

[0006] An object of the present invention is to increase printing efficiency for the can bodies as compared to a case in which a unit of detecting a phase of a can body is provided on a main body side of a printing apparatus.

Solution to Problem

[0007] A printing apparatus to which the present invention is applied includes: an image forming unit performing image formation onto a can body; plural moving bodies each of which supports the can body in a rotatable state and moves toward the image forming unit; and a detection unit provided to each of the moving bodies to detect a phase of the can body.

[0008] Here, the detection unit detects a phase of a rotation body rotating in synchronization with rotation of the can body to detect the phase of the can body.

[0009] Moreover, each of the moving bodies is provided with a transmission shaft for transmitting a rotational driving force to the can body, and a rotation center of the rotation body is positioned at a location deviated from the transmission shaft.

[0010] Moreover, the moving body supports plural can bodies, and a phase of each of the plural can bodies is detected by the detection unit that is shared.

[0011] Moreover, the printing apparatus is provided with a driving source rotating the can body supported by the moving body, and the driving source is provided at a location different from the moving body.

[0012] Moreover, transmission of a driving force from a driving-source-side rotation body provided on a driving source side to a moving-body-side rotation body provided on a moving body side rotates the can body supported by the moving body.

[0013] Moreover, use of a magnetic force rotates the moving-body-side rotation body in synchronization with the driving-source-side rotation body to transmit the driving force from the driving-source-side rotation body to the moving-body-side rotation body.

[0014] Moreover, when the driving force is transmitted from the driving-source-side rotation body to the moving-body-side rotation body, the driving-source-side rotation body and the moving-body-side rotation body are disposed in a non-contact state.

[0015] Moreover, the printing apparatus is provided with a transmission part disposed along a moving route of the moving body, receiving contact from a part of the moving body, and transmitting a detection result by the detection unit.

[0016] Moreover, the printing apparatus is provided with the plural transmission parts, and each of the moving bodies is provided with the transmission part receiving contact from the part included in each of the moving bodies.

[0017] Moreover, the plural transmission parts are disposed in line in a direction crossing a direction in which the moving route of the moving body extends.

[0018] Moreover, a position of the part included in each of the plural moving bodies in the crossing direction is different per the moving body, and the transmission part with which the part included in each of the plural moving bodies comes in contact is different per the moving body.

Advantageous Effects of Invention

[0019] According to the present invention, it is possible to increase printing efficiency for the can bodies as compared to a case in which a unit of detecting a phase of a can body is provided on a main body side of a printing apparatus.

Brief Description of Drawings

[0020]

FIG. 1 is a side elevational view of a printing appa-

ratus;

FIG. 2 is a diagram illustrating an inspection device;

FIG. 3 is a diagram showing another configuration example of the printing apparatus;

FIG. 4 is a diagram showing a case in which a first inkjet head, a second inkjet head and a moving unit are viewed from a direction of the arrow IV in FIG. 1; and

FIG. 5 is a diagram showing a case in which the moving unit and the like are viewed from a direction of the arrow V in FIG. 4.

Description of Embodiments

[0021] Hereinafter, an exemplary embodiment according to the present invention will be described in detail with reference to attached drawings.

[0022] FIG. 1 is a side elevational view of a printing apparatus 500.

[0023] The printing apparatus 500 is provided with a can body supply part 510 to which can bodies 10 are supplied. In the can body supply part 510, the can body 10 is supplied (attached) to a support member 20 supporting the can body 10.

[0024] Specifically, the support member 20 is formed into a cylindrical shape and the support member 20 is inserted into the cylindrically-shaped can body 10; thereby the can body 10 is supplied to the support member 20.

[0025] Further, the can body supply part 510 is provided with an inspection device 92.

[0026] The inspection device 92 inspects whether or not the can body 10 is deformed.

[0027] More specifically, as shown in FIG. 2 (a diagram illustrating the inspection device 92), the inspection device 92 is provided with a light source 92A.

[0028] The light source 92A is provided on one end portion side of the can body 10 and the light source 92A emits laser light that proceeds in an axial direction of the can body 10 along the outer circumferential surface of the can body 10. Further, on the other end portion side of the can body 10, there is provided a light receiving part 92B that receives laser light from the light source 92A.

[0029] When a part of the can body 10 is deformed as indicated by the reference sign 3A, the laser light is cut off and the light receiving part 92B cannot receive the laser light. Consequently, deformation of the can body 10 is detected.

[0030] Then, in the exemplary embodiment, when it is determined by the inspection device 92 that the can body 10 does not satisfy predetermined conditions (when it is determined that the can body 10 is deformed), a discharge mechanism 93 (refer to FIG. 1) discharges the can body 10 to the outside of the printing apparatus 500.

[0031] The discharge mechanism 93 is, as shown in FIG. 1, disposed between the inspection device 92 and an inkjet printing part 700 (disposed on an upstream side of the inkjet printing part 700).

[0032] In the exemplary embodiment, before image formation by the inkjet printing part 700 is performed, a deformed can body 10 is discharged from the printing apparatus 500.

[0033] In the discharge mechanism 93, compressed air is supplied to the inside of the cylindrically-formed support member 20, to move the can body 10 in the axial direction thereof (in the direction orthogonal to the page of FIG. 1).

[0034] Further, the bottom portion 10A (the closed end portion) of the can body 10 is sucked by a not-shown suction member. Then, by the suction member, the can body 10 is conveyed to the outside of the printing apparatus 500; thereby the can body 10 is discharged to the outside of the printing apparatus 500.

[0035] On a downstream side of the discharge mechanism 93, the inkjet printing part 700 is provided.

[0036] The inkjet printing part 700 as an example of an image forming unit forms an image on the can body 10 by use of the inkjet printing method, the can body 10 having moved from the upstream side.

[0037] To additionally describe, in the exemplary embodiment, in performing image formation by the inkjet printing part 700, moving units 550 sequentially move toward the inkjet printing part 700 from an upstream side of the inkjet printing part 700 (refer to the arrow 1A).

[0038] Then, in the exemplary embodiment, image formation by the inkjet printing part 700 is performed on the can bodies 10 on the moving units 550.

[0039] Here, image formation by the inkjet printing method refers to image formation performed by ejecting ink from inkjet heads 11 to attach the ink to the can body 10.

[0040] In the image formation by the inkjet printing method, known methods can be used. Specifically, for example, a piezo system, a thermal (bubble) system, a continuous system or the like can be used.

[0041] On a downstream side of the inkjet printing part 700, a light irradiation part 750 is provided as an example of a light irradiation unit.

[0042] The light irradiation part 750 includes a light source and irradiates the outer circumferential surface of the can body 10, on which image formation by the inkjet printing part 700 has been performed, with light, to thereby cure the image formed on the outer circumferential surface.

[0043] In the inkjet printing part 700, the image is formed by use of ultraviolet cure ink. To additionally describe, in the inkjet printing part 700, the image is formed by use of actinic radiation cure ink.

[0044] In the light irradiation part 750, the formed image is irradiated with light, such as ultraviolet light. This cures the image formed on the outer circumferential surface of the can body 10.

[0045] Here, the inkjet printing part 700 and the light irradiation part 750 are disposed on a lateral side of a first linear part 810 (details thereof will be described later).

[0046] The protection layer forming part 770 is disposed on the downstream side of the inkjet printing part

700 and the light irradiation part 750.

[0047] The protection layer forming part 770 attaches transparent paint onto an image formed by the inkjet printing part 700 to form a transparent layer covering the image. Consequently, in the exemplary embodiment, a transparent protection layer is formed as the outermost layer of the can body 10.

[0048] On the downstream side of the protection layer forming part 770, a detachment part 780 detaching the can body 10 from the support member 20 is provided.

[0049] In the exemplary embodiment, the can body 10 is detached from the support member 20 in the detachment part 780 to be discharged to the outside of the printing apparatus 500.

[0050] Further, the printing apparatus 500 is provided with plural moving units 550 as an example of moving bodies that move while supporting the can bodies 10.

[0051] In the exemplary embodiment, the support member 20 supporting the can body 10 is attached to the moving unit 550, and the can body 10 moves together with the moving unit 550.

[0052] Note that FIG. 1 shows the case in which the moving unit 550 supports a single can body 10; however, as described later (as shown in FIG. 4), two (plural) can bodies 10 may be placed on the moving unit 550 to thereby cause a single moving unit 550 to support plural can bodies 10.

[0053] Moreover, in the case where a single moving unit 550 supports the plural can bodies 10, plural inkjet heads 11 are installed at each stop location P for the moving unit 550 as described later (as shown in FIG. 4).

[0054] The support member 20 (refer to FIG. 1) is formed cylindrically, and further, provided in a state being rotatable in the circumferential direction.

[0055] In the exemplary embodiment, since the can body 10 is supported by the support member 20 that is rotatable in the circumferential direction, the can body 10 is also supported in the state being rotatable in the circumferential direction.

[0056] The can body 10 is formed into a cylindrical shape and an opening portion is provided to one end thereof. Moreover, the other end of the can body 10 is closed and the other end is provided with a bottom portion 10A. The support member 20 is inserted into the can body 10 from the opening portion.

[0057] Further, in the exemplary embodiment, a moving mechanism 560 that functions as a mover unit that moves the moving units 550. The moving mechanism 560 is provided with an annular-shaped guidance member 561 that guides the moving units 550.

[0058] Each of the moving units 550 is guided by the guidance member 561 and orbitally moves along a predetermined annular-shaped movement route 800.

[0059] With this, in the exemplary embodiment, the support member 20 provided to the moving unit 550 and the can body 10 supported by the support member 20 also move along the predetermined annular-shaped movement route 800.

[0060] The movement route 800 is disposed so that the axial center 800C thereof is arranged along the horizontal direction. To put it another way, the movement route 800 is disposed around the axial center 800C along the horizontal direction. Here, the axial center 800C extends in the direction orthogonal to the page in FIG. 1.

[0061] In this case, in the exemplary embodiment, the support member 20 and the can body 10 orbitally move around the axial center 800C extending in the direction orthogonal to the page in the figure.

[0062] The movement route 800 is provided with the first linear part 810, which is a linear movement route, and a second linear part 820, which is similarly a linear movement route.

[0063] Each of the first linear part 810 and the second linear part 820 is disposed to extend along the horizontal direction. Moreover, the first linear part 810 and the second linear part 820 are disposed to be substantially in parallel with each other. Further, in the exemplary embodiment, the first linear part 810 is disposed above the second linear part 820.

[0064] Further, the first linear part 810 is provided to an uppermost portion of the annular-shaped movement route 800, whereas the second linear part 820 is provided to a lowermost portion of the annular-shaped movement route 800.

[0065] Further, in the exemplary embodiment, the inkjet printing part 700 is provided above the first linear part 810 where the uppermost portion is positioned.

[0066] Further, the movement route 800 is provided with a first curved part 830 and a second curved part 840, each of which is formed into an arc with a curvature.

[0067] The first curved part 830 connects a right end portion of the first linear part 810 in the figure and a right end portion of the second linear part 820 in the figure. In addition, the first curved part 830 is formed to head downward from above.

[0068] Moreover, the second curved part 840 connects a left end portion of the first linear part 810 in the figure and a left end portion of the second curved part 820 in the figure. In addition, the second curved part 840 is formed to head upward from below.

[0069] Next, the inkjet printing part 700 will be described.

[0070] The inkjet printing part 700 is disposed above the first linear part 810 to perform image formation onto the can body 10 positioned at the first linear part 810.

[0071] The inkjet printing part 700 is provided with plural inkjet heads 11 arranged in line in the left and right directions in the figure. The portion where the plural inkjet heads 11 are provided can be grasped as an image forming unit that performs image formation onto the can body 10.

[0072] Specifically, the inkjet printing part 700 is provided with the first inkjet head 11C ejecting the cyan ink, the second inkjet head 11M ejecting the magenta ink, the third inkjet head 11Y ejecting the yellow ink and the fourth inkjet head 11K ejecting the black ink.

[0073] In the following description, in the case where there are no particular distinctions among the first inkjet head 11C to the fourth inkjet head 11K, the inkjet heads are simply referred to as "inkjet heads 11."

[0074] Note that, in the exemplary embodiment, the case in which the four inkjet heads 11 were provided was shown as an example; however, an inkjet head 11 ejecting ink of a special color, such as a corporate color, or an inkjet head 11 for forming a white layer may be provided further.

[0075] Here, the four inkjet heads 11, namely, the first inkjet head 11C to the fourth inkjet head 11K perform image formation onto the can body 10 by use of the ultraviolet cure ink.

[0076] Moreover, in the exemplary embodiment, the can body 10 is moved in a state of being laid (the can body 10 is moved in the state in which the axial direction of the can body 10 extends along the horizontal state), and a part of the outer circumferential surface of the can body 10 faces upward in the vertical direction.

[0077] In the exemplary embodiment, ink is ejected downwardly from above the outer circumferential surface, to thereby perform image formation onto the outer circumferential surface of the can body 10.

[0078] Moreover, in the exemplary embodiment, the moving unit 550 stops below each inkjet head 11, and the ink is ejected onto the can body 10 on the moving unit 550, to thereby perform image formation onto the can body 10.

[0079] Then, in the exemplary embodiment, when image formation onto the can body 10 is finished, the moving unit 550 moves toward the inkjet head 11 positioned next in the downstream side, and image formation onto the can body 10 is further performed at the inkjet head 11.

[0080] Further, in the exemplary embodiment, the four inkjet heads 11 are arranged in line along the moving direction of the can body 10. Moreover, each of the four inkjet heads 11 is disposed along a direction orthogonal to (crossing) the moving direction of the can body 10.

[0081] In the exemplary embodiment, in a process in which the can body 10 passes through below the four inkjet heads 11, ink is ejected to the can body 10 from above, and thereby an image is formed on the can body 10.

[0082] More specifically, in the exemplary embodiment, the moving unit 550 stops at the installation location of each of the plural inkjet heads 11 that have been provided.

[0083] Then, in each of the inkjet heads 11, ink is ejected onto the can body 10, to thereby form an image onto the can body 10. Note that, when the image formation if performed in each of the inkjet heads 11, the can body 10 rotates in the circumferential direction.

[0084] Each of the moving units 550, as an example of a moving body, moves at a predetermined moving speed.

[0085] Moreover, each of the moving units 550 stops at each of the can body supply part 510, the inspection device 92, the discharge mechanism 93, each inkjet head 11, the light irradiation part 750, the protection layer forming part 770 and the detachment part 780.

[0086] Moreover, at the installation location of each of the inspection device 92, each inkjet head 11, the light irradiation part 750, the protection layer forming part 770 and the like, the can body 10 on the moving unit 550 rotates in the circumferential direction at the predetermined rotation speed.

[0087] In addition, in the printing apparatus 500 of the exemplary embodiment, the moving units 550 of the number larger than the number of can bodies 10 positioned in the printing apparatus 500 are installed. Further, the moving units 550 move around the axial center 800C.

[0088] The moving mechanism 560 is provided with an annular-shaped guidance member 561 that guides the moving units 550. Inside the guidance member 561, electromagnets (not shown) are provided.

[0089] Further, in the moving unit 550, a permanent magnet (not shown) is installed.

[0090] In the exemplary embodiment, a linear-motor mechanism is used to move the moving units 550.

[0091] More specifically, the printing apparatus 500 of the exemplary embodiment is provided with a control part 900, and the control part 900 controls energization to the above-described electromagnets, to thereby generate magnetic fields and move each of the moving units 550. Note that the control unit 900 is composed of a program-controlled CPU (Central Processing Unit).

[0092] As shown in FIG. 1, the moving unit 550 is provided with a pedestal part 551 guided by the guidance member 561. In the pedestal part 551, the permanent magnet (not shown) is installed.

[0093] In the exemplary embodiment, a propulsive force occurs in the moving unit 550 by magnetic fields generated by electromagnets provided to the guidance member 561 and the permanent magnet provided to the pedestal part 551 of the moving unit 550, and thereby the moving unit 550 moves along the annular-shaped movement route 800.

[0094] Further, the moving unit 550 of the exemplary embodiment is provided with the cylindrical support member 20 supporting the can body 10 and a fixing member 553 for fixing the support member 20 to the pedestal part 551. The fixing member 553 is provided in the shape of standing from the pedestal part 551.

[0095] The support member 20 of the exemplary embodiment is formed into the cylindrical shape, and inserted into the can body 10 through the opening portion formed in the can body 10 to support the can body 10. In addition, the support member 20 is disposed in the state of being laid (along the horizontal direction). Consequently, in the exemplary embodiment, the can body 10 is also disposed in the state of being laid.

[0096] In the exemplary embodiment, when the can body 10 reaches each of the inkjet heads 11, ink is ejected from each of the inkjet heads 11 to the can body 10 positioned below. Consequently, an image is formed on the

outer circumferential surface of the can body 10.

[0097] The light irradiation part 750 is disposed on the downstream side of the inkjet printing part 700 and irradiates the can body 10 with the ultraviolet light being an example of light. Consequently, the image formed on the outer circumferential surface of the can body 10 (the image formed by the inkjet printing part 700) is cured.

[0098] Note that, when image formation onto the can body 10 is performed, thermosetting ink may also be used; in this case, for example, a heat source, not a light source, is installed at the location where the light irradiation part 750 is provided.

[0099] In the exemplary embodiment, the moving unit 550 stops every time the moving unit 550 reaches below each of the inkjet heads 11. In other words, the moving unit 550 stops at each of predetermined stop locations.

[0100] Then, in the exemplary embodiment, onto the outer circumferential surface of the can body 10 held by the moving unit 550 stopped at the predetermined stop location, an image is formed by the inkjet heads 11 as an example of the image forming unit.

[0101] More specifically, at the installation location of each of the inkjet heads 11, ejection of ink from the inkjet head 11 is performed in the state in which the support member 20 (the can body 10) rotates in the circumferential direction, to thereby form an image onto the outer circumferential surface of the can body 10.

[0102] In the exemplary embodiment, when the support member 20 rotates 360° after ejection of ink is started, ejection of ink is stopped. Consequently, an image is formed on the entire region in the circumferential direction of the outer circumferential surface of the can body 10.

[0103] In the exemplary embodiment, the support member 20 shown in FIG. 1 is disposed along the direction orthogonal to the page of FIG. 1. To put it another way, the support member 20 is disposed to extend along the horizontal direction.

[0104] Moreover, the support member 20 is disposed along the direction orthogonal to (crossing) the moving direction of the moving unit 550.

[0105] Moreover, in the exemplary embodiment, the inkjet heads 11 are positioned above the can body 10, and the ink is ejected to the can body 10 from above.

[0106] In this case, as compared to a case in which the inkjet heads 11 are disposed at the lateral side of the can body 10 or below the can body 10, it is possible to reduce the effect of gravity acting on ink droplets ejected from the inkjet heads 11, to thereby increase accuracy of ink adhesive positions in the can body 10.

[0107] Further, in the exemplary embodiment, the inkjet printing part 700 (the plural inkjet heads 11) is provided on the lateral side of (above) the first linear part 810.

[0108] Consequently, as compared to the case in which the inkjet printing part 700 (the plural inkjet heads 11) is provided on the lateral side of the curved part (the first curved part 830 or the second curved part 840), quality of the image to be formed on the can body 10 is likely to be improved.

[0109] Here, in the case where the inkjet heads 11 are provided on the lateral side of the curved part, for example, as shown in FIG. 3 (a diagram showing another configuration example of the printing apparatus 500), the attitudes of the inkjet heads 11 are different in each of the inkjet heads 11.

[0110] In this case, as compared to the case where the attitudes of the inkjet heads 11 are the same, the quality of the image to be formed is likely to be degraded due to occurrence of misregistration among images formed by the respective inkjet heads 11.

[0111] In contrast thereto, if the inkjet printing part 700 is provided on the lateral side of the linear part (the first linear part 810) as in the exemplary embodiment, the attitudes of the plural inkjet heads 11 are easily aligned, and thereby degradation of quality of the image to be formed can be suppressed.

[0112] FIG. 4 is a diagram showing a case in which the first inkjet head 11C, the second inkjet head 11M, and the moving unit 550 are viewed from the direction of the arrow IV in FIG. 1.

[0113] Note that, in FIG. 4, illustration of the moving unit 550 positioned directly below the second inkjet head 11M is omitted.

[0114] Though illustration was omitted in FIG. 1, in the exemplary embodiment, as shown in FIG. 4, each of the stop locations P, where the moving unit 550 stops, is provided with a servomotor M as an example of a driving source to rotate the can body 10.

[0115] To additionally describe, beside the moving route R of the moving unit 550, a servomotor M that rotates the can body 10 supported by the moving unit 550 is provided.

[0116] In the exemplary embodiment, the driving source (servomotor M) rotating the can body 10 is not provided to the moving unit 550, but is provided to the main body side of the printing apparatus 500 (refer to FIG. 1).

[0117] To additionally describe, in the exemplary embodiment, the driving source for rotating the can body 10 is not provided to the moving unit 550, but is provided to a different location from the moving unit 550.

[0118] Consequently, the moving unit 550 can be made light, and therefore, vibrations of the printing apparatus 500 caused by movement of the moving units 500 are reduced.

[0119] Here, if the moving unit 550 is provided with the driving source and thereby the moving unit 550 has a large weight, vibrations of the printing apparatus 500 when the moving units 550 are stopped are likely to be increased. Then, in this case, the inkjet heads 11 and the like vibrate, to thereby lead to degradation of image quality.

[0120] In contrast thereto, as in the exemplary embodiment, in the configuration in which the driving source is provided to the main body side of the printing apparatus 500, the moving unit 550 is made lighter in weight, and

thereby vibrations of the printing apparatus 500 when the moving units 550 are stopped are reduced.

[0121] As shown in FIG. 4, the moving unit 550 is provided with the pedestal part 551.

[0122] Further, on the pedestal part 551, two can bodies 10 are provided. The support member 20 is inserted into each of the can bodies 10, and thereby the can body 10 is supported by the support member 20.

[0123] Further, the moving unit 550 is provided with a transmission shaft 555 for transmitting a rotational driving force to the can body 10; in the exemplary embodiment, the rotational driving force from the servomotor M is transmitted to the can body 10 via the transmission shaft 555.

[0124] More specifically, the exemplary embodiment is provided with rotation gears 556 that are in contact with the respective support members 20 to rotate thereof; the rotation gears 556 are rotated by the transmission shafts 555, to thereby rotate the can bodies 10 in the circumferential direction. Note that, in the exemplary embodiment, the two can bodies 10 provided to each moving unit 550 are rotated in the same direction.

[0125] Further, in the exemplary embodiment, there is provided a phase detection mechanism 570 as an example of a detection unit that detects a phase of the can body 10.

[0126] The phase detection mechanism 570 is provided with an encoder 571.

[0127] The encoder 571 is a publicly known encoder 571 and is provided with a rotation body 571A rotating in synchronization with the can body 10. In the rotation body 571A, a slit (not shown) extending in the radial direction of the rotation body 571A is formed.

[0128] Further, though illustration is omitted, the encoder 571 is provided with a light source emitting light to the rotation body 571A and a light receiving part receiving light passed through the slit.

[0129] In the exemplary embodiment, the phase (the rotation angle) of the rotation body 571A is detected, and thereby the phase (the rotation angle) of the can body 10 is detected.

[0130] In the exemplary embodiment, the rotation body 571A is disposed to position the rotation center 571B of the rotation body 571A at a location deviated from the transmission shaft 555.

[0131] Here, suppose that the rotation center 571B of the rotation body 571A is positioned on the transmission shaft 555 (suppose that the encoder 571 is positioned on the transmission shaft 555), the size of the moving unit 550 in the direction indicated by the reference sign 4A (in the direction orthogonal to the moving direction of the moving unit 550) is likely to be increased.

[0132] In contrast thereto, configuration in which the rotation center 571B of the rotation body 571A is positioned at a location deviated from the transmission shaft 555 tends to reduce the size of the moving unit 550 in the direction indicated by the reference sign 4A.

[0133] Further, the phase detection mechanism 570 is provided with a transmission mechanism 572 transmitting the rotational driving force from the transmission shaft 555 to the encoder 571.

[0134] The transmission mechanism 572 is provided with: a first rotation body 572A formed into a columnar shape and disposed coaxially with the transmission shaft 555; a circulating belt 572B orbitally moving upon receiving the driving force from the first rotation body 572A; and a second rotation body 572C disposed coaxially with the rotation body 571A and rotating upon receiving the driving force from the circulating belt 572B.

[0135] In the exemplary embodiment, the rotational driving force is transmitted from the transmission shaft 555 to the encoder 571 by the transmission mechanism 572, and thereby the rotation body 571A is rotated.

[0136] The exemplary embodiment includes a configuration in which each of the moving units 550 is provided with plural can bodies 10, and the phase of each of the plural can bodies 10 is detected by the common phase detection mechanism 570.

[0137] To additionally describe, in the exemplary embodiment, the phase detection mechanism 570 is not provided to every can body 10, but the single phase detection mechanism 570 is provided for two can bodies 10.

[0138] This makes it possible to save the weight or reduce the number of parts of the moving unit 550, as compared to the case in which the phase detection mechanism 570 is provided to every can body 10.

[0139] Here, in the exemplary embodiment, transmission of the driving force from the servomotor M, which is the driving source, to the moving unit 550 is carried out by so-called magnet coupling.

[0140] Specifically, in the exemplary embodiment, on the servomotor M side (on the main body side of the printing apparatus 500), a driving-source-side rotation body 581 rotated by the servomotor M is provided.

[0141] Further, in the exemplary embodiment, on the moving unit 550 side, a moving-body-side rotation body 582 disposed coaxially with the transmission shaft 555 is provided.

[0142] In the exemplary embodiment, the driving force is transmitted from the driving-source-side rotation body 581 to the moving-body-side rotation body 582, and thereby the can body 10 is rotated.

[0143] More specifically, in the exemplary embodiment, use of the magnetic force rotates the moving-body-side rotation body 582 in synchronization with the driving-source-side rotation body 581, to thereby transmit the driving force from the driving-source-side rotation body 581 to the moving-body-side rotation body 582.

[0144] To additionally describe, in the exemplary embodiment, a magnet is provided to at least one of the driving-source-side rotation body 581 and the moving-body-side rotation body 582, and an attracted body to be attracted by the magnet is provided to the other one.

[0145] Consequently, in the exemplary embodiment, the magnetic force generated in the magnet is used to rotate the moving-body-side rotation body 582 in synchronization with the driving-source-side rotation body

581.

[0146] Then, in the exemplary embodiment, the transmission shaft 555 is rotated in response to the rotation of the moving-body-side rotation body 582, and, in accordance with this, the can body 10 is rotated in the circumferential direction.

[0147] In the exemplary embodiment, when the driving force is transmitted from the driving-source-side rotation body 581 to the moving-body-side rotation body 582 (when the moving unit 550 stops at the stop location P), as shown in FIG. 4, the driving-source-side rotation body 581 and the moving-body-side rotation body 582 are disposed to face each other.

[0148] Further, in the exemplary embodiment, the driving-source-side rotation body 581 and the moving-body-side rotation body 582 are disposed in the non-contact state at this time.

[0149] Here, in the case of non-contact state like this, displacement of the moving unit 550 caused by contact between the driving-source-side rotation body 581 and the moving-body-side rotation body 582 can be suppressed; therefore, misregistration of image formation positions due to displacement of the moving unit 550 can be suppressed.

[0150] Further, in the exemplary embodiment, a transmission part 300 for transmitting the phase detection result by the phase detection mechanism 570 to the control part 900 (refer to FIG. 1) is provided. The transmission part 300 is disposed along the moving route R of the moving unit 550. Moreover, the transmission part 300 is composed of so-called signal rails.

[0151] In the exemplary embodiment, part of the moving unit 550 is in contact with the transmission part 300, and thereby the detection result by the phase detection mechanism 570 provided to the moving unit 550 is forwarded to the control part 900 (refer to FIG. 1) via the transmission part 300.

[0152] More specifically, in the exemplary embodiment, a signal brush 558 to be brought into contact with the transmission part 300 is provided to a lower portion of the pedestal part 551 of the moving unit 550, and the detection result by the phase detection mechanism 570 is forwarded to the control part 900 via the signal brush 558 and the transmission part 300 (the signal rail).

[0153] Upon receiving the detection result, the control part 900 controls image formation by use of the inkjet printing part 700.

[0154] FIG. 5 is a diagram showing a case in which the moving unit 550 is viewed from the direction of the arrow V in FIG. 4.

[0155] In the exemplary embodiment, plural (plural pairs of) transmission parts 300 are provided. Specifically, four transmission parts 300, namely, a first transmission part 310 to a fourth transmission part 340 are provided.

[0156] The four transmission parts 300 are disposed in line in a direction crossing the direction in which the moving route R (also refer to FIG. 4) of the moving unit 550 extends.

[0157] Each of the four transmission parts 300 is provided with plural signal rails SR.

[0158] Here, a part of the signal rails SR of the plural signal rails SR supplies electric power to the encoder 571 (refer to FIG. 4).

[0159] Moreover, the other part of the signal rails SR forwards the detection result by the phase detection mechanism 570 to the control part 900.

[0160] As shown in FIG. 5, the signal brush 558 (refer to the reference sign 5E) provided to the moving unit 550 stopping at the installation location of the first inkjet head 11C is in contact with the first transmission part 310 among the four transmission parts 300.

[0161] Moreover, in FIG. 5, a signal brush 558 provided to a moving unit 550 (the moving unit 550 indicated by the reference sign 1D in FIG. 1) immediately following the moving unit 550 (hereinafter, referred to as the "preceding moving unit 550") is also shown together (refer to the reference sign 5F); when arriving at the installation location of the first inkjet head 11C, the signal brush 558 is brought into contact with the second transmission part 320.

[0162] Further, FIG. 5 also shows a signal brush 558 (refer to the reference sign 5G) provided to a moving unit 550 (the moving unit 550 indicated by the reference sign 1E in FIG. 1) following second after the preceding moving unit 550, and the signal brush 558 is brought into contact with the third transmission part 330.

[0163] Moreover, FIG. 5 also shows a signal brush 558 (refer to the reference sign 5H) provided to a moving unit 550 (the moving unit 550 indicated by the reference sign 1F in FIG. 1) following third after the preceding moving unit 550, and the signal brush 558 is brought into contact with the fourth transmission part 340.

[0164] Thus, in the exemplary embodiment, the transmission part 300 to be in contact with the signal brush 558 included in each moving unit 550 is provided for each moving unit 550.

[0165] To additionally describe, the installation positions of the signal brushes 558 included in the respective plural moving units 550 are different among the moving units 550. Consequently, the transmission part 300 with which the signal brush 558 included by each moving unit 550 is in contact is different per each moving unit 550.

[0166] More specifically, in the exemplary embodiment, in the direction (the direction indicated by the reference sign 5X in FIG. 5) crossing the moving direction of the moving unit 550, the installation positions of the signal brushes 558 included in the respective moving units 550 are different from one another.

[0167] Moreover, in the same manner, the installation positions of the first transmission part 310 to the fourth transmission part 340 are different from one another in the direction crossing the moving direction of the moving unit 550.

[0168] Consequently, in the exemplary embodiment, the transmission part 300 to be in contact with the signal

brush 558 included in each of the moving units 550 is different per each moving unit 550.

[0169] Note that, in moving units 550 subsequent to a moving unit 550 (the moving unit 550 indicated by the reference sign 1G in FIG. 1) following fourth after the preceding moving unit 550, similarly, the transmission part 300 to be in contact with the signal brush 558 included in each of the moving units 550 is different per each moving unit 550.

[0170] To additionally describe, in the exemplary embodiment, the four kinds of moving units 550 with the installation positions of the signal brushes 558 different from one another move on the moving route R in the order from the first kind to the fourth kind. Consequently, in the exemplary embodiment, at the installation location of the inkjet printing part 700, the transmission part 300 to be in contact with the signal brush 558 included in each of the moving units 550 is different per each moving unit 550.

[0171] Here, if there is only one transmission part 300 and the signal brushes 558 included in the plural respective moving units 550 are brought into contact with the one transmission part 300, the phase of the can body 10 in each of the moving units 550 cannot be detected in the control part 900.

[0172] In the exemplary embodiment, different transmission parts 300 are provided to the respective moving units 550, to thereby enable the control part 900 to detect the phase of the can body 10 in each of the moving units 550.

[0173] To additionally describe, at the installation location of the inkjet printing part 700, only one signal brush 558 is brought into contact with one transmission part 300, and thereby detection of the phase of the can body 10 can be carried out per each moving unit 550.

[0174] Further, in the exemplary embodiment, as shown in FIG. 5, each of the stop locations P (the main body side of the printing apparatus 500) for the moving units 550 is provided with a suction mechanism 980 sucking the can body 10. The suction mechanism 980 is provided with a contacted part 981 with which the moving unit 550 is to be brought into contact and a suction tube 982 connected to the contacted part 981.

[0175] On the other hand, the moving unit 550 is provided with a contact part 591 coming into contact with the contacted part 981 and a connection tube 592 connecting the contact part 591 and the support member 20.

[0176] In the exemplary embodiment, when the moving unit 550 stops at the stop location P, the contact part 591 comes into contact with the contacted part 981, and the suction tube 982 and the connection tube 592 are connected. Consequently, the can body 10 is sucked and the can body 10 is biased toward the root side of the support member 20.

[0177] Consequently, in the exemplary embodiment, positioning of the can body 10 in the axial direction thereof is performed by the biasing.

[0178] Here, the printing processing in the inkjet printing part 700 will be described.

[0179] In the exemplary embodiment, before starting ink ejection (before starting image formation) at the first inkjet head 11C (refer to FIG. 1), the control part 900 detects the phase of the can body 10 positioned below the first inkjet head 11C based on the detection result forwarded via the transmission part 300.

[0180] In other words, when ink ejection is to be started at the first inkjet head 11C, the control part 900 detects the phase of the can body 10 on the moving unit 550 stopping below the first inkjet head 11C.

[0181] To additionally describe, the control part 900 detects the phase of the can body 10 when starting ink ejection onto the can body 10 positioned below the first inkjet head 11C.

[0182] Then, the control part 900 retains the detected phase. Hereinafter, the retained phase is referred to as a "retained phase."

[0183] Next, in the exemplary embodiment, the moving unit 550 moves to the second inkjet head 11M, and ink ejection by the second inkjet head 11M is started. At this time, the control part 900 controls the ink ejection at the second inkjet head 11M to start ink ejection when the phase of the can body 10 has shifted to the retained phase.

[0184] Based on the detection result forwarded via the transmission part 300, the control part 900 has grasped the phase of the can body 10 positioned directly below the second inkjet head 11M; accordingly, the control part 900 controls the ink ejection at the second inkjet head 11M to start ink ejection when the phase has shifted to the retained phase.

[0185] To additionally describe, the control part 900 controls the ink ejection at the second inkjet head 11M to align the image formation starting position by the first inkjet head 11C and the image formation starting position by the second inkjet head 11M.

[0186] More specifically, in the exemplary embodiment, when the ink ejection by the second inkjet head 11M is started, the can body 10 is in the state of rotating in the circumferential direction.

[0187] The control part 900 controls the second inkjet head 11M to start the ink ejection from the second inkjet head 11M when the image formation starting position by the first inkjet head 11C reaches directly below the second inkjet head 11M.

[0188] This prevents misregistration between the first-color image formed by the first inkjet head 11C and the second-color image formed by the second inkjet head 11M.

[0189] Thereafter, in the exemplary embodiment, the moving unit 550 moves to the third inkjet head 11Y and the fourth inkjet head 11K; then, the processes similar to the above are also performed.

[0190] Specifically, the control part 900 controls the ink ejection at the third inkjet head 11Y to align the image formation starting position by the first inkjet head 11C and the image formation starting position by the third

inkjet head 11Y.

[0191] Moreover, the control part 900 controls the ink ejection at the fourth inkjet head 11K to align the image formation starting position by the first inkjet head 11C and the image formation starting position by the fourth inkjet head 11K.

[0192] Consequently, in the exemplary embodiment, generation of misregistration among the images formed by the respective colors can be suppressed.

[0193] Here, if the can body 10 does not rotate until reaching the next inkjet head 11 after the can body 10 has rotated 360° below each inkjet head 11, image formation onto the can body 10 can be performed without detecting the phase of the can body 10.

[0194] To additionally describe, in the case where the can body 10 does not rotate until reaching the next inkjet head 11 after the can body 10 has rotated 360° below each inkjet head 11, the above-described image formation starting position is always located directly below each inkjet head 11. In this case, image formation onto the can body 10 can be performed without detecting the phase of the can body 10.

[0195] However, in actuality, it is assumed that the can body 10 rotates from completion of image formation in the inkjet head 11 until arrival of the can body 10 at the next inkjet head 11; in this case, misregistration among the images formed by the respective colors is likely to occur.

[0196] In contrast thereto, occurrence of the misregistration can be suppressed by controlling the ink ejection in each inkjet head 11 based on the detection result of the phase of the can body 10 as in the exemplary embodiment.

[0197] Here, as another mode, it is also possible to provide the mechanism for detecting the phase of the can body 10 to, for example, each of the installation positions of the inkjet heads 11, not the moving unit 550, to thereby detect the phase of the can body 10 every time the moving unit 550 reaches the installation position.

[0198] By the way, in this case, since the phase detection is started after the moving unit 550 reaches the installation position, the time until starting the image formation becomes longer and the printing efficiency is deteriorated.

[0199] In contrast thereto, in the exemplary embodiment, since detection of the phase of the can body 10 is finished when the can body 10 reaches each inkjet head 11, image formation can be started earlier and the printing efficiency can be increased.

[Others]

[0200] In the above, the moving unit 550 is moved by using a so-called linear motor mechanism, but movement of the moving unit 550 is not limited to the linear motor mechanism; for example, the movement may be performed by attaching the moving unit 550 to an endless member (a member such as a belt or a chain) and orbitally moving the endless member.

[0201] Moreover, for example, it may be possible to provide a driving source, such as a motor, for moving the moving unit 550 to each of the moving units 550, to thereby move the moving unit 550 autonomously.

[0202] Moreover, in the above, the case in which a driving source (the servomotor M) was provided to the installation location of the inkjet head 11 was shown; however, the driving sources are provided to other locations, such as the inspection device 92 (refer to FIG. 1), the light irradiation part 750 and the protection layer forming part 770.

[0203] In the exemplary embodiment, in the other locations, the can body 10 is rotated by the driving source provided separately from the moving unit 550.

[0204] Moreover, in the above, the detection result from the moving unit 550 was outputted by use of the transmission part 300 coming into contact with the moving unit 550; however, the output of the detection result from the moving unit 550 (the detection result by the phase detection mechanism 570) is not limited to the contact system, and the detection result may be outputted by a non-contact system, such as outputting by use of wireless communication.

[0205] Further, the transmission part 300 for transmitting the signal output from the moving unit 550 to the control part 900 may be provided above the moving unit 550.

[0206] Moreover, though the printing efficiency is deteriorated as compared to the case of using the above-described transmission part 300, a terminal for reading the detection result by the phase detection mechanism 570 may be provided to the installation location of each inkjet head 11 to read the detection result every time the moving unit 550 reaches each of the inkjet heads 11.

[0207] Moreover, in the above, the phase of the can body 10 was detected by using the encoder 571, but the phase detection of the can body 10 may be carried out by using other mechanisms.

[0208] Specifically, for example, an imaging unit, such as a CCD (Charge Coupled Device), may be provided to the moving unit 550, and the imaging result by the imaging unit can be analyzed to detect the phase of the can body 10.

[0209] Note that, in this case, it is preferable to form images for detecting the phase of the can body 10 on the outer circumferential surface of the can body 10 in advance, such as to provide tick marks (images indicating the tick marks) on the outer circumferential surface of the can body 10.

Reference Signs List

[0210]

10 Can body
300 Transmission unit
500 Printing apparatus

550 Moving unit
555 Transmission shaft
558 Signal brush
570 Phase detection mechanism
571A Rotation body
571B Rotation center
581 Driving-source-side rotation body
582 Moving-body-side rotation body
700 Inkjet printing part
M Servomotor
R Moving route

Claims

1. A printing apparatus comprising:

an image forming unit performing image formation onto a can body;
a plurality of moving bodies each of which supports the can body in a rotatable state and moves toward the image forming unit; and
a detection unit provided to each of the moving bodies to detect a phase of the can body.

2. The printing apparatus according to claim 1, wherein the detection unit detects a phase of a rotation body rotating in synchronization with rotation of the can body to detect the phase of the can body.

3. The printing apparatus according to claim 2, wherein each of the moving bodies is provided with a transmission shaft for transmitting a rotational driving force to the can body, and
a rotation center of the rotation body is positioned at a location deviated from the transmission shaft.

4. The printing apparatus according to claim 1, wherein the moving body supports a plurality of can bodies, and
a phase of each of the plurality of can bodies is detected by the detection unit that is shared.

5. The printing apparatus according to claim 1, further comprising:

a driving source rotating the can body supported by the moving body, wherein
the driving source is provided at a location different from the moving body.

6. The printing apparatus according to claim 5, wherein transmission of a driving force from a driving-source-side rotation body provided on a driving source side to a moving-body-side rotation body provided on a moving body side rotates the can body supported by the moving body.

7. The printing apparatus according to claim 6, wherein use of a magnetic force rotates the moving-body-side rotation body in synchronization with the driving-source-side rotation body to transmit the driving force from the driving-source-side rotation body to the moving-body-side rotation body.

8. The printing apparatus according to claim 7, wherein, when the driving force is transmitted from the driving-source-side rotation body to the moving-body-side rotation body, the driving-source-side rotation body and the moving-body-side rotation body are disposed in a non-contact state.

9. The printing apparatus according to claim 1, further comprising:
a transmission part disposed along a moving route of the moving body, receiving contact from a part of the moving body, and transmitting a detection result by the detection unit.

10. The printing apparatus according to claim 9, wherein the transmission part includes a plurality of transmission parts, and
each of the moving bodies is provided with the transmission part receiving contact from the part included in each of the moving bodies.

11. The printing apparatus according to claim 10, wherein the plural transmission parts are disposed in line in a direction crossing a direction in which the moving route of the moving body extends.

12. The printing apparatus according to claim 11, wherein a position of the part included in each of the plural moving bodies in the crossing direction is different per the moving body, and the transmission part with which the part included in each of the plural moving bodies comes in contact is different per the moving body.

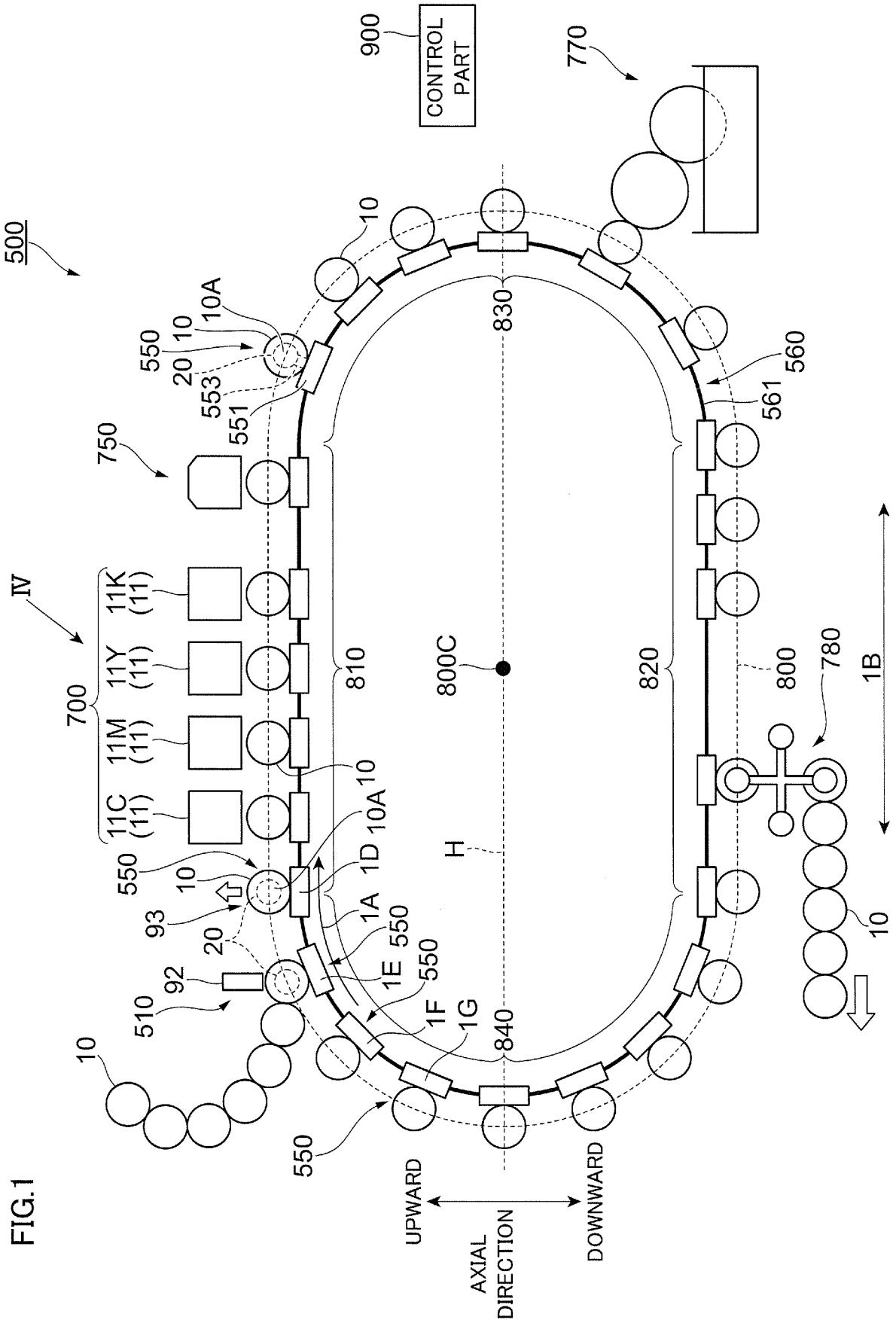

500
900
CONTROL PART
770
10
830
10A
550
10
20
553
551
560
561
750
IV
700
11K (11)
11Y (11)
11M (11)
11C (11)
810
800C
820
800
780
1B
H
10
10A
1D
550
10
93
1A
20
1E
550
92
550
510
1F
1G
840
10
550
UPWARD
AXIAL DIRECTION
DOWNWARD

FIG.1

FIG.2

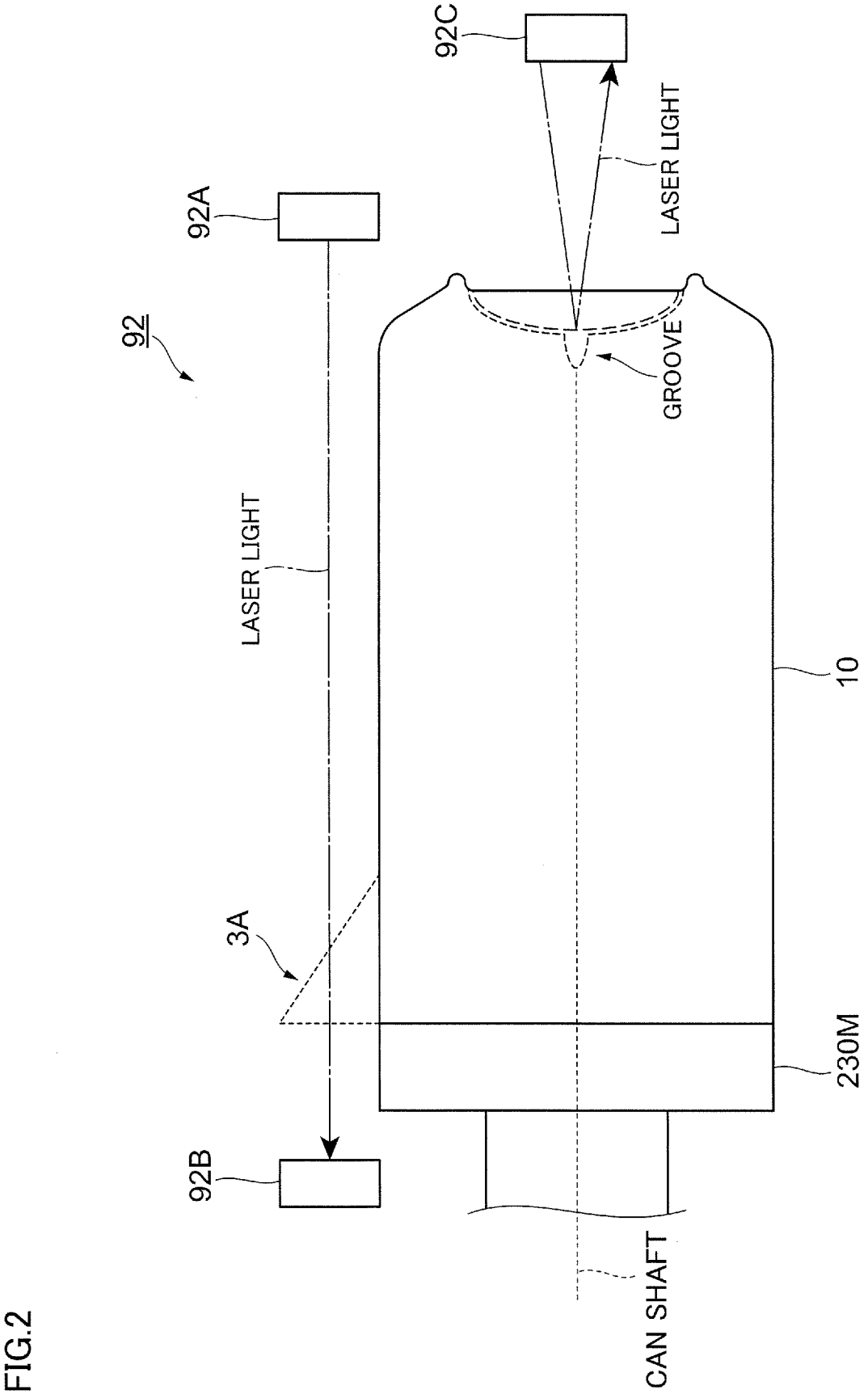

92C
LASER LIGHT
92A
92
GROOVE
LASER LIGHT
10
3A
230M
92B
CAN SHAFT

FIG.3

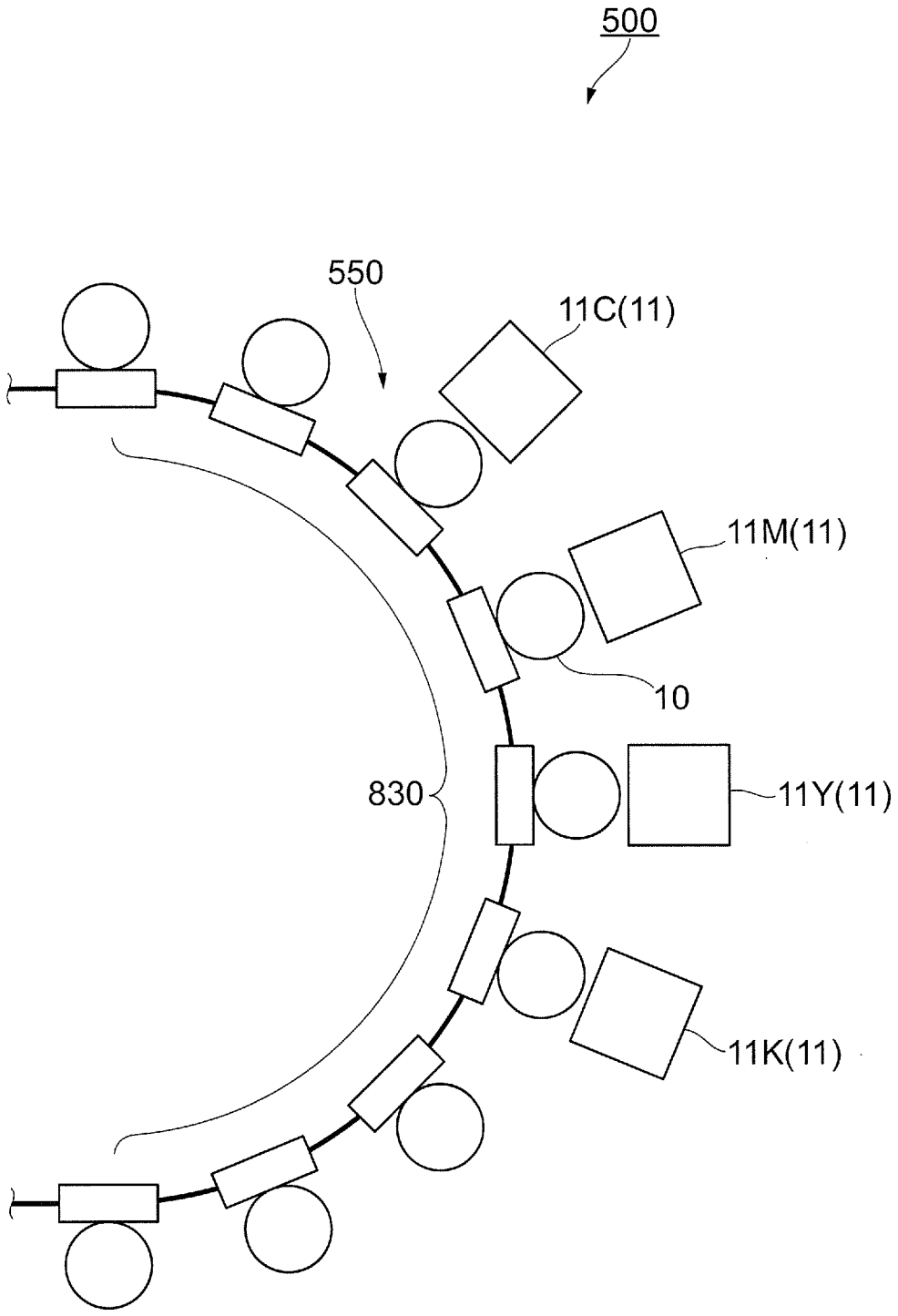


FIG.4

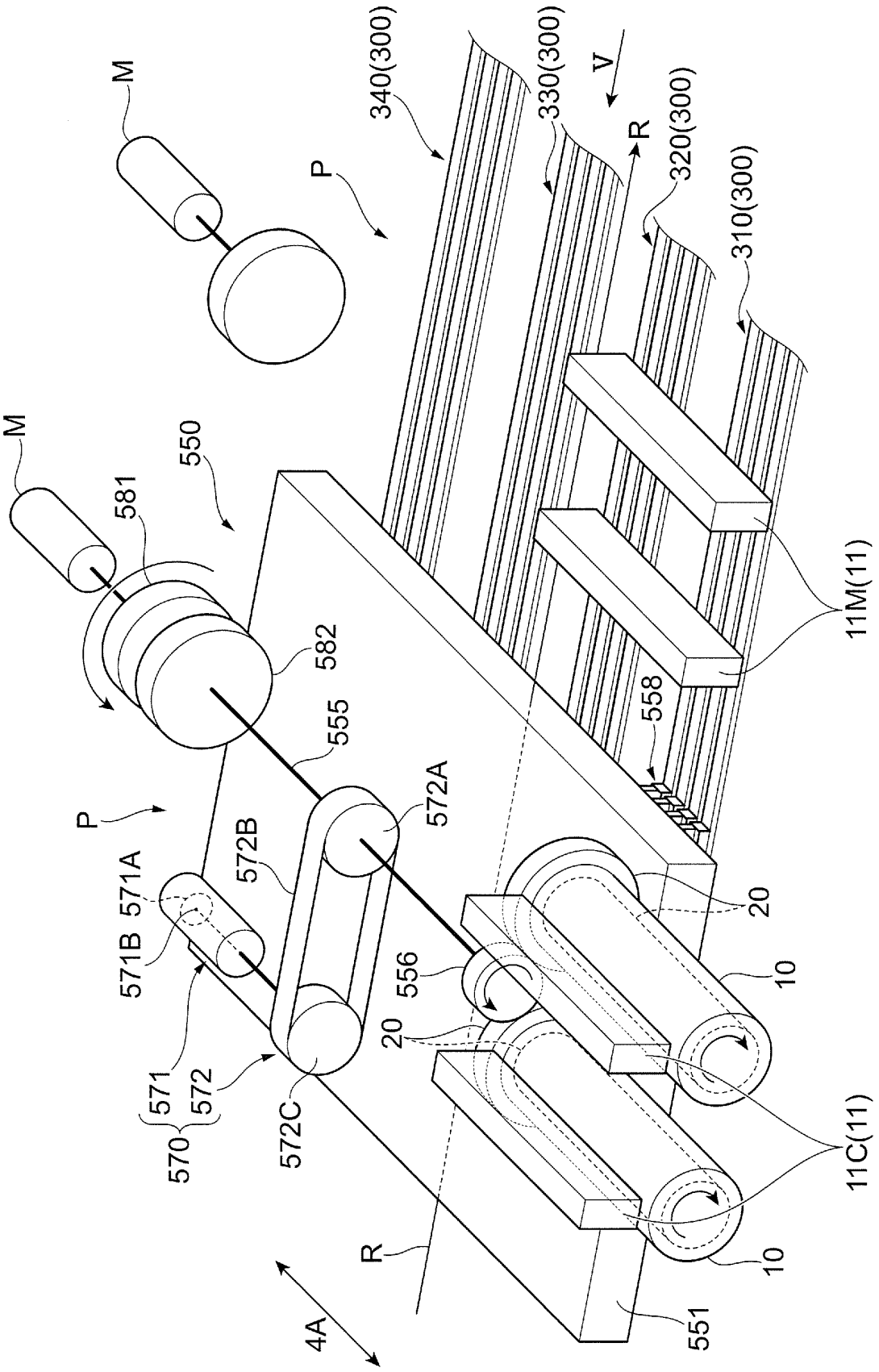
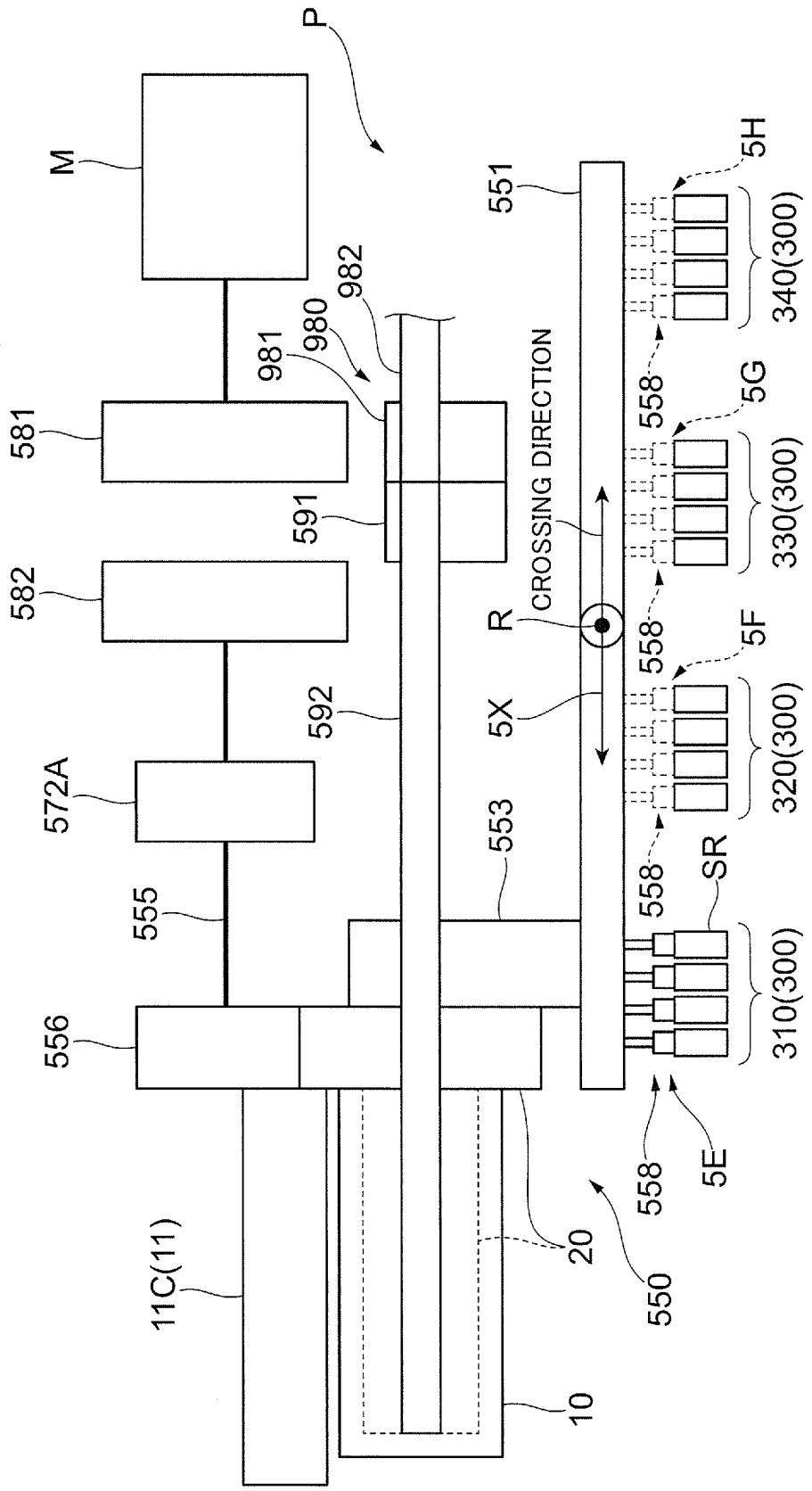

M
340(300)
330(300)
V
P
R
320(300)
310(300)
M
581
550
582
555
558
11M(11)
P
572A
572B
571A
571B
556
20
10
571
572
570
572C
20
11C(11)
R
10
4A
551

FIG.5


P
M
581
582
572A
555
556
11C(11)
10
20
550
982
980
981
591
592
553
551
CROSSING DIRECTION
R
5X
558
5H
340(300)
5G
330(300)
5F
320(300)
SR
310(300)
5E

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/025374

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. B41J23/02(2006.01)i, B41J3/413(2006.01)i, B65B61/02(2006.01)i

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)
Int.Cl. B41J23/02, B41J3/413, B65B61/02, B41J2/01-2/215

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2019
Registered utility model specifications of Japan	1996-2019
Published registered utility model applications of Japan	1994-2019

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 2016/140015 A1 (SHOWA ALUMINUM CAN CORPORATION) 09 September 2016, paragraphs [0010], [0013], [0017], fig. 1-4 & JP 2016-159583 A	1-2 3-12
X A	WO 2017/187863 A1 (SHOWA ALUMINUM CAN CORPORATION) 02 November 2017, paragraphs [0020]-[0024], [0042], [0109]-[0115], fig. 1-4, 20 & JP 2017-200752 A & JP 2017-200840 A & US 2019/0070866 A1, paragraphs [0067]-[0077], [0116]-[0119], [0269]-[0282], fig. 1-4, 20 & EP 3450172 A1 & CN 108778750 A	1-4 5-12

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed
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"&" document member of the same patent family

Date of the actual completion of the international search 23.08.2019	Date of mailing of the international search report 03.09.2019
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/025374

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2015-64217 A (I. MER CO., LTD.) 09 April 2015, paragraphs [0028]-[0047], fig. 6-9 & US 2016/0229198 A1, paragraphs [0139]-[0159], fig. 9-12 & WO 2015/046119 A1 & EP 3050705 A1 & KR 10-2016-0067876 A & CN 105764692 A	1-12
A	JP 2017-1395 A (SEIKO EPSON CORPORATION) 05 January 2017, paragraphs [0014]-[0020], [0031], [0034]-[0047], [0076], fig. 1-5 (Family: none)	1-12
A	JP 2016-153194 A (SHOWA ALUMINUM CAN CORPORATION) 25 August 2016, entire text, all drawings & WO 2016/132755 A1	1-12
A	US 2011/0273726 A1 (BECKHAUS, C.) 10 November 2011, entire text, all drawings & WO 2010/108527 A1 & DE 102009014663 A1	1-12

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