



(11) **EP 3 403 835 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.11.2018 Bulletin 2018/47

(51) Int Cl.:
B41J 15/04 ^(2006.01) **B41J 3/407** ^(2006.01)
B41J 11/00 ^(2006.01) **B41J 11/42** ^(2006.01)

(21) Application number: **18173315.5**

(22) Date of filing: **18.05.2018**

(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:
KH MA MD TN

(71) Applicant: **Seiko Epson Corporation**
Tokyo 160-8801 (JP)

(72) Inventor: **KOJIMA, Kenji**
Suwa-shi, Nagano 392-8502 (JP)

(74) Representative: **Miller Sturt Kenyon**
9 John Street
London WC1N 2ES (GB)

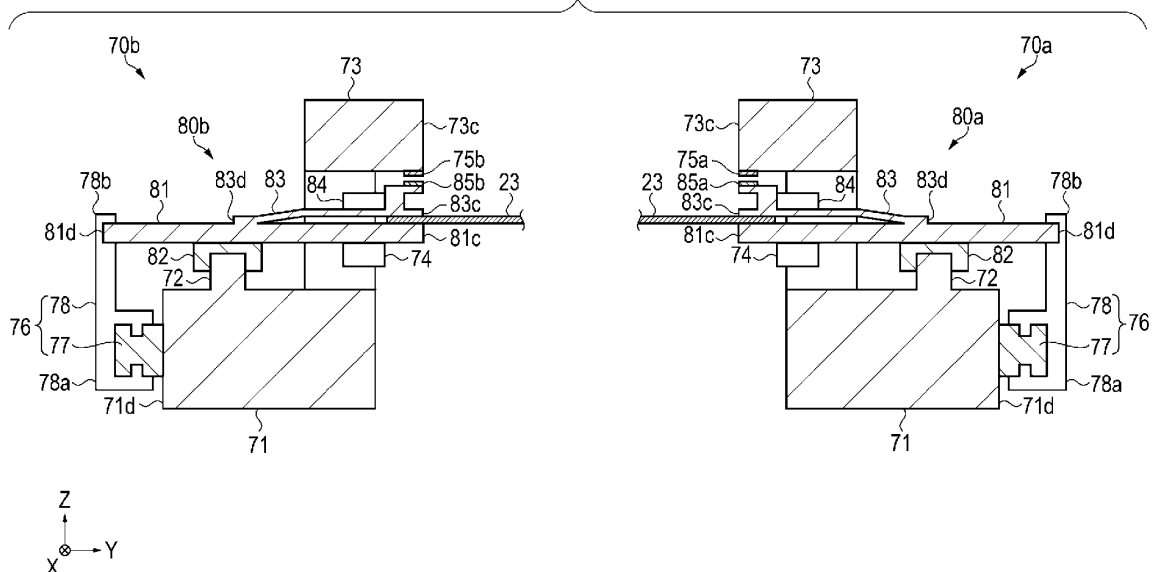
(30) Priority: **19.05.2017 JP 2017099543**

(54) **PRINTING APPARATUS AND METHOD FOR MEASURING DIFFERENCE IN BELT MOVING AMOUNT**

(57) A printing apparatus includes a transport belt (23) which transports a medium in a transport direction, a first and a second scale portions (75a, 75b) which are provided along the transport direction, a first measuring unit (85a) which measures a relative moving amount with respect to the first scale portion (75a), a second measuring unit (85b) which measures a relative moving amount with respect to the second scale portion (75b), a first holding unit (80a) which is configured integrally with the first measuring unit (85a) and holds one side of

the transport belt (23) to move along with the transport belt, a second holding unit (80b) which is configured integrally with the second measuring unit (85b), and holds the other side of the transport belt (23) to move along with the transport belt (23), and a control unit which determines whether or not a difference between a first moving amount measured by the first measuring unit (85a) and a second moving amount measured by the second measuring unit (85b) is equal to or greater than a reference value.

FIG. 4



Description

BACKGROUND

1. Technical Field

[0001] The present invention relates to a printing apparatus and a method for measuring a difference in belt moving amount.

2. Related Art

[0002] Recently, in textile printing on fabrics such as cotton, silk, wool, chemical fiber, and mixed fabrics, an ink jet type printing apparatus which discharges ink toward a surface of fabrics and performs printing patterns or the like on fabrics is used. The printing apparatus used in textile printing is provided with a transport belt which mounts a medium and transports the medium in a transport direction to handle fabrics having flexibility as a medium. In this kind of printing apparatus, in order to improve transport accuracy of the transport belt, the printing apparatus provided with a mechanism for measuring a moving amount of the transport belt is known. For example, JP-A-2013-28143 discloses an ink jet type recording apparatus (printing apparatus) provided with a moving amount measuring unit configured with a scale portion which is engaged with the transport belt and moves therewith and a sensor unit which is fixed to a base and measures a moving amount of the scale portion.

[0003] However, in the transport belt, there is a case where a difference is generated between the moving amount of one side of the transport belt in an intersecting direction intersecting with the transport direction and the other side thereof. In the printing apparatus described in JP-A-2013-28143, a moving amount measuring unit which measures the moving amount of the transport belt is only provided on one or the other side of the transport belt in the intersecting direction. With this configuration, it was difficult to measure the difference in the moving amount generated between one side and the other side of the transport belt in the intersecting direction.

SUMMARY

[0004] The invention can be realized in the following aspects or application examples.

Application Example 1

[0005] According to this application example, there is provided a printing apparatus including a printing unit which performs printing on a medium; a transport belt which rotationally moves to transport the medium in a transport direction; a first and a second scale portions which are provided along the transport direction; a first measuring unit which measures a relative moving amount with respect to the first scale portion; a second

measuring unit which measures a relative moving amount with respect to the second scale portion; a first holding unit which is configured to move integrally with the first scale portion or the first measuring unit, and holds one side from a center of the transport belt in an intersecting direction intersecting with the transport direction to move along with the transport belt; a second holding unit which is configured to move integrally with the second scale portion or the second measuring unit, and holds the other side from the center of the transport belt in the intersecting direction to move along with the transport belt; and a control unit which determines whether or not a difference between a first moving amount measured by the first measuring unit and a second moving amount measured by the second measuring unit is equal to or greater than a reference value.

[0006] According to the application example, the printing apparatus includes a first measuring unit which measures a relative moving amount with respect to the first scale portion provided along the transport direction, and a first holding unit which moves integrally with the first scale portion or the first measuring unit, and holds one side from a center of the transport belt in an intersecting direction intersecting with the transport direction. In other words, the first measuring unit measures the moving amount (first moving amount) on one side of the transport belt. In addition, the printing apparatus includes a second measuring unit which measures a relative moving amount with respect to the second scale portion provided along the transport direction, and a second holding unit which moves integrally with the second scale portion or the second measuring unit, and holds the other side from the center of the transport belt in the intersecting direction intersecting with the transport direction. In other words, the second measuring unit measures the moving amount (second moving amount) on the other side of the transport belt. Moreover, the printing apparatus includes a control unit which determines whether or not a difference between a first moving amount and a second moving amount is equal to or greater than a reference value. Accordingly, the printing apparatus can measure that the generated difference between the moving amount of one side of the transport belt and the moving amount of the other side of the transport belt is equal to or greater than a reference value.

Application Example 2

[0007] In the printing apparatus of the application example, it is preferable that the control unit control the rotational movement of the transport belt based on one moving amount of the first moving amount and the second moving amount.

[0008] According to the application example, the control unit controls the rotational movement of the transport belt based on the one moving amount of the first moving amount and the second moving amount, and thereby it is possible to prevent the control of the transport belt

being complicated.

Application Example 3

[0009] In the printing apparatus of the application example, it is preferable that the control unit control the rotational movement of the transport belt based on an average moving amount obtained by averaging the first moving amount and the second moving amount.

[0010] According to the application example, the control unit controls the rotational movement of the transport belt based on the average moving amount obtained by averaging the first moving amount and the second moving amount, and thereby it is possible to prevent the difference in the moving amount between one side and the other side of the transport belt from becoming large.

Application Example 4

[0011] In the printing apparatus of the application example, it is preferable that the control unit stop printing on the medium by the printing unit in a case where the control unit determines that a difference between the first moving amount and the second moving amount is equal to or greater than a reference value.

[0012] According to the application example, the control unit stops printing on the medium by the printing unit in a case where the control unit determines that the difference between the first moving amount and the second moving amount is equal to or greater than a reference value, and thereby it is possible to prevent printing an image with degraded image quality on the medium beforehand.

Application Example 5

[0013] In the printing apparatus of the application example, it is preferable that the control unit receive input of a print mode from a plurality of print modes with different required image qualities and use a reference value corresponding to the image quality of the received print mode.

[0014] According to the application example, the control unit uses the reference value corresponding to the image quality of the print mode, and thereby it is possible to suitably perform printing on the medium.

Application Example 6

[0015] In the printing apparatus of the application example, it is preferable that the control unit receive input of a type of an image to be printed and use a reference value corresponding to the received type of the image.

[0016] According to the application example, the control unit uses the reference value corresponding to the type of the image to be printed, and thereby it is possible to suitably perform printing on the medium.

Application Example 7

[0017] In the printing apparatus of the application example, it is preferable that, when the number of times that the transport belt transports the medium is n , the control unit calculate the difference between the first moving amount and the second moving amount, store the difference as an n th moving amount difference, and store the difference between the first moving amount and the second moving amount calculated before storing the n th moving amount difference as an $(n-1)$ th moving amount difference.

[0018] According to the application example, the printing apparatus stores the difference between the first moving amount and the second moving amount as an $(n-1)$ th moving amount difference and an n th moving amount difference in time series, and thereby it is possible to check the changes over time on the difference in the moving amount between one side and the other side of the transport belt.

Application Example 8

[0019] In the printing apparatus of the application example, it is preferable that the control unit perform a warning operation in a case where the control unit determines that a variation of the $(n-1)$ th moving amount difference with respect to the n th moving amount difference is equal to or greater than a reference value.

[0020] According to the application example, the control unit performs the warning operation in a case where a variation of the $(n-1)$ th moving amount difference with respect to the n th moving amount difference is equal to or greater than a reference value. By comparing the first moving amount difference and the second moving amount difference, it is possible to predict increase in the difference between the first moving amount and the second moving amount, and thereby it is possible to inform a user of abnormality of the apparatus beforehand. Application Example 9

[0021] In the printing apparatus of the application example, it is preferable that a first reference value and a second reference value having a value lower than the first reference value be usable as the reference value in the control unit, and, in a case where the control unit determines that the difference between the first moving amount and the second moving amount is lower than the first reference value and equal to or greater than the second reference value, the control unit perform a preliminary warning operation.

[0022] According to the application example, the control unit uses two reference values of the first reference value and the second reference value to determine whether the difference between the first moving amount and the second moving amount is equal to or greater than a reference value. The control unit performs the preliminary warning operation in a case where the control unit determines that the difference between the first mov-

ing amount and the second moving amount is lower than the first reference value and is equal to or greater than the second reference value. For example, by setting the first reference value as a tolerance limit of the difference between the first moving amount and the second moving amount and the second reference value as a value lower than the first reference value, it is possible to inform the user that the tolerance limit of the difference between the first moving amount and the second moving amount is coming close.

Application Example 10

[0023] It is preferable that the printing apparatus according to the application example include a driving unit which rotationally moves the transport belt, and in which the driving unit be provided on a downstream side from the printing unit in the transport direction, and the first holding unit and the second holding unit hold the transport belt on an upstream side from the printing unit in the transport direction.

[0024] According to the application example, the driving unit of the transport belt is provided on a downstream side from the printing unit and the first and the second holding units hold the transport belt on an upstream side from the printing unit. In a case where the driving unit is rotationally driven to move the first and the second holding units holding the transport belt along with the transport belt in the transport direction, a portion of the transport belt, that is the downstream side from the driving unit in the transport direction and the upstream side from the first and the second holding units in the transport direction in the rotational moving direction of the transport belt, is easy to loosen. Since it is possible to shorten a range where looseness easily occurs in the transport belt by setting the driving unit on the downstream side from the printing unit and the first and the second holding units on the upstream side from the printing unit, it is possible to make the difference between the first moving amount and the second moving amount hard to occur.

Application Example 11

[0025] According to this application example, there is provided a method for measuring a difference in belt moving amount of a printing apparatus which includes a printing unit which performs printing on a medium, a transport belt which rotationally moving to transport the medium in a transport direction, a first and a second scale portions which are provided along the transport direction, a first measuring unit which measures a relative moving amount with respect to the first scale portion, a second measuring unit which measures a relative moving amount with respect to the second scale portion, a first holding unit which is configured to move integrally with the first scale portion or the first measuring unit, and holds one side from a center of the transport belt in an intersecting direction intersecting with the transport direction

to move along with the transport belt, and a second holding unit which is configured to move integrally with the second scale portion or the second measuring unit, and holds the other side from the center of the transport belt in the intersecting direction to move along with the transport belt, the method includes determining whether or not a difference between a first moving amount measured by the first measuring unit and a second moving amount measured by the second measuring unit is equal to or greater than a reference value.

[0026] According to the application example, the method for measuring a difference in belt moving amount of a printing apparatus includes determining whether or not the difference between the first moving amount measured by the first measuring unit and the second moving amount measured by the second measuring unit is equal to or greater than a reference value. The first moving amount is the relative moving amount of the first scale portion and the first measuring unit provided along the transport direction. The first scale portion or the first measuring unit moves integrally with the first holding unit holding one side from the center of the transport belt in the intersecting direction intersecting with the transport direction, and thereby the first measuring unit measures the moving amount of one side of the transport belt. The second moving amount is the relative moving amount of the second scale portion and the second measuring unit provided along the transport direction. The second scale portion or the second measuring unit moves integrally with the second holding unit holding the other side from the center of the transport belt in the intersecting direction, and thereby the second measuring unit measures the moving amount of the other side of the transport belt. According to the method for measuring a difference in belt moving amount, it is possible to measure that the difference generated between the moving amount (transport amount) of one side and the moving amount of the other side (transport amount) of the transport belt is equal to or greater than a reference value.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, wherein like numbers reference like elements.

Fig. 1 is a schematic view illustrating an entire schematic configuration of a printing apparatus according to an embodiment.

Fig. 2 is a plan view illustrating a main portion of the printing apparatus.

Fig. 3 is a perspective view illustrating a configuration of a first belt moving amount measuring unit.

Fig. 4 is a cross-sectional view taken along line IV-IV of Fig. 2.

Fig. 5 is an electrical block diagram illustrating an electrical configuration of the printing apparatus.

Fig. 6 is a flowchart illustrating a method for measuring a difference in belt moving amount.

Fig. 7 is a table illustrating a relationship between a print mode and a reference value.

Fig. 8 is a table illustrating a relationship between a type of an image and a reference value.

Fig. 9 is a flowchart illustrating the method for measuring a difference in belt moving amount according to a modification example.

Fig. 10 is a graph illustrating a variation in the moving amount difference of the transport belt.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0028] Hereinafter, an embodiment of the invention will be described with reference to drawings. Furthermore, in each drawing, scales of each layer and member are made different from the actual scales thereof to a size large enough to be recognized.

[0029] Also, in Figs. 1 to 4, for convenience of explanation, three axes, X axis, Y axis, and Z axis, orthogonal to each other are illustrated in the drawings, and the tip end side of the arrow illustrating the axial direction is set to "+ side" and base end side to "- side". A direction parallel to the X axis is referred to as an "X axial direction", a direction parallel to the Y axis is referred to as a "Y axial direction", and a direction parallel to the Z axis is referred to as a "Z axial direction".

Embodiment

Schematic Configuration of Printing Apparatus

[0030] Fig. 1 is a schematic view illustrating an entire schematic configuration of a printing apparatus according to an embodiment. Fig. 2 is a plan view illustrating a main portion of the printing apparatus. First, a schematic configuration of a printing apparatus 100 according to the embodiment will be explained with reference to Figs. 1 and 2. Furthermore, in the embodiment, an ink jet type printing apparatus 100 which performs textile printing on a medium 95 with forming an image or the like on the medium 95 will be described as an example.

[0031] As illustrated in Fig. 1, the printing apparatus 100 includes a medium transport portion 20, a medium close contact portion 60, a printing unit 40, a drying unit 27, a first belt moving amount measuring unit 70a, a second belt moving amount measuring unit 70b, and a cleaning unit 50. The printing apparatus also includes a control unit 1 which controls each of these parts. Each part of the printing apparatus 100 is attached to a frame portion 90.

[0032] The medium transport portion 20 transports the medium 95 in the transport direction. The medium transport portion 20 includes a medium supply portion 10, a transport roller 22, a transport belt 23, a belt rotating roller 24, a belt driving roller 25, transport rollers 26 and 28, and a medium collecting portion 30. First, a transport

path of the medium 95 from the medium supply portion 10 to the medium collecting portion 30 will be described. In addition, in the embodiment, a direction along gravity is set as a Z axis, a direction to which the medium 95 is transported in the printing unit 40 as an X axis, and a width direction of the medium 95 that intersects with both Z axis and X axis as a Y axis. Furthermore, the positional relationship along the transport direction of the medium 95 or the moving direction of the transport belt 23 may be referred to as "upstream side" or "downstream side".

[0033] The medium supply portion 10 supplies the medium 95 for forming an image to the printing unit 40 side. Fabrics such as cotton, wool, and polyester are used as the medium 95.

[0034] The medium supply portion 10 includes a supply shaft portion 11 and a bearing portion 12. The supply shaft portion 11 is formed in a cylindrical shape or a columnar shape, and is provided so as to be rotatable in a circumferential direction. On the supply shaft portion 11, a strip-shaped medium 95 is wound into a roll shape. The supply shaft portion 11 is detachably attached to the bearing portion 12. In this way, the medium 95 in a state wound around the supply shaft portion 11 in advance can be attached to the bearing portion 12 along with the supply shaft portion 11.

[0035] The bearing portion 12 rotatably supports both ends of the supply shaft portion 11 in an axial direction. The medium supply portion 10 includes a rotational driving unit (not illustrated) which rotationally drives the supply shaft portion 11. The rotational driving unit rotates the supply shaft portion 11 in a direction in which the medium 95 is sent out. The operation of the rotational driving unit is controlled by the control unit 1. The transport roller 22 relays the medium 95 from the medium supply portion 10 to the transport belt 23.

[0036] The transport belt 23 is held between at least two rollers which rotate the transport belt 23, and transports the medium 95 in the transport direction (+X axial direction) as the transport belt 23 rotationally moves. For details, both end portions of a strip-shaped belt of the transport belt 23 are connected to form an endless shape, and set on between two rollers of the belt rotating roller 24 and the belt driving roller 25. The transport belt 23 is held in a state in which a predetermined tension is applied, so as the part between the belt rotating roller 24 and the belt driving roller 25 become horizontal. On a surface (supporting surface) 23a of the transport belt 23, an adhesive layer 29 to which the medium 95 is adhered is provided. The transport belt 23 supports (holds) the medium 95 supplied from the transport roller 22 and brought into close contact with the adhesive layer 29 at the medium close contact portion 60 described later. In this way, fabrics having flexibility or the like can be handled as the medium 95.

[0037] The belt rotating roller 24 and the belt driving roller 25 support an inner peripheral surface 23b of the transport belt 23. Furthermore, a supporting portion such as a roller for supporting the transport belt 23 may be

provided between the belt rotating roller 24 and the belt driving roller 25.

[0038] The belt driving roller 25 is a driving unit that rotationally moves the transport belt 23 and includes a motor (not illustrated) that rotationally drives the belt driving roller 25. The belt driving roller 25 as the driving unit is provided on the downstream side from the printing unit 40 with respect to the transport direction of the medium 95 and the belt rotating roller 24 is provided on the upstream side from the printing unit 40. When the belt driving roller 25 is rotationally driven, the transport belt 23 rotates as the belt driving roller 25 rotates, and the belt rotating roller 24 rotates by the rotation of the transport belt 23. By the rotation of the transport belt 23, the medium 95 supported by the transport belt 23 is transported in the transport direction (+X axial direction), and an image is formed on the medium 95 at the printing unit 40 described later.

[0039] In the embodiment, medium 95 is supported on a side (+Z axial side) where the surface 23a of the transport belt 23 is opposite to the printing unit 40, and the medium 95 is transported from the belt rotating roller 24 side to the belt driving roller 25 side along with the transport belt 23. In addition, on a side (-Z axial side) where the surface 23a of the transport belt 23 is opposite to the cleaning unit 50, only the transport belt 23 moves to the belt rotating roller 24 side from the belt driving roller 25 side. Furthermore, it is noted that the transport belt 23 is provided with the adhesive layer 29 to which the medium 95 is adhered, but the invention is not limited thereto. For example, the transport belt may be an electrostatic adsorption type belt which electrostatically adsorbs a medium to a belt.

[0040] The transport roller 26 separates the medium 95 on which an image is formed from the adhesive layer 29 of the transport belt 23. The transport rollers 26 and 28 relay the medium 95 from the transport belt 23 to the medium collecting portion 30.

[0041] The medium collecting portion 30 collects the medium 95 transported by the medium transport portion 20. The medium collecting portion 30 includes a winding shaft portion 31 and a bearing portion 32. The winding shaft portion 31 is formed in a cylindrical shape or a columnar shape, and is provided so as to be rotatable in a circumferential direction. In the winding shaft portion 31, the strip-shaped medium 95 is wound in a roll shape. The winding shaft portion 31 is detachably attached to the bearing portion 32. In this way, the medium 95 in a state wound around the winding shaft portion 31 can be removed with the winding shaft portion 31.

[0042] The bearing portion 32 rotatably supports both ends of the winding shaft portion 31 in an axial line direction. The medium collecting portion 30 includes the rotational driving unit (not illustrated) which rotationally drives the winding shaft portion 31. The rotational driving unit rotates the winding shaft portion 31 in a direction on which the medium 95 is wound. The operation of the rotational driving unit is controlled by the control unit 1.

[0043] Next, each part of the medium close contact portion 60, the first belt moving amount measuring unit 70a, the second belt moving amount measuring unit 70b, the printing unit 40, the drying unit 27, and the cleaning unit 50 provided along the medium transport portion 20 will be described.

[0044] The medium close contact portion 60 brings the medium 95 into close contact with the transport belt 23. The medium close contact portion 60 is provided on the upstream side (-X axial side) from the printing unit 40. The medium close contact portion 60 includes a pressing roller 61, a pressing roller driving unit 62 and a roller supporting portion 63. The pressing roller 61 is formed in a cylindrical shape or a columnar shape, and is provided so as to be rotatable in a circumferential direction. The pressing roller 61 is disposed so that the axial line direction thereof intersects with the transport direction to rotate in a direction along the transport direction. The roller supporting portion 63 is disposed on the inner peripheral surface 23b side of the transport belt 23 opposite to the pressing roller 61 via the transport belt 23 interposed therebetween.

[0045] The pressing roller driving unit 62 moves the pressing roller 61 in the transport direction (+X axial direction) and in a reverse direction of the transport direction (-X axial direction) while pressing the pressing roller 61 to a lower side (-Z axial side) in the vertical direction thereof. The medium 95 superimposed on the transport belt 23 is pressed against the transport belt 23 between the pressing roller 61 and the roller supporting portion 63. In this way, it becomes possible to firmly adhere the medium 95 to the adhesive layer 29 provided on the surface 23a of the transport belt 23, and thereby it is possible to prevent the occurrence of floating of the medium 95 on the transport belt 23.

[0046] The first belt moving amount measuring unit 70a and the second belt moving amount measuring unit 70b are provided between the medium close contact portion 60 and the printing unit 40 in the transport direction. The first belt moving amount measuring unit 70a is provided on one side from the center of the transport belt 23 (+Y axial side) in the intersecting direction (Y axial direction) intersecting with the transport direction, the second belt moving amount measuring unit 70b is provided on the other side from the center of the transport belt 23 (-Y axial side) in a direction intersecting with the transport direction. The configuration of the first belt moving amount measuring unit 70a and the second belt moving amount measuring unit 70b will be described later.

[0047] The printing unit 40 is disposed above (+Z axial side) the arrangement position of the transport belt 23, and performs printing on the medium 95 mounted on the surface 23a of the transport belt 23. The printing unit 40 includes a head unit 42, a carriage 43 on which the head unit 42 is mounted, a carriage moving unit 45 that moves the carriage 43 in the width direction (Y axial direction) of the medium 95 which intersects with the transport direction, and the like. The head unit 42 of the embodiment

is configured with four subunits 42a, and, in the subunit 42a, a plurality of discharge heads (not illustrated) for discharging ink (for example, yellow, cyan, magenta, black, and the like) supplied from an ink supply portion (not illustrated) to the medium 95 mounted on the transport belt 23 as liquid are provided.

[0048] The carriage moving unit 45 is provided above (+Z axial side) the transport belt 23. The carriage moving unit 45 includes a pair of guide rails 45a and 45b extending along the Y axial direction. The guide rails 45a and 45b are laid between frame portions 90a and 90b provided vertically on an outer side of the transport belt 23. The head unit 42 is supported by the guide rails 45a and 45b in a state reciprocable along the Y axial direction along with the carriage 43.

[0049] The carriage moving unit 45 is provided with a moving mechanism and a power source (not illustrated). As a moving mechanism, for example, a mechanism combining a ball screw with a ball nut, a linear guide mechanism, or the like can be adopted. Moreover, the carriage moving unit 45 includes a motor (not illustrated) as the power source for moving the carriage 43 along the guide rails 45a and 45b. As a motor, various types of motors such as a stepping motor, a servo motor, and a linear motor can be adopted. When the motor is driven by the control of the control unit 1, the head unit 42 moves in the Y axial direction along with the carriage 43.

[0050] The drying unit 27 is provided between the transport roller 26 and the transport roller 28. The drying unit 27 dries ink discharged on the medium 95. In the drying unit 27, for example, an IR heater is included, and it is possible to dry the ink discharged on the medium 95 in a short period of time by driving the IR heater. In this way, it is possible to wind the strip-shaped medium 95 on which an image or the like is formed around the winding shaft portion 31.

[0051] The cleaning unit 50 is disposed between the belt rotating roller 24 and the belt driving roller 25 in the X axial direction. The cleaning unit 50 includes a cleaning portion 51, a pressing portion 52 and a moving portion 53. The moving portion 53 moves integrally with the cleaning unit 50 along a floor surface 99 and fixes the cleaning unit at a predetermined position.

[0052] The pressing portion 52, for example, is a lifting device configured with an air cylinder 56 and a ball bush 57, and causes the cleaning portion 51 provided thereabove to abut and move away from the surface 23a of the transport belt 23. The cleaning portion 51 is set between the belt rotating roller 24 and the belt driving roller 25 in a state in which a predetermined tension is applied, and cleans the surface (supporting surface) 23a of the transport belt 23 moving from the belt driving roller 25 toward the belt rotating roller 24 from below (-Z axial direction).

[0053] The cleaning portion 51 includes a cleaning tank 54, a cleaning roller 58 and a blade 55. The cleaning tank 54 is a tank for storing a cleaning liquid used for cleaning ink or foreign matters adhered to the surface 23a of the

transport belt 23, and the cleaning roller 58 and the blade 55 are provided inside the cleaning tank 54. As a cleaning liquid, for example, water or a water-soluble solvent (alcohol solution or the like) can be used, and a surfactant or an antifoaming agent may be added as necessary.

[0054] When the cleaning roller 58 rotates, the cleaning liquid is supplied to the surface 23a of the transport belt 23, and the cleaning roller 58 and the transport belt 23 slide on each other. In this way, the ink adhered to the transport belt 23, fibers of the fabrics serving as the medium 95, or the like are removed by the cleaning roller 58.

[0055] The blade 55, for example, can be made of a flexible material such as silicone rubber. The blade 55 is provided on the downstream side from the cleaning roller 58 in the transport direction of the transport belt 23. The remaining cleaning liquid on the surface 23a of the transport belt 23 is removed as the blade 55 and the transport belt 23 slide on each other.

[0056] Fig. 3 is a perspective view illustrating a configuration of a first belt moving amount measuring unit. Fig. 4 is a cross-sectional view taken along line IV-IV of Fig. 2. Note that, the second belt moving amount measuring unit 70b is configured symmetric with the first belt moving amount measuring unit 70a with respect to the center of the transport belt 23 in the intersecting direction intersecting with the transport direction, and the perspective view thereof will be omitted.

[0057] Next, the configuration of the first belt moving amount measuring unit 70a will be described with reference to Figs. 2 to 4.

[0058] The first belt moving amount measuring unit 70a is provided on the upstream side of the printing unit 40, and is positioned on a +Y axial side of the transport belt 23.

[0059] The first belt moving amount measuring unit 70a includes a first scale portion 75a provided along the transport direction (X axial direction), a first measuring unit 85a for measuring the relative moving amount with respect to the first scale portion 75a, and a first holding unit 80a which is configured to move integrally with the first measuring unit 85a, and holds one side (+Y axial direction) from the center of the transport belt 23 in the intersecting direction (Y axial side) to move along with the transport belt 23.

[0060] For details, the first belt moving amount measuring unit 70a includes a rectangular shaped base 71 long along the transport direction (X axial direction) of the medium 95, a scale pasting portion 73 provided above the base 71, the first holding unit 80a, which is provided on the base 71 and moves along a guide rail 72 extending in the X axial direction, a return portion 76 which moves the first holding unit 80a to the upstream side in the transport direction, and the like.

[0061] The scale pasting portion 73 is laid between column portions 73a and 73b vertically provided on both ends of the base 71 in a longitudinal direction (X axial direction). The scale pasting portion 73 in the first belt

moving amount measuring unit 70a has a protruding portion protruding like eaves in the -Y axial direction, and a part thereof overlaps with the transport belt 23 in a plan view.

[0062] The first scale portion 75a is provided on a lower surface (-Z axial side surface) of the protruding portion of the scale pasting portion 73. In the first scale portion 75a of the embodiment, a magnetic scale in which magnets having different polarities are alternately arranged is used.

[0063] The first holding unit 80a includes a holding substrate 81, a guide block 82, the first measuring unit 85a, and the like. The holding substrate 81 has a rectangular plate shape long in the width direction (Y axial direction) of the transport belt 23. An end portion 81c on a -Y axial side of the holding substrate 81 substantially coincides with a side wall 73c on the -Y axial side of the scale pasting portion 73 in a plan view, and overlaps with the transport belt 23. An end portion 81d on the +Y axial side of the holding substrate 81 protrudes in a +Y axial direction from a side wall 71d on the +Y axial side of the base 71 in a plan view. The guide block 82 is provided on a bottom surface of the holding substrate 81 (-Z axial side surface). On the guide block 82, a concave groove opened on the -Z axial side is formed following the shape of the convexly protruding guide rail 72 along the X axial direction from the base 71. As the guide block 82 and the guide rail 72 are engaged with each other, the first holding unit 80a is formed to move reciprocally along the transport direction (X axial direction).

[0064] An elastic member 83 is provided on an upper surface (+Z axial side surface) of the holding substrate 81. The elastic member 83 has a rectangular plate shape shorter than the holding substrate 81. An end portion 83d on the +Y axial side of the elastic member 83 is joined with the holding substrate 81 at substantially the center of the holding substrate 81. An end portion 83c on the -Y axial side of the elastic member 83 substantially coincides with the end portion 81c on the -Y axial side of the holding substrate 81 in a plan view. The end portion 81c of the holding substrate 81 and the end portion 83c of the elastic member 83 have a gap slightly larger than the thickness of the transport belt 23. The first holding unit 80a is configured to sandwich the transport belt 23 between the end portion 81c of the holding substrate 81 and the end portion 83c of the elastic member 83 by the elastic force of the elastic member 83. As a material for the elastic member 83, a carbon fiber or the like can be used.

[0065] The first holding unit 80a has a ferromagnetic material 84 on an upper surface (+Z axial side surface) of the elastic member 83 that does not overlap with the transport belt 23 in a plan view. As the ferromagnetic material 84, iron, nickel, cobalt, and the like can be used.

[0066] In addition, at a position that is a lower surface of the holding substrate 81 of the first holding unit 80a and opposite to the ferromagnetic material 84, a switching unit 74 that switches the state of the first holding unit

80a between a holding state and an unholding state is provided. The switching unit 74 includes an electromagnet, and the ferromagnetic material 84 is attracted to the switching unit 74 (electromagnet) by the magnetic force generated in a case where current flows in the electromagnet. At this time, the elastic member 83 is elastically deformed toward the holding substrate 81 side, and the state of the transport belt 23 is changed to the holding state held between the holding substrate 81 and the elastic member 83 by the elastic force. Moreover, in a case where the current flowing in the electromagnet is blocked, the state of the first holding unit 80a is changed from the holding state to the unholding state.

[0067] The first measuring unit 85a is an upper surface of the end portion 83c of the elastic member 83 and is provided on a position opposite to the first scale portion 75a. The first measuring unit 85a is provided with an element for converting a change in a magnetic field into an electric signal (for example, hall element or MR element) and measures a relative moving amount with respect to the first scale portion 75a. The first measuring unit 85a of the embodiment is provided on a pedestal for placing the first measuring unit close to the first scale portion 75a. The first measuring unit 85a is configured to move integrally with the first holding unit 80a.

[0068] The return portion 76 moves the first holding unit 80a in the unholding state in a reverse direction (-X axial direction) of the transport direction. The return portion 76 includes a moving lever 78 and a lever moving portion 77 reciprocally moving the moving lever 78 along the transport direction. The lever moving portion 77 has a rectangular shape long in the transport direction, and is fixed to the side wall 71d on the +Y axial side of the base 71. On an upper surface (+Z axial side surface) and a lower surface (-Z axial side surface) of the lever moving portion 77, a concave guide groove extending in the transport direction is provided.

[0069] The moving lever 78 includes a pedestal 78a having a projection following the shape of the guide groove and an elongated portion 78b extending from the pedestal 78a in a vertical direction (+Z axial direction). The moving lever 78 is configured such that the guide groove of the lever moving portion 77 and the pedestal 78a are engaged with each other and move reciprocally along the X axial direction. The lever moving portion 77 includes the moving mechanism (not illustrated) reciprocally moving the moving lever 78 in the transport direction. As the moving mechanism, for example, an air cylinder or the like can be adopted. When the moving lever 78 is moved to the upstream side of the transport direction by the lever moving portion 77, the elongated portion 78b of the moving lever 78 abuts on the holding substrate 81 of the first holding unit 80a, and the first holding unit 80a in the unholding state is returned to an upstream side in the reverse direction of the transport direction. In this way, it is possible to repeatedly move the first holding unit 80a along with the transport belt 23.

[0070] The first belt moving amount measuring unit 70a

is configured as described above, and the first measuring unit 85a moves in the transport direction (+X axial direction) along with the transport belt 23 holding the first holding unit 80a, and measures the moving amount of +Y axial side (one side) of the transport belt 23 (hereinafter, referred to as first moving amount).

[0071] The second belt moving amount measuring unit 70b is provided on the upstream side of the printing unit 40, and is positioned on a -Y axial side of the transport belt 23.

[0072] The second belt moving amount measuring unit 70b includes a second scale portion 75b provided along the transport direction, a second measuring unit 85b which measures the relative moving amount with respect to the second scale portion 75b, and a second holding unit 80b which is configured to move integrally with the second measuring unit 85b, and holds the other side (-Y axial side) from the center of the transport belt 23 in the intersecting direction to move along with the transport belt 23.

[0073] The second belt moving amount measuring unit 70b has the same configuration symmetrical to the first belt moving amount measuring unit 70a in the intersecting direction, so the explanation of the configuration will be omitted.

[0074] The second measuring unit 85b moves in the transport direction (+X axial direction) along with the transport belt 23 held by the second holding unit 80b and measures the moving amount of the -Y axial side (the other side) of the transport belt 23 (hereinafter, referred to as second moving amount).

[0075] The first and the second holding units 80a and 80b of the embodiment hold the transport belt 23 on the upstream side from the printing unit 40 in the transport direction. In a case where the belt driving roller 25 is rotationally driven in order to move the first and the second holding units 80a and 80b in the holding state in the transport direction along with the transport belt 23, since the transport belt 23 has elasticity, a portion of the transport belt 23, that is the downstream side from the belt driving roller 25 in the transport direction and the upstream side from the first and the second holding units 80a and 80b in the transport direction in the rotational moving direction of the transport belt 23, is easy to loosen. Since it is possible to shorten a range where looseness easily occurs in the transport belt 23 by setting the first and the second holding units 80a and 80b on the upstream side from the printing unit 40 than the case where the first and the second holding units 80a and 80b are provided on the downstream side from the printing unit 40, it is possible to make the difference between the first moving amount and the second moving amount hard to occur.

[0076] Furthermore, in the embodiment, a configuration of the first and the second measuring units 85a and 85b moving integrally with the first and the second holding units 80a and 80b and the first and the second scale portions 75a and 75b being fixed is described, but the

configuration may be such that the first and the second scale portions move integrally with the first and the second holding units and the first and the second measuring units are fixed.

[0077] In addition, in the embodiment, a so-called magnetic encoder that obtains a relative moving amount between the first scale portion 75a and the first measuring unit 85a and a relative moving amount between the second scale portion 75b and the second measuring unit 85b from a change in the magnetic field is exemplified, but an optical encoder that obtains the moving amount from optical change may be used.

Electrical Configuration

[0078] Fig. 5 is an electrical block diagram illustrating an electrical configuration of the printing apparatus. Next, the electrical configuration of the printing apparatus 100 will be described with reference to Fig. 5.

[0079] The printing apparatus 100 includes an input device 6 to which printing conditions or the like are input, the control unit 1 which controls each part of the printing apparatus 100, or the like. As the input device 6, a desktop type or a laptop type personal computer (PC) provided with a display unit 6a, a tablet type terminal, a portable terminal, and the like can be used. The input device 6 may be provided separately from the printing apparatus 100.

[0080] The control unit 1 includes an interface (I/F) 2, a central processing unit (CPU) 3, a storage unit 4, a control circuit 5, and the like. The interface 2 transmits and receives data between the input device 6 and the control unit 1 for handling input signals and images. The CPU 3 is an arithmetic processing device for processing an input signal from various measuring device groups 7 including the first and the second measuring units 85a and 85b, and controlling a printing operation of the printing apparatus 100. For example, the CPU 3 calculates the first and second moving amounts of the transport belt 23 from the input signal output from the first and the second measuring units 85a and 85b and input to the CPU 3.

[0081] The storage unit 4 is a storage medium for securing an area for storing a program of the CPU 3 or a work area, and has a storage element such as random access memory (RAM), electrically erasable programmable read-only memory (EEPROM), and the like.

[0082] The control unit 1 controls driving of a discharge head provided in the head unit 42 by a control signal output from the control circuit 5 and discharges ink toward the medium 95. The control unit 1 controls driving of the motor provided in the carriage moving unit 45 by the control signal output from the control circuit 5 and reciprocally moves the carriage 43 mounted with the head unit 42 in a main scanning direction (Y axial direction). The control unit 1 controls driving of the motor provided in the belt driving roller 25 by the control signal output from the control circuit 5 and rotationally moves the transport belt 23. In this way, the medium 95 mounted on the transport belt

23 is moved in the transport direction (+X axial direction).

[0083] An image or the like is formed on the medium 95 by the alternately repeated printing operation of main scanning in which the control unit 1 controls the carriage moving unit 45 and the head unit 42 and moves the head unit 42 (carriage 43) while discharging ink from the discharge head, and sub-scanning in which the control unit controls the belt driving roller 25 and transports the medium 95 in the transport direction.

[0084] The control unit 1 controls the current flowing in the electromagnet provided in the switching unit 74 by the control signal output from the control circuit 5 and switches the state of the first and the second holding units 80a and 80b between the holding state and the unholding state. The control unit 1 controls the moving mechanism of the lever moving portion 77 by the control signal output from the control circuit 5 and reciprocally moves the moving lever 78 along the transport direction. In addition, the control unit 1 controls each device (not illustrated).

Method for Measuring Difference in Belt Moving Amount

[0085] Fig. 6 is a flowchart illustrating a method for measuring a difference in belt moving amount. Fig. 7 is a table illustrating a relationship between a print mode and a reference value. Fig. 8 is a table illustrating a relationship between a type of an image and a reference value.

[0086] Next, the method for measuring a difference in belt moving amount in the printing operation of the printing apparatus 100 will be described with reference to Figs. 6 to 8.

[0087] Step S1 is a print information receiving step for receiving print data. The control unit 1 receives input of the print data or the print information for recording an image on the medium 95 from the input device 6 and stores the print data in the storage unit 4.

[0088] Step S2 is a reference value setting step for setting a reference value. In the print information received in step S1, information on the print mode or the type of the image is included. In addition, in the storage unit 4, for example, a table illustrating a relationship between the print mode and a reference value as illustrated in Fig. 7, and a table illustrating a relationship between the type of the image and a reference value as illustrated in Fig. 8 are stored in advance.

[0089] As illustrated in Fig. 7, a plurality of modes with different required image qualities, expressed as, for example, "super-high image quality", "high image quality", "fast", and the like are prepared in the print mode. In each the print mode, a reference value serving as a criterion for the determination in the determination step S5 described later is set, and it is possible to use two reference values of a first reference value and a second reference value corresponding to the print mode. For example, in a case where the print mode is "super-high image quality", "medium" in the first reference value and "low" in the second reference value are used, and in a case where

the print mode is "fast", only "high" in the first reference value is used. In a case where the control unit 1 received the input of any one print mode from the plurality of print modes, the control unit 1 refers to the table stored in the storage unit 4 and sets a reference value corresponding to the image quality of the received print mode. Furthermore, the first reference value is set to a value at which a desired image quality cannot be satisfied and the second reference value is set to a value lower than the first reference value. In this way, by using a reference value corresponding to the image quality in the print mode, it is possible to suitably perform print on the medium 95.

[0090] As shown in Fig. 8, a plurality of kinds expressed as, for example, "line image", "plane image", and the like, are prepared in the image type. Here, the "line image" means an image mainly composed of text, a ruled line, and the like, and the "plane image" means an image mainly composed of a photograph, an illustration, or the like. For example, in a case where the type of the image is "line image", since the displacement of the ruled line is likely to be visually recognized, "medium" in the first reference value, and "low" in the second reference value are used, and in a case where the type of the image is "plane image", "high" in the first reference value and "medium" in the second reference value are used. In a case where the control unit 1 receives input of the type of the image to be printed, the control unit 1 refers to the table stored in the storage unit 4 and uses a reference value corresponding to the received type of the image. Furthermore, the first reference value is set to a value at which a desired image quality cannot be satisfied and the second reference value is set to a value lower than the first reference value. In this way, by using a reference value corresponding to the type of the image, it is possible to suitably perform print on the medium 95.

[0091] Step S3 is a holding step for holding the first and the second holding units 80a and 80b by the transport belt 23. The control unit 1 applies current to the electromagnet of the switching unit 74 and generates magnetic force to the electromagnet. In this way, the first and the second holding units 80a and 80b are brought into the holding state and holds the transport belt 23.

[0092] Step S4 is a sub-scanning step for transporting the transport belt 23 in the transport direction. The control unit 1 controls the belt driving roller 25 to move the first and the second holding units 80a and 80b in the holding state along with the transport belt 23. The control unit 1, in accordance with the movement of the transport belt 23, calculates a first moving amount from a signal output from the first measuring unit 85a, calculates a second moving amount from a signal output from the second measuring unit 85b, and controls the rotation operation of the transport belt 23 based on one of the first moving amount and the second moving amount.

[0093] In the embodiment, since the control unit 1 controls the rotation operation of the transport belt 23 based on the first moving amount, it is possible to prevent the control of the transport belt 23 being complicated. Then,

the control unit 1 stops the rotation of the transport belt 23 based on the first moving amount measured by the first measuring unit 85a in a case where the first holding unit 80a is moved from a first position (initial position) to a second position positioned on a downstream side from the first position in the transport direction. Moreover, in the initial sub-scanning step, a distance between the first position and the second position is the transport amount up to a predetermined position for starting the printing operation. In the second and subsequent the sub-scanning steps, the distance between the first position and the second position is the line feed amount generated during the printing operation.

[0094] Step S5 is a determination step for determining whether or not the difference between the first moving amount measured by the first measuring unit 85a and the second moving amount measured by the second measuring unit 85b is equal to or greater than a reference value (first reference value). Since the transport belt 23 has elasticity, there is a concern that a slight shift in the moving amount (transport amount) between one side and the other side in the intersecting direction may occur. Therefore, after stopping the movement (transport) of the transport belt 23, the control unit 1 calculates the difference between the first moving amount (moving amount of one side of transport belt 23) measured by the first measuring unit 85a and the second moving amount (moving amount of the other side of transport belt 23) measured by the second measuring unit 85b, and determines whether or not the difference is equal to or greater than the first reference value. In a case where the difference between the first moving amount and the second moving amount is less than the first reference value (No in step S5), the process proceeds to step S6. In a case where the difference between the first moving amount and the second moving amount is equal to or greater than the first reference value (Yes in step S5), the control unit 1 determines that the desired image quality cannot be obtained and stops (ends) printing on the medium 95 by the printing unit 40. As a result, it is possible to prevent the image having the deteriorated image quality from being printed on the medium 95 in advance. Furthermore, when the printing is stopped, the control unit 1 may display on the display unit 6a that the printing is stopped since it exceeds the first reference value.

[0095] Step S6 is a determination step for determining whether or not the difference between the first moving amount measured by the first measuring unit 85a and the second moving amount measured by the second measuring unit 85b is equal to or greater than a reference value (second reference value). In a case where the second reference value is not set, or the difference between the first moving amount and the second moving amount is less than the second reference value (No in step S6), the process proceeds to step S8. In a case where the difference between the first moving amount and the second moving amount is equal to or greater than the second reference value (Yes in step S6), the process proceeds

to step S7.

[0096] As described in steps S5 and S6, the control unit 1 determines whether or not the difference between the moving amount (first moving amount) of one side of the transport belt 23 measured by the first measuring unit 85a and the moving amount (second moving amount) of the other side of the transport belt 23 is equal to or greater than a reference value (first reference value or second reference value). This makes it possible to measure that the difference generated between the moving amount of one side of the transport belt 23 measured by the second measuring unit 85b and the moving amount of the other side of the transport belt 23 is equal to or greater than a reference value.

[0097] Step S7 is a preliminary warning step for giving a preliminary warning to a user. In a case where the difference between the first moving amount and the second moving amount is less than the first reference value and equal to or greater than the second reference value, the control unit 1 determines that there is a possibility that the image quality may be deteriorated, and performs the preliminary warning operation.

[0098] The preliminary warning operation is to notify a user that the difference between the first moving amount and the second moving amount is within an allowable range that is less than the first reference value but it is approaching the limit of the allowable range (first reference value). The control unit 1 displays a message on the display unit 6a of the input device 6 via the interface 2, for example, "The difference in belt moving amount is getting bigger. Print is possible, but maintenance is recommended". Accordingly, it is possible to notify the user that the difference between the first moving amount and the second moving amount (difference between moving amounts of one side and the other side of transport belt 23) is approaching the tolerance limit. In the embodiment, the preliminary warning operation is described as an operation displaying a message as a preliminary warning on the display unit 6a of the input device 6. However, the printing apparatus may be provided with a notifying unit that performs a preliminary warning operation, and the user may be notified of the preliminary warning by emitting sound, light, or the like from the notifying unit.

[0099] Step S8 is a main scanning step for discharging ink toward the medium 95. The control unit 1 controls the head unit 42 and the carriage moving unit 45 to perform the main scanning of discharging ink toward the medium 95 from the head unit 42 while moving the carriage 43 mounted with the head unit 42 in the width direction (Y axial direction) of the medium 95 intersecting with the transport direction.

[0100] Step S9 is an unholding step for changing the state of the first and the second holding units 80a and 80b holding the transport belt 23 to the unholding state. The control unit 1 blocks current flowing in the electromagnet of the switching unit 74 to demagnetize the magnetic force of the electromagnet. In this way, the first and the second holding units 80a and 80b are in the unholding

state.

[0101] Step S10 is a returning step for returning the return portion 76 to the upstream side of the transport direction. The control unit 1 controls the lever moving portion 77 to move the moving lever 78 waiting at a predetermined position on the downstream side in the transport direction to the upstream side in the transport direction from the first and the second holding units 80a and 80b. In this way, the first and the second holding units 80a and 80b abut on the moving lever 78, and the first and the second holding units 80a and 80b in the unholding state positioned at the second position are returned to the first position. In this way, it is possible to repeatedly move the first and the second holding units 80a and 80b in the holding state from the first position to the second position along with the transport belt 23. Next, the moving lever 78 is moved to the downstream side from the second position in the transport direction and waits at a predetermined position. Furthermore, for convenience of explanation, the steps from the main scanning step for step S8 to the returning step for step S10 are explained in different steps, but, step S7 and step S8 are performed substantially simultaneously with step S6.

[0102] Step S11 is a determination step for determining whether there is print data for the next line. The control unit 1 determines whether there is the print data for the next line with reference to the print data stored in the storage unit 4. In a case where there is the print data for the next line (Yes in step S11), the process returns to step S3 and step S3 to step S11 are repeated. In this way, the main scanning and the sub-scanning are repeated and an image or the like is printed on the medium 95. In a case where there is no print data for the next line (No in step S11), the control unit 1 ends the printing operation of the printing apparatus 100.

[0103] In step S4, it is noted that the control unit 1 controls the rotation operation of the transport belt 23 based on one of the first moving amount and the second moving amount. However, the control unit 1 may control the rotation operation of the transport belt 23 based on an average moving amount obtained by averaging the first moving amount and the second moving amount. This makes it possible to suppress the difference in the moving amount between one side and the other side of the transport belt 23 from becoming large.

[0104] Further, in the embodiment, the flow of performing the returning step for each sub-scanning step and the main scanning step is described, but a flow of returning the moving amount of the first and the second holding units 80a and 80b moved a plurality of times by a single returning step after repeatedly performing the sub-scanning step and the main scanning step a plurality of times may be adopted.

[0105] As described above, the following effects can be obtained according to the printing apparatus 100 and the method for measuring a difference in belt moving amount of the embodiment.

[0106] The printing apparatus 100 includes the first belt

moving amount measuring unit 70a that measures a moving amount of one end side of the transport belt 23 in the intersecting direction, and the second belt moving amount measuring unit 70b that measures a moving amount of the other end side of the transport belt 23. The first belt moving amount measuring unit 70a includes the first scale portion 75a provided along the transport direction and the first holding unit 80a which moves integrally with the first measuring unit 85a that measures the relative moving amount with respect to the first scale portion 75a and holds one side of the transport belt 23. The second belt moving amount measuring unit 70b includes the second scale portion 75b provided along the transport direction and the second holding unit 80b which moves integrally with the second measuring unit 85b that measures the relative moving amount with respect to the second scale portion 75b and holds the other side of the transport belt 23. With this configuration, the first measuring unit 85a measures the moving amount of one end side of the transport belt 23, and the second measuring unit 85b measures the moving amount of the other end side of the transport belt 23. The printing apparatus 100 further includes the control unit 1 that determines whether or not the difference between the first moving amount and the second moving amount is equal to or greater than a reference value. As a result, the printing apparatus 100 can measure that a difference equal to or greater than a reference value is generated between the moving amount of one side of the transport belt 23 and the moving amount for the other side.

[0107] Since the control unit 1 of the printing apparatus 100 controls the rotation operation of the transport belt 23 based on the first moving amount, it is possible to suppress the control of the transport belt 23 being complicated.

[0108] The control unit 1 of the printing apparatus 100 determines that a desired image quality cannot be obtained in a case where the difference between the first moving amount and the second moving amount is equal to or greater than the first reference value, and stops printing on the medium 95 by the printing unit 40. As a result, it is possible to prevent the image having the deteriorated image quality from being printed on the medium 95 in advance.

[0109] In a case where the control unit 1 of the printing apparatus 100 receives input of any one of the print modes or image types from the plurality of print modes or image types, the control unit of the printing apparatus refers to the table stored in the storage unit 4, and a reference value corresponding to the image quality of the received print mode or the received type of the image is used. The two reference values of the first reference value and the second reference value can be used as a reference value. The first reference value is set to a value at which a desired image quality cannot be satisfied, and the second reference value is set to a value lower than the first reference value. As a result, it is possible to suitably perform print on the medium 95.

[0110] The first and the second holding units 80a and 80b of the printing apparatus 100 hold the transport belt 23 on the upstream side from the printing unit 40 in the transport direction. This makes it possible to shorten the range in which looseness easily occurs in the transport belt 23 as compared with the case where the first and the second holding units 80a and 80b are provided on the downstream side from the printing unit 40. Therefore, it is possible to make the difference between the first moving amount and the second moving amount hard to occur.

[0111] The method for measuring a difference in belt moving amount of the printing apparatus 100 includes a determination step for determining whether or not the difference between the first moving amount measured by the first measuring unit 85a and the second moving amount measured by the second measuring unit 85b is equal to or greater than a reference value. The first moving amount is a relative moving amount between the first scale portion 75a and the first measuring unit 85a provided along the transport direction. Since the first measuring unit 85a moves integrally with the first holding unit 80a which holds one side from the center of the transport belt 23 in the intersecting direction intersecting the transport direction, the first measuring unit 85a measures the moving amount of one side of the transport belt 23. The second moving amount is a relative moving amount between the second scale portion 75b and the second measuring unit 85b provided along the transport direction. Since the second measuring unit 85b moves integrally with the second holding unit 80b that holds the other side from the center of the transport belt 23 in the intersecting direction, the second measuring unit 85b measures the moving amount of the other side of the transport belt 23. Therefore, according to the method for measuring a difference in belt moving amount, it is possible to measure whether the difference generated between the moving amount (transport amount) of one side and the moving amount of the other side (transport amount) of the transport belt 23 is equal to or greater than a reference value.

[0112] The invention is not limited to the above-described embodiments, and various modifications and improvements can be added to the above-described embodiments. A modification example will be described below.

Modification Example

[0113] Fig. 9 is a flowchart illustrating the method for measuring a difference in belt moving amount according to a modification example. Fig. 10 is a graph illustrating a variation in the moving amount difference of the transport belt. In the method for measuring a difference in belt moving amount of the printing apparatus 100 described in this modification example, the difference (moving amount difference) between the first moving amount and the second moving amount is stored in time series, and

is different from the embodiment in that the warning operation is performed in a case where the variation in the moving amount difference stored before and after reaches a reference value or more.

[0114] Below, a method for measuring a difference in belt moving amount of the printing operation of the printing apparatus 100 according to the modification example will be described with reference to Figs. 9 and 10. Since the configuration of the printing apparatus 100 is the same as that of the embodiment, its description will be omitted. In the flowchart illustrated in Fig. 9, the step S101 is the same as the step S1 described in the embodiment, the step S102 and the step S103 are the same as the steps S3 and S4 explained in the embodiment, and the steps S107 to S110 are the same as the steps S8 to S11 described in the embodiment, so that the description thereof will be omitted.

[0115] Step S104 is a variation in moving amount difference storing step for calculating and storing the moving amount difference. When the number of times the transport belt 23 has transported the medium 95 (the number of times of sub-scanning) is n , the control unit 1 calculates the difference between the first moving amount (moving amount of one side of transport belt 23) and the second moving amount (moving amount of the other side of transport belt 23), and stores the difference as the n th moving amount difference in the storage unit 4. As a result, it is possible to check the changes over time on the difference in the moving amount (moving amount difference = second moving amount - first moving amount) between one side and the other side of the transport belt 23. Further, the control unit 1 calculates the variation (hereinafter, referred to as variation in moving amount difference) in the n th moving amount difference with respect to the $(n-1)$ th moving amount difference, that is the difference between the first moving amount and the second moving amount calculated before storing the n th moving amount difference and stored in the storage unit 4, and stores the variation in the storage unit 4.

[0116] For example, the difference between the first moving amount and the second moving amount calculated in the first sub-scanning ($n = 1$) is stored in the storage unit 4 as the first moving amount difference, and the difference between the first moving amount and the second moving amount calculated in the second sub-scanning ($n = 2$) is stored in the storage unit 4 as the second moving amount difference. Then, in the second sub-scanning, the control unit 1 calculates the difference (variation in moving amount difference = second moving amount difference - first moving amount difference) of the second moving amount difference with respect to the first moving amount difference. Furthermore, in the case of the first sub-scanning, the first moving amount difference is set as the variation in moving amount difference. As a result, it is possible to grasp the change overtime on the variation in moving amount difference.

[0117] The graph of Fig. 10 shows an example of the variation in moving amount difference calculated when

the sub-scanning is performed from the first time to the 13th time. The vertical axis of the graph shown in Fig. 10 represents the variation in moving amount difference, and a predetermined reference value is set. The horizontal axis represents the number n times of sub-scanning. From this graph, it can be seen that in the sub-scanning from the first time to the ninth time, the moving amount of one side of the transport belt 23 and the moving amount of the other side are substantially equal to the predetermined moving amount. In the tenth and subsequent sub-scannings, since the variation in moving amount difference continuously changes toward the +reference value side, it can be seen that the second moving amount (moving amount of the other side of transport belt 23) continues to increase. This makes it possible to predict that the difference between the first moving amount and the second moving amount (difference between moving amounts of one side and the other side of transport belt 23) increases.

[0118] Step S105 is a determination step for determining whether or not the variation in moving amount difference is equal to or greater than a reference value. The control unit 1 refers to the variation in moving amount difference stored in the storage unit 4 and determines whether or not the variation in moving amount difference is equal to or greater than a predetermined reference value. In a case where the variation in moving amount difference is less than the predetermined reference value (No in step S105), the process proceeds to step S107. In a case where the variation in moving amount difference is equal to or greater than the predetermined reference value (Yes in step S105), the process proceeds to step S106.

[0119] Step S106 is a warning step for giving a warning to the user. In a case where the variation (variation in moving amount difference) in the $(n-1)$ th moving amount difference with respect to the n th moving amount difference is equal to or greater than a reference value, the control unit 1 determines that the image quality is deteriorated and performs a warning operation. For example, in Fig. 10, since the variation in moving amount difference (variation in the twelfth moving amount difference with respect to the thirteenth moving amount difference) calculated in the thirteenth sub-scanning is equal to or greater than a reference value, a warning operation will be performed after performing the thirteenth sub-scanning step. As a warning operation, the control unit 1 displays a message on the display unit 6a of the input device 6 via the interface 2, for example, "The difference in belt moving amount is getting bigger. Please carry out maintenance". In this way, it is possible to notify the user of abnormality of the apparatus in advance. In the present modification example, the warning operation is described as an operation displaying a message as a preliminary warning on the display unit 6a of the input device 6. However, the printing apparatus may include a notifying unit that performs a warning operation, and the user may be notified of the preliminary warning by emitting sound,

light, or the like. In addition, two thresholds can be used in this modification example similar to the embodiment. Moreover, the embodiment and the modification example can be combined. In the modification example, after a YES determination in S105, the printing operation may be stopped.

Claims

1. A printing apparatus (100) comprising:

a printing unit (40) configured to perform printing on a medium (95);
 a transport belt (23) which rotationally moves to transport the medium in a transport direction;
 a first and a second scale portions (75a, 75b) which are provided along the transport direction;
 a first measuring unit (85a) configured to measure a relative moving amount with respect to the first scale portion;
 a second measuring unit (85b) configured to measure a relative moving amount with respect to the second scale portion;
 a first holding unit (80a) which is configured to move integrally with the first scale portion or the first measuring unit, and holds the transport belt on one side from a center of the transport belt in an intersecting direction intersecting with the transport direction to move along with the transport belt;
 a second holding unit (80b) which is configured to move integrally with the second scale portion or the second measuring unit, and holds the transport belt on the other side from the center of the transport belt in the intersecting direction to move along with the transport belt; and
 a control unit (1) configured to determine whether or not a difference between a first moving amount measured by the first measuring unit and a second moving amount measured by the second measuring unit is equal to or greater than a reference value.

2. The printing apparatus according to Claim 1, wherein the control unit is configured to control the rotational movement of the transport belt based on one moving amount of the first moving amount and the second moving amount.

3. The printing apparatus according to Claim 1, wherein the control unit is configured to control the rotational movement of the transport belt based on an average moving amount obtained by averaging the first moving amount and the second moving amount.

4. The printing apparatus according to any one of the

- preceding claims,
 wherein the control unit is configured to stop printing
 on the medium by the printing unit in a case where
 the control unit determines that a difference between
 the first moving amount and the second moving
 amount is equal to or greater than a reference value. 5
5. The printing apparatus according to any one of the
 preceding claims,
 wherein the control unit is configured to receive input 10
 of a print mode from a plurality of print modes with
 different required image qualities and to use a refer-
 ence value corresponding to the image quality of the
 received print mode. 15
6. The printing apparatus according to any one of the
 claims 1 to 4,
 wherein the control unit is configured to receive input
 of a type of an image to be printed and to use a
 reference value corresponding to the received type 20
 of the image. 25
7. The printing apparatus according to any one of the
 preceding claims,
 wherein, when the number of times that the transport
 belt transports the medium is n ,
 the control unit is configured to calculate the differ- 25
 ence between the first moving amount and the sec-
 ond moving amount, store the difference as an n th
 moving amount difference, and store the difference 30
 between the first moving amount and the second
 moving amount calculated before storing the n th
 moving amount difference as an $(n-1)$ th moving
 amount difference. 35
8. The printing apparatus according to Claim 7,
 wherein the control unit is configured to perform a
 warning operation in a case where the control unit
 determines that a variation of the $(n-1)$ th moving
 amount difference with respect to the n th moving
 amount difference is equal to or greater than a ref- 40
 erence value. 45
9. The printing apparatus according to any one of the
 preceding claims, 45
 wherein a first reference value and a second refer-
 ence value having a value lower than the first refer-
 ence value are usable as the reference value in the
 control unit, and
 wherein, in a case where the control unit determines 50
 that the difference between the first moving amount
 and the second moving amount is lower than the first
 reference value and equal to or greater than the sec-
 ond reference value, the control unit is configured to
 perform a preliminary warning operation. 55
10. The printing apparatus according to any one of the
 preceding claims, further comprising:

a driving unit (25) configured to rotationally move
 the transport belt,
 wherein the driving unit is provided on a down-
 stream side from the printing unit in the transport
 direction, and
 wherein the first holding unit and the second
 holding unit are configured to hold the transport
 belt on an upstream side from the printing unit
 in the transport direction.

11. A method for measuring a difference in belt moving
 amount of a printing apparatus (100) which includes
 a printing unit (40) which performs printing on a me-
 dium (95), a transport belt (23) which rotationally
 moves to transport the medium in a transport direc-
 tion, a first and a second scale portions (75a, 75b)
 which are provided along the transport direction, a
 first measuring unit (85a) which measures a relative
 moving amount with respect to the first scale portion,
 a second measuring unit (85b) which measures a
 relative moving amount with respect to the second
 scale portion, a first holding unit (80a) which is con-
 figured to move integrally with the first scale portion
 or the first measuring unit, and holds the transport
 belt on one side from a center of the transport belt
 in an intersecting direction intersecting with the
 transport direction to move along with the transport
 belt, and a second holding unit (80b) which is con-
 figured to move integrally with the second scale por-
 tion or the second measuring unit, and holds the
 transport belt on the other side from the center of the
 transport belt in the intersecting direction to move
 along with the transport belt, the method comprising:
 determining whether or not a difference between a
 first moving amount measured by the first measuring
 unit and a second moving amount measured by the
 second measuring unit is equal to or greater than a
 reference value.

FIG. 1

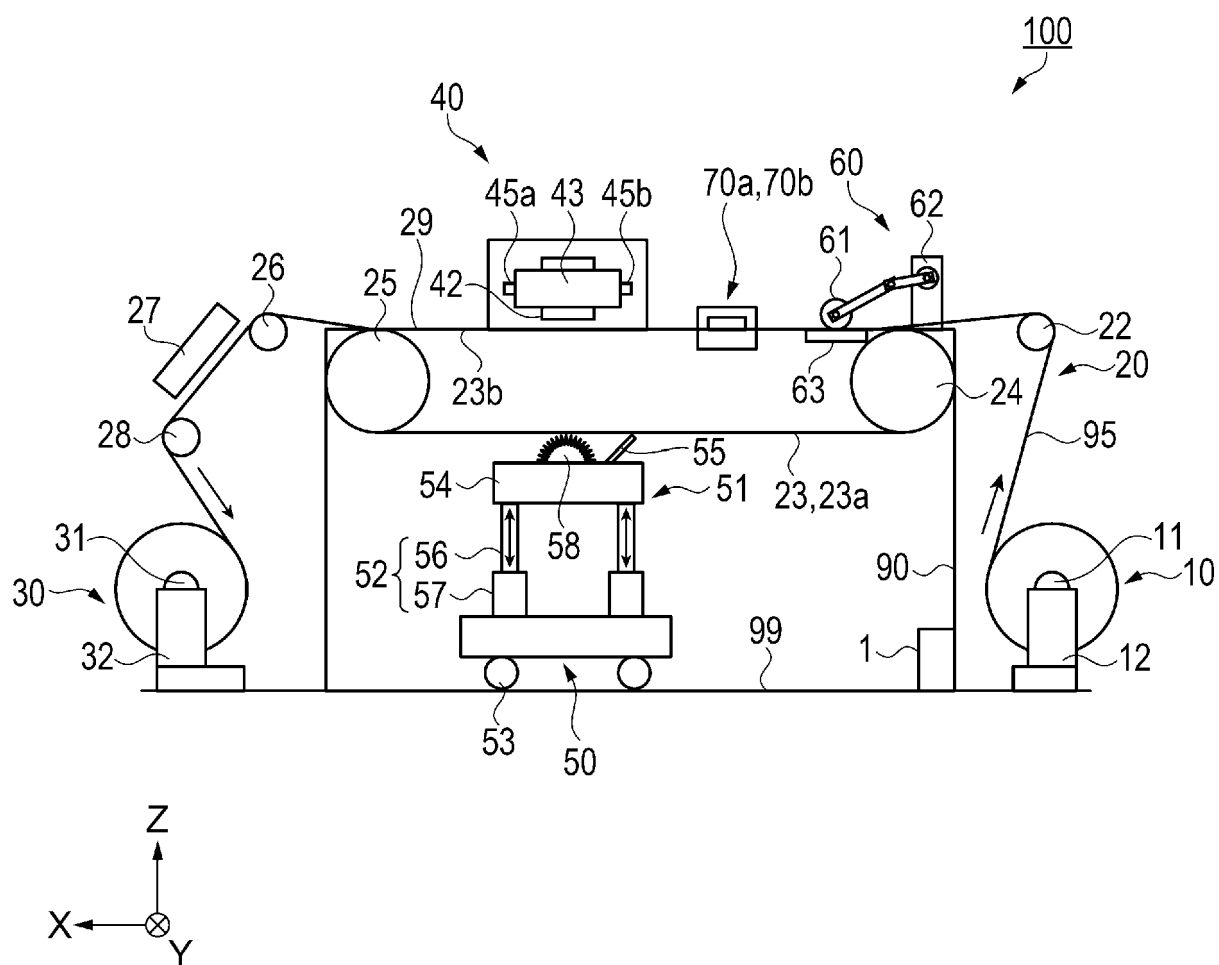


FIG. 2

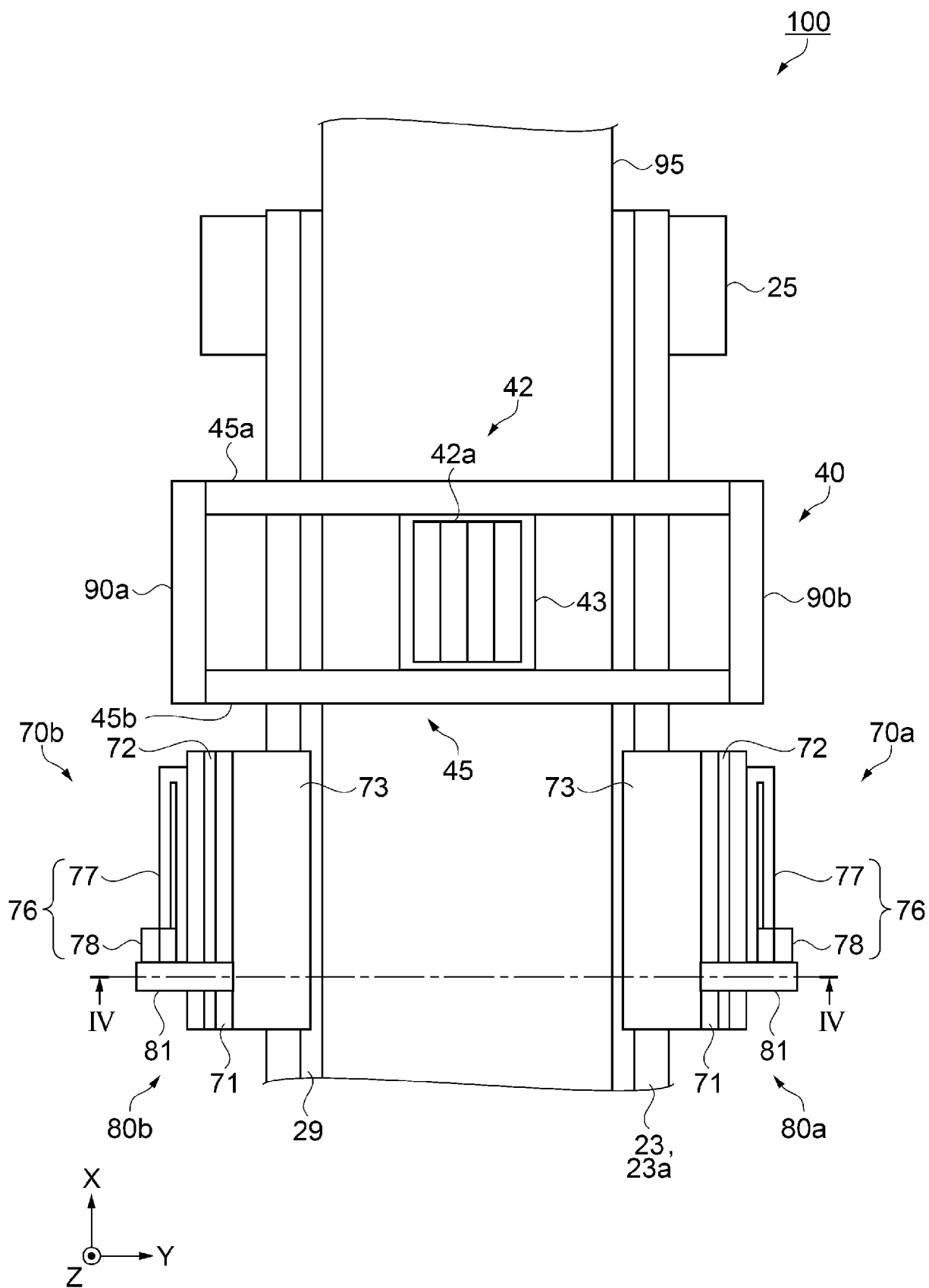


FIG. 3

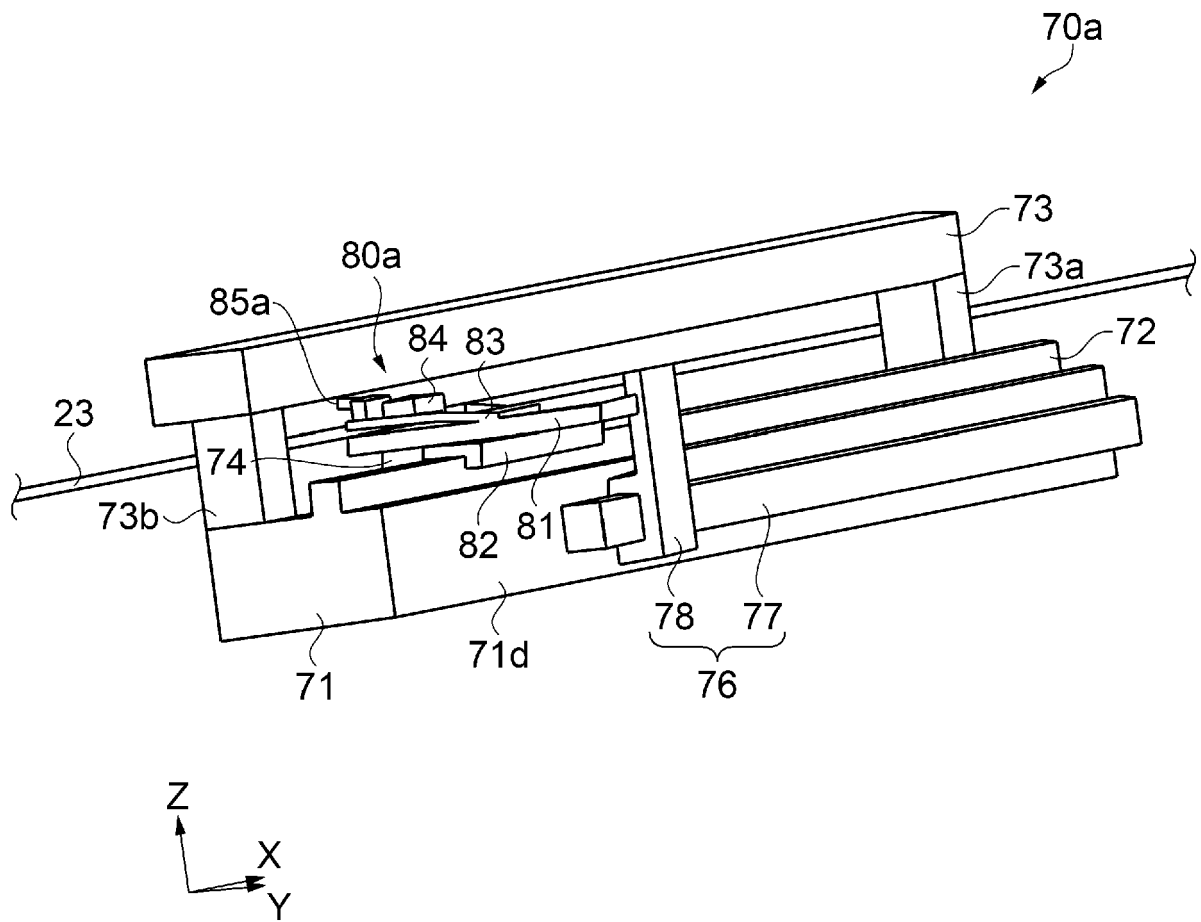


FIG. 4

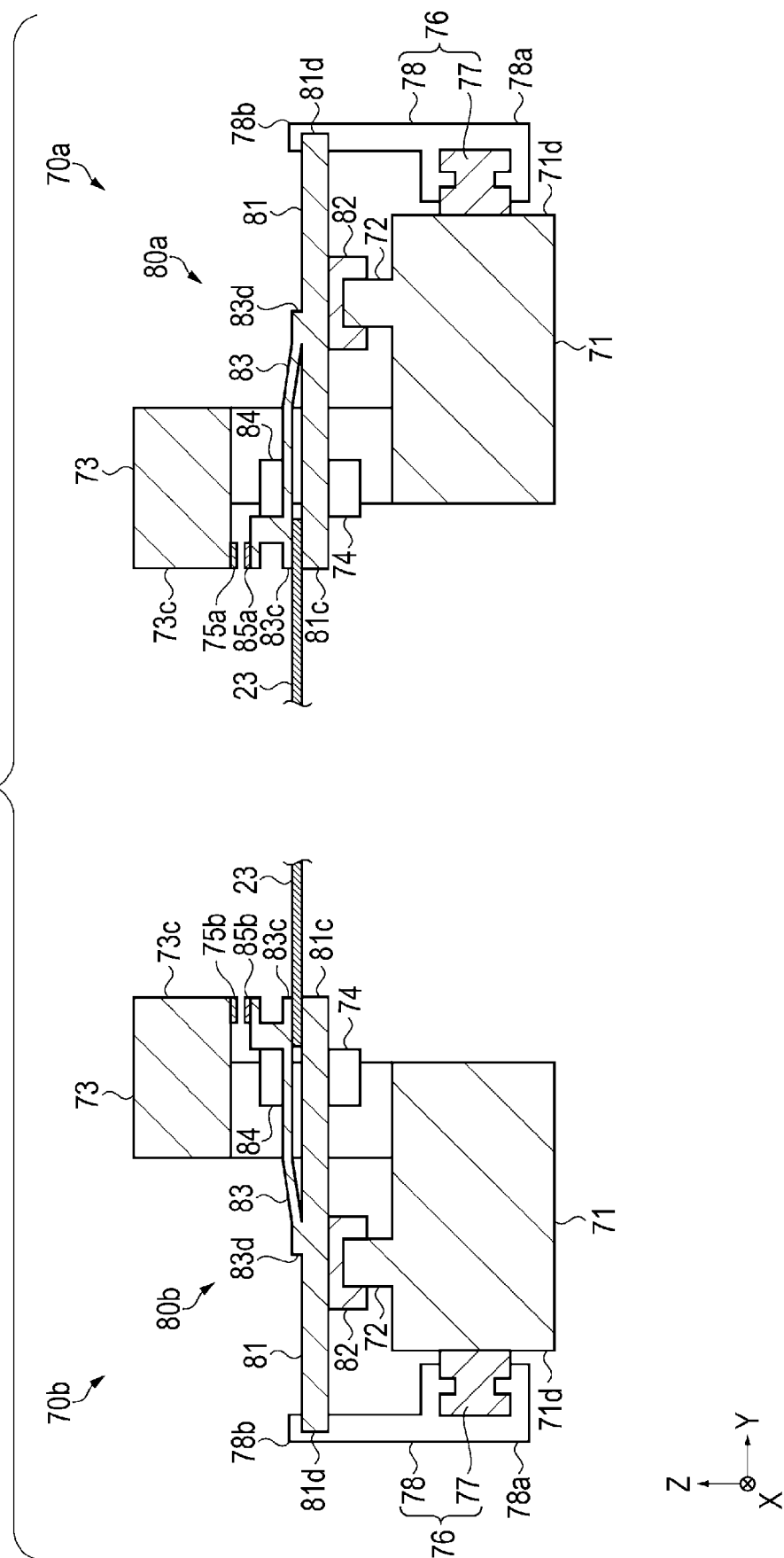


FIG. 5

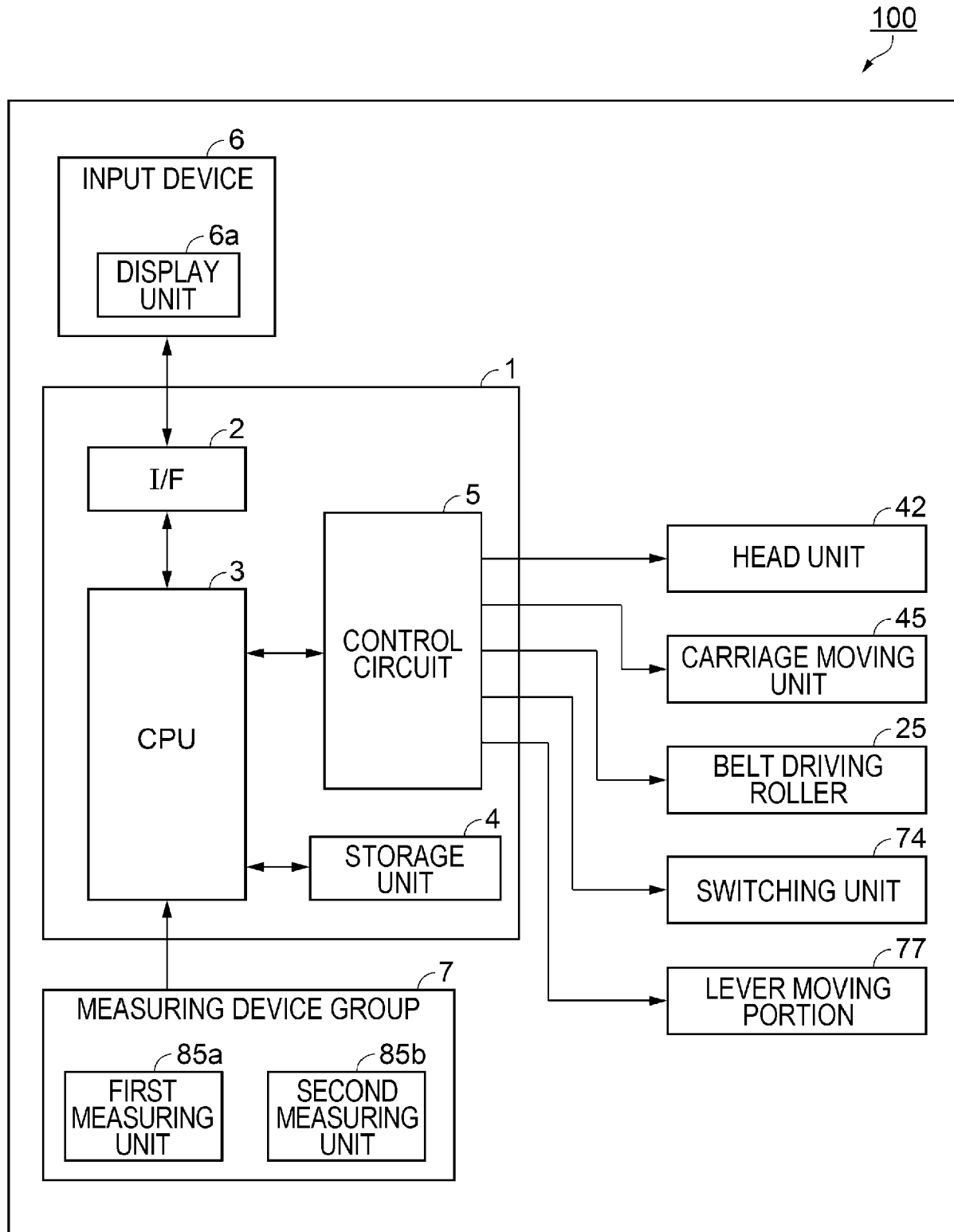


FIG. 6

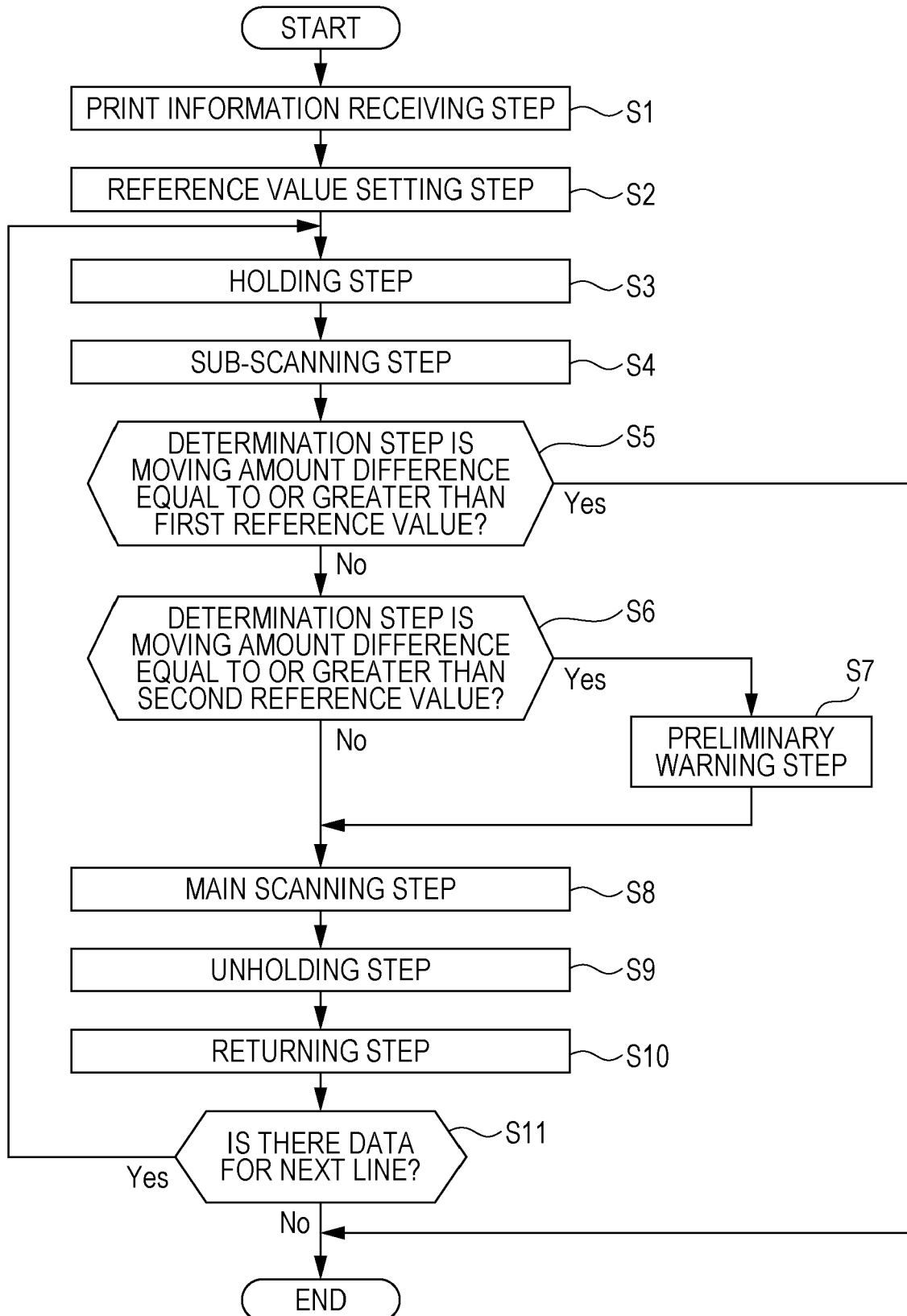


FIG. 7

PRINT MODE	FIRST REFERENCE VALUE	SECOND REFERENCE VALUE
SUPER-HIGH IMAGE QUALITY	MEDIUM	LOW
HIGH IMAGE QUALITY	HIGH	MEDIUM
FAST	HIGH	—

FIG. 8

TYPE OF IMAGE	FIRST REFERENCE VALUE	SECOND REFERENCE VALUE
LINE IMAGE	MEDIUM	LOW
PLANE IMAGE	HIGH	MEDIUM

FIG. 9

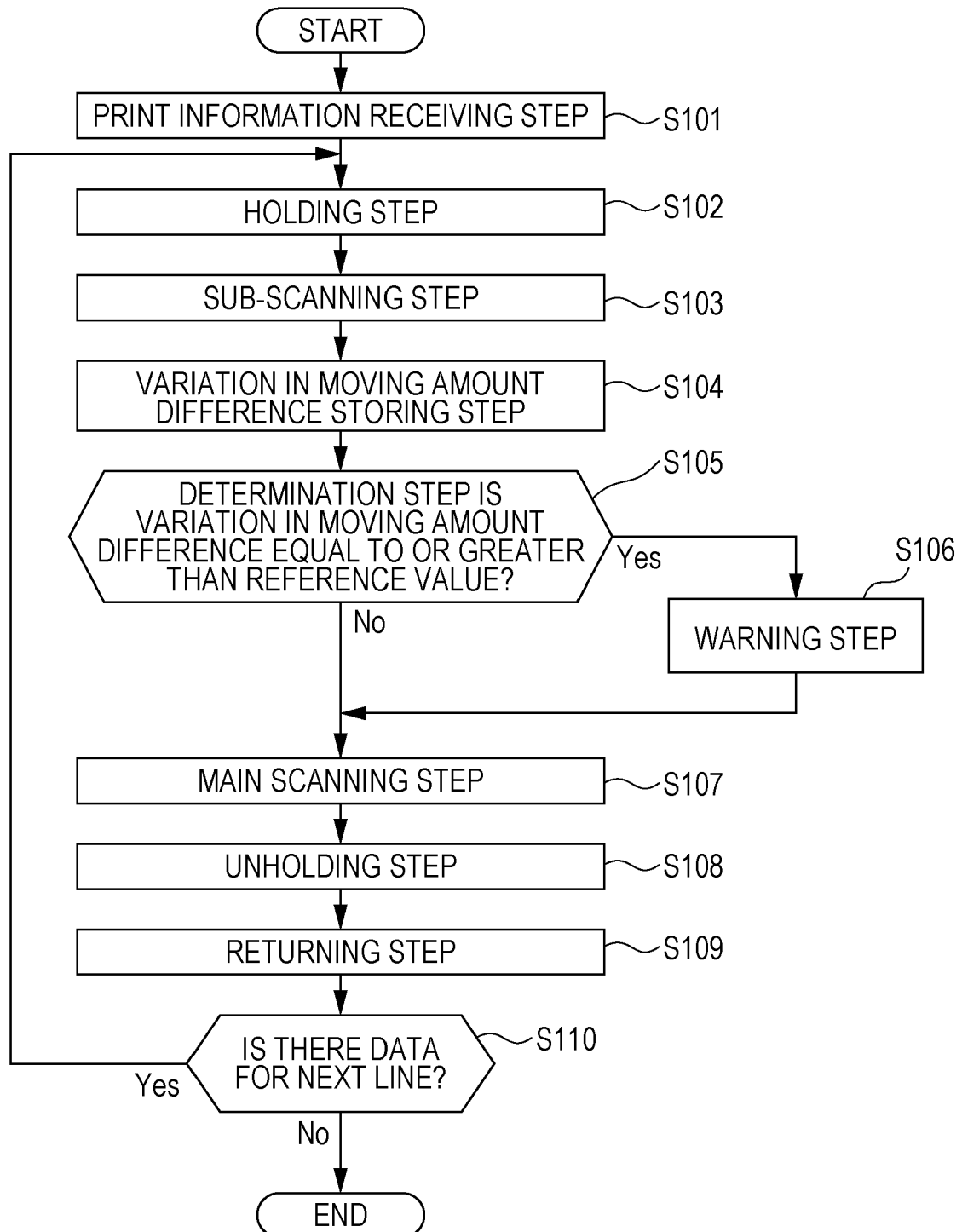
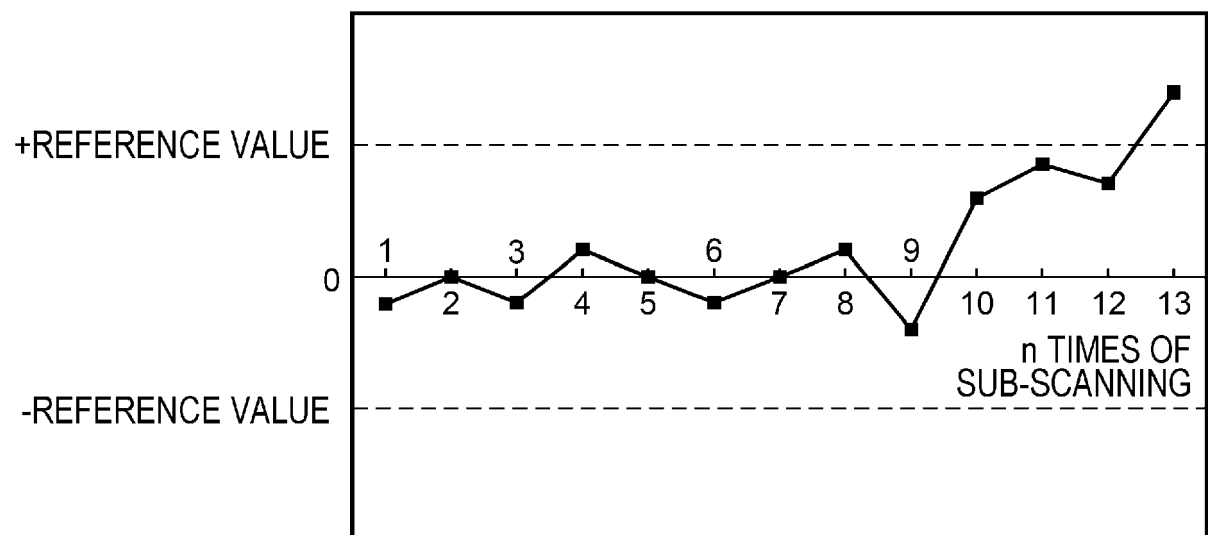


FIG. 10





EUROPEAN SEARCH REPORT

Application Number
EP 18 17 3315

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2016/152051 A1 (ITO SHIN [JP] ET AL) 2 June 2016 (2016-06-02)	1-7,9-11	INV. B41J15/04 B41J3/407 B41J11/00 B41J11/42
A	* paragraphs [0028], [0032] - [0047], [0057] - [0060]; figures 1-5 *	8	
A	EP 2 679 391 A1 (KONICA MINOLTA INC [JP]) 1 January 2014 (2014-01-01) * paragraphs [0015] - [0024]; figures 2-4 *	1-11	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B41J
Place of search		Date of completion of the search	Examiner
The Hague		10 October 2018	Gaubinger, Bernhard
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 17 3315

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-10-2018

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 2016152051	A1	02-06-2016	CN	105358325 A	24-02-2016
			EP	3020560 A1	18-05-2016
			JP	6080711 B2	15-02-2017
			JP	2015013455 A	22-01-2015
			US	2016152051 A1	02-06-2016
			WO	2015005268 A1	15-01-2015

EP 2679391	A1	01-01-2014	CN	103402776 A	20-11-2013
			EP	2679391 A1	01-01-2014
			JP	WO2012114594 A1	07-07-2014
			US	2013314484 A1	28-11-2013
			WO	2012114594 A1	30-08-2012

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2013028143 A [0002] [0003]