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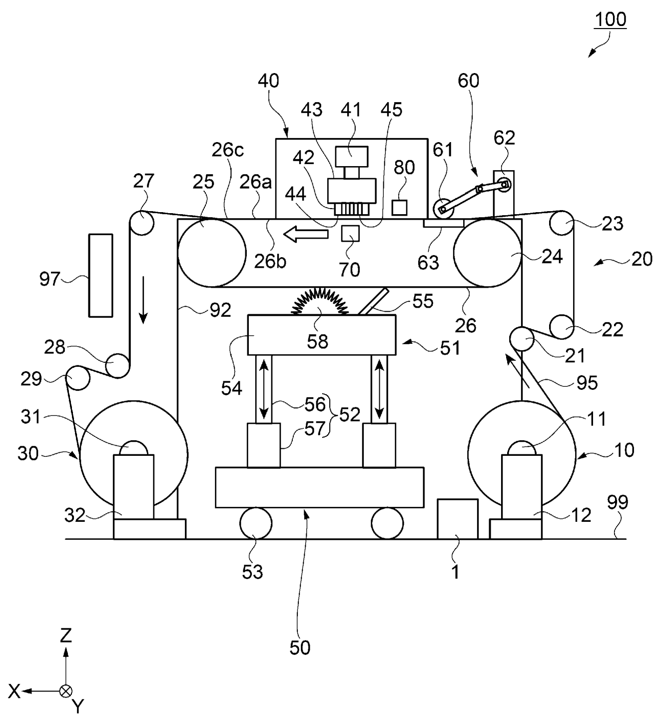
(54) **PRINTING APPARATUS**

(57) A printing apparatus includes a driving roller, an endless belt that transports a recording medium using rotation of the driving roller, a roller correction table acquisition unit that acquires a roller correction table, which represents a relationship between a point of origin position of the driving roller and a movement error of the endless belt, a belt correction table acquisition unit that acquires a belt correction table, which represents a relationship between a point of origin position of the endless belt and a movement error of the endless belt, and a control section that controls driving of the driving roller by calculating a rotation amount of the driving roller on the basis of the roller correction table and the belt correction table.

FIG. 1



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Description

BACKGROUND

1. Technical Field

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

2. Related Art

[0002] In recent years, an ink jet type printing apparatus that performs printing of patterns, or the like, on a fabric by discharging an ink toward an outer surface of the fabric, has been used in textile printing on fabrics such as cotton, silk, wool, chemical fibers, and blended fabrics. In order to handle a stretchable fabric as a recording medium, a printing apparatus that is used in textile printing moves a recording medium by mounting the recording medium on an endless belt having a sticky property. In this kind of printing apparatus, an error in the movement amount of the endless belt occurs due to variations in the dimensions in the thickness direction of the endless belt. Therefore, for example, Japanese Patent No. 5332884 discloses an ink jet recording apparatus (a printing apparatus) that corrects a feeding amount of an endless belt by determining a corrected feeding amount that depends on a feeding position of a transport belt (the endless belt) using a test print. As a result of this, it is stated that it is possible to control fluctuations in the feeding amount caused by the thickness of a joining section of the endless belt.

[0003] In a printing apparatus that is provided with this kind of endless belt, in addition to variations in the thickness of the endless belt, a movement error amount of an endless belt differs depending on various printing conditions that are stipulated at a time of printing such as decentering of a belt driving roller that moves the endless belt, the type of recording medium, and the like. However, the printing apparatus that is disclosed in Japanese Patent No. 5332884 is not provided with a unit that corrects movement error of the endless belt caused by factors other than variations in the thickness of the endless belt.

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 driving roller, an endless belt that transports a recording medium using rotation of the driving roller, a roller correction table acquisition unit that acquires a roller correction table, which represents a relationship between a point of origin position of the driving roller and a movement error of the endless belt, a belt correction table acquisition unit that acquires a belt correction table, which represents a relationship between a point of origin position of the endless belt and a movement error of the endless belt, and a control section that controls driving of the driving roller by calculating a rotation amount of the driving roller on the basis of the roller correction table and the belt correction table.

[0006] According to the application example, the printing apparatus includes the roller correction table acquisition unit that acquires a roller correction table, which represents a relationship between a point of origin position of the driving roller and a movement error of the endless belt. In other words, the printing apparatus includes a unit that determines a movement error of the endless belt caused by decentering of the driving roller. In addition, the printing apparatus includes a belt correction table acquisition unit that acquires a belt correction table, which represents a relationship between a point of origin position of the endless belt and a movement error of the endless belt. In other words, the printing apparatus includes a unit that determines a movement error of the endless belt caused by the thickness of the endless belt. Since the control section of the printing apparatus drives the driving roller by calculating a rotation amount of the driving roller on the basis of the roller correction table and the belt correction table, a movement error of the endless belt caused by decentering of the driving roller is corrected in addition to variations in the thickness of the endless belt. As a result of this, since the movement accuracy of the endless belt and the transport accuracy of a recording medium, which is mounted on the endless belt, are improved, it is possible to improve the printing quality of an image that is formed on the recording medium. Accordingly, it is possible to provide a printing apparatus in which the transport accuracy of a recording medium is improved and the printing quality of an image is improved.

Application Example 2

[0007] It is preferable that the printing apparatus according to the application example further includes roller correction tables and belt correction tables that correspond to printing conditions that are stipulated at a time of printing, and that the control section selects a roller correction table and a belt correction table that match the stipulated printing conditions.

[0008] According to the application example, the printing apparatus includes roller correction tables and a belt correction tables that are acquired on the basis of various printing conditions that are stipulated at the time of printing. As a result of the control section of the printing apparatus driving the driving roller by calculating a rotation amount of the driving roller by selecting a roller correction table and a belt correction table that match the stipulated printing conditions, it is possible to perform correction that includes a movement error of the endless belt caused by the printing conditions.

Application Example 3

[0009] In the printing apparatus according to the application example, it is preferable that the printing conditions include printing quality.

[0010] According to the application example, the printing apparatus includes the roller correction tables and a belt correction tables that are acquired on the basis of a printing quality that is stipulated at the time of printing. For example, a mode in which printing quality is prioritized, a mode in which printing velocity is prioritized, and the like, are examples of the printing quality. More specifically, the printing velocity differs depending on the printing quality. Since a movement error of the endless belt differs depending on the printing velocity, the printing apparatus of the present application example can perform correction that includes a movement error of the endless belt caused by differences in the printing velocity, which depends on the printing quality.

Application Example 4

[0011] In the printing apparatus according to the application example, it is preferable that the printing conditions include a medium type of the recording medium.

[0012] According to the application example, the printing apparatus includes the printing roller correction tables and a belt correction tables that are acquired on the basis of a recording medium to be used in the printing. Since a movement error of the endless belt differs depending on the stretchability, and the like, of a recording medium to be used, the printing apparatus of the present application example can perform correction that includes a movement error of the endless belt caused by the recording medium to be used.

Application Example 5

[0013] In the printing apparatus according to the application example, it is preferable that the printing conditions include a condition relating to a tension at a time of transporting the recording medium.

[0014] According to the application example, the printing apparatus includes roller correction tables and a belt correction tables that are acquired on the basis of a condition relating to a tension that is applied when transporting the recording medium, the condition being stipulated at the time of printing. For example, a "tension mode" that transports a recording medium by applying a predetermined amount of tension thereto, and a "slack mode" that reduces damage and transports a recording medium, and the like, are examples of transport methods. Since the amount of a movement error of the endless belt differs depending on a transport mode of a recording medium, the printing apparatus of the present application example can perform correction that includes a movement error of the endless belt caused by the transport method of the recording medium.

Application Example 6

[0015] It is preferable that the printing apparatus according to the application example further includes a tension measurement section that measures an amount of tension that is applied to the recording medium on at least one of an upstream side and a downstream side of the endless belt in a movement direction of the recording medium; and roller correction tables and belt correction tables that correspond to tension that can be measured by the tension measurement section, and that the control section selects a roller correction table and a belt correction table that match the tension that is measured by the tension measurement section.

[0016] According to the application example, the printing apparatus includes the roller correction tables and a belt correction tables that are acquired on the basis of an amount of tension of the recording medium, which is measured by the tension measurement section. Since the control section selects a roller correction table and a belt correction table that match the tension that is measured by the tension measurement section, it is even possible to perform correction that includes a movement error of the endless belt caused by tension in a case in which there are fluctuations in the amount of tension of a recording medium during printing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] 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 diagram that schematically shows an overall configuration of a printing apparatus according to Embodiment 1.
Fig. 2 is a perspective view in which an endless belt is displayed in an enlarged manner.
Fig. 3 is a cross-sectional view of a movement amount detection sensor.
Fig. 4 is an electrical block diagram that shows an electrical configuration of the printing apparatus.
Fig. 5 is a view that shows an example of a transport error of the endless belt.
Fig. 6 is a view that describes a point of origin of a driving axis of a belt driving roller.
Fig. 7 is a view that shows an example of a roller correction table.
Fig. 8 is a view that describes a belt phase of the endless belt.
Fig. 9 is a view that shows an example of a belt correction table.
Fig. 10 is a flowchart that describes a printing operation of the printing apparatus.
Fig. 11 is a schematic diagram that schematically shows an overall configuration of a printing apparatus according to Embodiment 2.

Fig. 12 is an enlarged view of a tension measurement section.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0018] Hereinafter, embodiments of the invention will be described with reference to the drawings. Additionally, in each of the drawings below, the scale of each layer and each member is altered from a practical scale in order to make each layer and each member have a size that is easy to understand.

[0019] In addition, in Figs. 1 to 3 and Figs. 6, 8, 11 and 12, for the sake of convenience, an X axis, a Y axis and a Z axis are illustrated as three axes that are orthogonal to one another, a tip end side of an arrow that illustrates an axial direction is referred to as a "+ side", and a base end side thereof is referred to as a "- side". In addition, hereinafter, a direction that is parallel to the X axis is referred to as an "X axis direction", a direction that is parallel to the Y axis is referred to as a "Y axis direction" and a direction that is parallel to the Z axis is referred to as a "Z axis direction".

Embodiment 1

Outline Configuration of Printing Apparatus

[0020] Fig. 1 is a schematic diagram that schematically shows an overall configuration of a printing apparatus according to Embodiment 1. A printing apparatus 100 is an apparatus that performs textile printing on a recording medium 95 by forming an image, or the like on the recording medium 95. For example, a fabric such as cotton, wool, a chemical fiber or a blended fabric can be used as the recording medium 95. In the present embodiment, a configuration that forms an image on a band-like recording medium 95 using a roll method will be illustrated by way of example, but the embodiment is not limited to this configuration. For example, the embodiment may use a method such as a sheet technique.

[0021] As shown in Fig. 1, the printing apparatus 100 includes a recording medium supply section 10, a recording medium transport section 20, a recording medium recovery section 30, a printing section 40, a cleaning unit 50, a medium adhesion section 60, a drying section 97, and the like. Further, the printing apparatus 100 includes a control section 1 that controls each of these sections. Each section of the printing apparatus 100 is attached to a frame section 92.

[0022] The recording medium supply section 10 is a section that supplies a recording medium 95 on which an image is to be formed, to a printing section 40 side. The recording medium supply section 10 includes a supply shaft section 11 and a bearing section 12. The supply shaft section 11 is formed in a cylindrical shape or a columnar shape, and is provided so as to be rotatable in a circumferential direction. A band-like recording medium 95 is wound around the supply shaft section 11 in roll shape. The supply shaft section 11 is attached to the bearing section 12 in an attachable and detachable manner. As a result of this, a recording medium 95 in a state of being wound around the supply shaft section 11 in advance, can be attached to the supply shaft section 11 and the bearing section 12.

[0023] The bearing section 12 supports both ends in an axial direction of the supply shaft section 11 in a rotatable manner. The recording medium supply section 10 includes a rotational driving section (not illustrated in the drawing) that drives the supply shaft section 11 in a rotational manner. The rotational driving section rotates the supply shaft section 11 in a direction in which a recording medium 95 is fed out. The operation of the rotational driving section is controlled by the control section 1.

[0024] The recording medium transport section 20 is a section that transports a recording medium 95 from the recording medium supply section 10 to the recording medium recovery section 30. The recording medium transport section 20 includes a transport roller 21, a tension roller 22, a transport roller 23, a belt rotation roller 24, a belt driving roller 25 as a driving roller, an endless belt 26, a transport roller 27, a tension roller 28 and a transport roller 29.

[0025] The transport rollers 21 and 23, and the tension roller 22 relay a recording medium 95 from the recording medium supply section 10 to the endless belt 26. The transport rollers 21 and 23 are fixed rollers that are fixed to the frame section 92, and the tension roller 22 is provided between the transport roller 21 and the transport roller 23, and is a movable roller that is movable in a vertical direction (the Z axis direction). As a result of being able to move the tension roller 22 in the vertical direction, the amount of tension of a recording medium 95, which is supplied to the endless belt 26 from the recording medium supply section 10, can be varied.

[0026] The endless belt 26 is formed in an endless shape in which both end portions of a band-like belt are connected to one another, and is hung on the belt rotation roller 24 and the belt driving roller 25. The endless belt 26 is maintained in a state in which a predetermined tension is applied thereto so that a portion between the belt rotation roller 24 and the belt driving roller 25 is parallel to a floor surface 99. A sticky layer 26c, which causes a recording medium 95 to stick to the endless belt 26, is provided on an outer surface (a support surface) 26a of the endless belt 26. The endless belt 26 supports (maintains) a recording medium 95, which is supplied from the transport roller 23, and is adhered to the sticky layer 26c by the medium adhesion section 60, which will be described later. As a result of this, it is possible to handle a stretchable fabric, or the like as a recording medium 95.

[0027] The belt rotation roller 24 and the belt driving roller 25 support an inner circumferential surface 26b of the endless belt 26. Additionally, a configuration in which a support section that supports the endless belt 26, is provided between the belt rotation roller 24 and the belt driving roller 25, may also be used.

[0028] The endless belt 26 moves a recording medium using rotation of the belt driving roller 25. To explain in more detail, when the belt driving roller 25 is driven, the endless belt 26 rotates in accordance with rotation of the belt driving roller 25, and the belt rotation roller 24 rotates due to rotation of the endless belt 26. As a result of rotation of the endless belt 26, a recording medium 95, which is supported on the endless belt 26, is transported in a predetermined transport direction, which is illustrated by an arrow, and an image is formed on the recording medium 95 by the printing section 40, which will be described later. In the present embodiment, a recording medium 95 is supported on a side (a +Z axis side) on which the outer surface 26a of the endless belt 26 faces the printing section 40, and the recording medium 95 is transported from a belt rotation roller 24 side to a belt driving roller 25 side along with the endless belt 26. In addition, on a side (a -Z axis side) on which the outer surface 26a of the endless belt 26 faces the cleaning unit 50, only the endless belt 26 moves from the belt driving roller 25 side to the belt rotation roller 24 side.

[0029] The transport roller 27 causes a recording medium 95, on which an image is formed, to peel away from the sticky layer 26c of the endless belt 26. The transport rollers 27 and 29, and the tension roller 28 relay a recording medium 95 from the endless belt 26 to the recording medium recovery section 30. The transport rollers 27 and 29 are fixed rollers that are fixed to the frame section 92, and the tension roller 28 is provided between the transport roller 27 and the transport roller 29, and is a movable roller that is movable in the vertical direction (the Z axis direction). As a result of being able to move the tension roller 28 in the vertical direction, the amount of tension of a recording medium 95, which is peeled away from the endless belt 26 and recovered by the recording medium recovery section 30, can be varied. Additionally, a "tension mode", and a "slack mode", which will be described later, and which are conditions relating to the tension when transporting the recording medium 95, are realized due to the movability of the tension rollers 22 and 28.

[0030] The recording medium recovery section 30 recovers a recording medium 95 that is transported by the recording medium transport section 20. The recording medium recovery section 30 includes a wind-up shaft section 31 and a bearing section 32. The wind-up shaft section 31 is formed in a cylindrical shape or a columnar shape, and is provided so as to be rotatable in a circumferential direction. A band-like recording medium 95 is wound up onto the wind-up shaft section 31 in roll shape. The wind-up shaft section 31 is attached to the bearing section 32 in an attachable and detachable manner. As a result of this, a recording medium 95 in a state of being wound-up onto the wind-up shaft section 31, is released along with the wind-up shaft section 31.

[0031] The bearing section 32 supports both ends in an axial direction of the wind-up shaft section 31 in a rotatable manner. The recording medium recovery section 30 includes a rotational driving section (not illustrated in the drawing) that drives the wind-up shaft section 31 in a rotational manner. The rotational driving section rotates the wind-up shaft section 31 in a direction in which a recording medium 95 is wound up. The operation of the rotational driving section is controlled by the control section 1.

[0032] Additionally, in the present embodiment, a drying section 97 is disposed between the transport roller 27 and the tension roller 28. The drying section 97 is a section that dries an image formed on a recording medium 95. For example, by including an IR heater in the drying section 97, and driving the IR heater, it is possible to dry an image formed on a recording medium 95 in a short period of time. As a result of this, it is possible to wind up a band-like recording medium 95 on which an image is formed, onto the wind-up shaft section 31.

[0033] The medium adhesion section 60 is a section that causes a recording medium 95 to adhere to the endless belt 26. The medium adhesion section 60 is disposed further on an upstream side (a -X axis side) than the printing section 40 in the transport direction of a recording medium 95. The medium adhesion section 60 includes a pressing roller 61, a pressing roller driving section 62 and a roller support section 63. The pressing roller 61 is formed in a cylindrical shape or a columnar shape, and is provided rotatable so as to be rotatable in a circumferential direction. The pressing roller 61 is disposed so that an axial direction thereof intersects the transport direction in a manner in which the pressing roller 61 rotates in a direction along the transport direction. The roller support section 63 is provided on an inner circumferential surface 26b side of the endless belt 26, which faces the pressing roller 61 with the endless belt 26 interposed therebetween.

[0034] The pressing roller driving section 62 moves the pressing roller 61 in the transport direction (a +X axis direction) and a direction (a -X axis direction) that is opposite to the transport direction while pressing the pressing roller 61 toward a lower side in the vertical direction (the -Z axis side). A recording medium 95 that is transported from the transport roller 23, and superimposed on the endless belt 26, is pressed against the endless belt 26 between the pressing roller 61 and the roller support section 63. As a result of this, it is possible to reliably cause a recording medium 95 to stick to the sticky layer 26c, which is provided on the outer surface 26a of the endless belt 26, and therefore, it is possible to prevent lifting of a recording medium 95 above the endless belt 26.

[0035] The printing section 40 includes an ink jet type discharge head 42 that discharges an ink toward a recording medium 95 as liquid droplets, a carriage movement section 41 that moves a carriage 43, in which the discharge head 42 is mounted, and the like. The printing section 40 is disposed above a disposition position of the endless belt 26 (on the +Z axis side). A discharge surface 44, on which a plurality of nozzle rows 45 are formed, is provided in the discharge head 42. For example, four nozzle rows 45 are formed on the discharge surface 44, and a different color of ink (for example, cyan: C, magenta: M, yellow: Y and black: K) is discharged from each nozzle row 45. The discharge surface 44 faces a recording medium 95 that is transported by the endless belt 26.

[0036] The carriage movement section 41 moves the discharge head 42 in a direction that intersects the transport direction of a recording medium 95 (a width direction of a recording medium 95 (the Y axis direction)). The carriage 43 is supported by a guide rail (not illustrated in the drawing), which is disposed along the Y axis direction, and the carriage 43 is configured so as to be able to reciprocate in a ±Y axis direction as a result of the carriage movement section 41. For example, it is possible to use a configuration in which a ball screw and a ball nut are combined, a linear guide mechanism or the like, as the carriage movement section 41.

[0037] Furthermore, a motor (not illustrated in the drawing) is provided in the carriage movement section 41 as a motive power source for moving the carriage 43 along the Y axis direction. When the motor is driven due to the control of the control section 1, the discharge head 42 reciprocates along the Y axis direction along with the carriage 43. Additionally, in the present embodiment, a serial head type discharge head, which is installed in a movable carriage and discharges an ink while moving in the width direction of a recording medium 95 (the ±Y axis direction), is illustrated as the discharge head 42 by way of example, but a line head type in which the discharge head is fixedly arranged extending in the width direction of a recording medium 95 (the Y axis direction) may be used instead.

[0038] The printing apparatus 100 is provided with the cleaning unit 50 for cleaning the endless belt 26. The cleaning unit 50 includes a cleaning section 51, a pressing section 52 and a movement section 53. The movement section 53 can be fixed in a predetermined position by moving the cleaning unit 50 along the floor surface 99 in an integral manner. The cleaning unit 50 is disposed between the belt rotation roller 24 and the belt driving roller 25 in the X axis direction.

[0039] The pressing section 52 is an elevation device that is configured by an air cylinder 56 and a ball bush 57, and is capable of moving the cleaning section 51, which is provided above the pressing section 52, between a cleaning position and a retreat position. The cleaning position is a position in which a cleaning roller 58 and a blade 55 abut against the endless belt 26. The retreat position is a position in which the cleaning roller 58 and the blade 55 are separated from the endless belt 26. In the cleaning position, the cleaning section 51 cleans the outer surface 26a (the support surface) of the endless belt 26, which is hanging in a state in which a predetermined amount of tension is applied between the belt rotation roller 24 and the belt driving roller 25, from below (a -Z axis direction). Additionally, Fig. 1 shows a case in which the cleaning section 51 is raised and disposed in the cleaning position.

[0040] The cleaning section 51 includes a cleaning tub 54, the cleaning roller 58 and the blade 55. The cleaning tub 54 is a tub in which a cleaning solution that is used in the cleaning of ink and foreign matter that is attached to the outer surface 26a of the endless belt 26, is retained, and the cleaning roller 58 and the blade 55 are provided on an inner side of the cleaning tub 54. For example, it is possible to use water, a water-soluble solvent (an alcohol aqueous solution or the like), or the like, as the cleaning solution, and a surfactant, an antifoaming agent, and the like may be added thereto according to necessity.

[0041] A lower side (the -Z axis side) of the cleaning roller 58 is immersed in the cleaning solution that is retained in the cleaning tub 54. When the cleaning roller 58 is rotated in the cleaning position, the cleaning solution is supplied to the outer surface 26a of the endless belt 26, and the cleaning roller 58 slides along the endless belt 26. As a result of this, ink and fibers or the like of a fabric of a recording medium 95, which are attached to the endless belt 26, are washed away using the cleaning roller 58.

[0042] For example, the blade 55 is configured by a material having a flexible property such as a silicon rubber. The blade 55 is provided further on a downstream side than the cleaning roller 58 in the transport direction of the endless belt 26. Cleaning solution that remains on the outer surface 26a of the endless belt 26, is removed as a result of the endless belt 26 sliding along the blade 55.

[0043] Fig. 2 is a perspective view in which an endless belt is displayed in an enlarged manner. Fig. 3 is a cross-sectional view of a movement amount detection sensor. A movement amount detection sensor 70 and a belt point of origin sensor 80 that determine a point of origin position and a movement amount of the endless belt 26 will be described with reference to Figs. 2 and 3.

[0044] The belt point of origin sensor 80 is a sensor that detects a point of origin of the endless belt 26. As shown in Fig. 2, markers 81 are provided at both end portions in the width direction of the endless belt 26 (the Y axis direction) on the outer surface 26a, on which the sticky layer 26c is not formed, as points of origin of the endless belt 26. The belt point of origin sensor 80 is provided above (in a +Z axis direction) the marker 81 in the vertical direction. When the marker 81 moves in accordance with movement of the endless belt 26 and passes under the belt point of origin sensor 80, the belt point of origin sensor 80 detects the marker 81 and outputs a detection signal thereof.

[0045] The movement amount detection sensor 70 is a sensor that performs image process measurement of a practical (or an actual amount of movement in practice) movement amount of the endless belt 26. The movement amount detection sensor 70 captures images for determining a practical movement amount that the endless belt 26 moves in a practical sense through comparison of positions before movement and after movement of the endless belt 26. As shown in Figs. 2 and 3, the movement amount detection sensor 70 is provided in a position that faces the printing section 40 (refer to Fig. 1) with the endless belt 26 interposed therebetween, and captures images of the inner circumferential surface 26b of the endless belt 26.

[0046] Additionally, in the present embodiment, a configuration in which the movement amount detection sensor 70 is provided on the inner circumferential surface 26b of the endless belt 26 is shown, but the movement amount detection sensor 70 is not limited to this configuration. The movement amount detection sensor 70 may be provided in any position in which it is possible to capture images of the outer surface 26a, on which the sticky layer 26c of the endless belt 26 is not formed, the outer surface of a recording medium 95 that is mounted on the endless belt 26, or the like. In addition, it is preferable that the movement amount detection sensor 70 is provided in the vicinity of the printing section 40. In addition, in a case in which images of the outer surface 26a or the inner circumferential surface 26b of the endless belt 26 are captured, it is preferable that undulations are formed on the outer surface of a target of the image capture section. As a result of this, since a clear image is captured, the calculate accuracy of the movement amount of the endless belt 26 is improved.

[0047] As shown in Fig. 3, the movement amount detection sensor 70 is provided with a light-emitting section 72, a condensing lens 73, and an image capturing element 74 on an inner side of a case 76.

[0048] The case 76 configures the exterior of the movement amount detection sensor 70. The case 76 has a truncated cone shape, and a light-transmissive glass 71 is attached to a tip end portion (an upper end portion) thereof. The light-transmissive glass 71 faces a gap between the light-transmissive glass 71 and the inner circumferential surface 26b of the endless belt 26 in a vertical manner in a state in which a gap is interposed therebetween.

[0049] The light-emitting section 72 is a section that radiates light toward the endless belt 26. The light-emitting section 72 is provided on an inner wall surface of the case 76 with an angled posture in which it is possible to emit light toward the light-transmissive glass 71. For example, it is possible to use a light emitting diode (LED) as the light-emitting section 72.

[0050] The condensing lens 73 is a lens that condenses reflected light that passes through the light-transmissive glass 71 for a second time and is incident to the inside of the case 76 after light that is emitted from the light-emitting section 72 and passes through the light-transmissive glass 71 is reflected by the inner circumferential surface 26b of the endless belt 26, and is provided in a cylindrical portion of the case 76.

[0051] The image capturing element 74 is an element that captures images of the inner circumferential surface 26b of the endless belt 26, which are condensed by the condensing lens 73, and includes an image capturing surface 74a in a position in which images are formed. The image capturing element 74 is provided on an inner bottom surface of the case 76. Additionally, the condensing lens 73 is retained at a height at which an image of the inner circumferential surface 26b of the endless belt 26 on the image capturing surface 74a of the image capturing element 74 can obtained, by a retention member 75.

[0052] The movement amount detection sensor 70 outputs image capturing data that is captured by the image capturing element 74, to the control section 1. The control section 1 compares image capturing data before and after movement of the endless belt 26, and outputs a practical movement amount that the endless belt 26 has moved in a practical sense.

[0053] Additionally, in the present embodiment, a method that uses the movement amount detection sensor 70 as a measurement method of the practical movement amount of the endless belt 26, is illustrated by way of example, but the measurement method is not limited to this configuration. The measurement method of the practical movement amount of the endless belt 26 may be a method that uses a laser length measurement machine. For example, it is possible to measure the practical movement amount of the endless belt 26 by providing a reflective body, which reflects laser light emitted along a movement direction of the endless belt 26, on the endless belt 26, and measuring a distance between a laser length measurement machine and the reflective body, which moves along with the endless belt 26. In addition, it is possible to determine the practical movement amount of the endless belt 26 by repeating movement of the endless belt 26 and the discharge of liquid droplets onto a recording medium 95 such as photographic paper, and measuring a position of a measurement pattern (dots) that is formed on the recording medium 95.

Electrical Configuration of Printing Apparatus

[0054] Fig. 4 is an electrical block diagram that shows an electrical configuration of the printing apparatus. Next, the electrical configuration of the printing apparatus 100 will be described with reference to Fig. 4.

[0055] The control section 1 is a control unit for performing control of the printing apparatus 100. The control section 1 is configured to include a control circuit 4, an interface section (I/F) 2, a CPU (Central Processing Unit) 3, and a storage section 5. The interface section 2 is a section for performing the communication of data between an external apparatus 6, which handles images, such as a computer or a digital camera, and the printing apparatus 100. The CPU 3 is an arithmetic processing device for performing an input signal process from various detector groups 7 and overall control of the printing apparatus 100. The detector groups 7 include the movement amount detection sensor 70 for measuring the movement amount of the endless belt 26, the belt point of origin sensor 80 that detects a belt point of origin of the endless belt 26, and a driving shaft point of origin sensor 85 that detects a driving shaft point of origin of the belt driving roller 25.

[0056] The storage section 5 is a section for securing a region that stores a program of the CPU 3, a work region, or the like, and includes storage elements such as RAM (Random Access Memory), EEPROM (Electrically Erasable Programmable Read-Only Memory), or the like. In addition, roller correction tables and belt correction tables that correct a transport error of the endless belt 26, which will be described later, are stored in the storage section 5.

[0057] The CPU 3 controls the belt driving roller 25 that moves the endless belt 26 in the transport direction, the carriage movement section 41 that moves the carriage 43, in which the discharge head 42 is mounted, in a direction that intersects the transport direction, the discharge head 42 that discharges ink toward a recording medium 95, and each device that is not illustrated in the drawings, on the basis of printing data and printing conditions that are received from the external apparatus 6 using the control circuit 4. Additionally, for example, a printing quality, which is represented by "clear", "fast", or the like, a medium type to be used as a recording medium 95, a condition relating to the tension when transporting the recording medium, which is represented by a "tension mode", a "slack mode", or the like, are included as the printing conditions of the present embodiment.

Transport Error

[0058] Next, a transport error of the endless belt 26 will be described.

[0059] Fig. 5 is a view that shows an example of a transport error of the endless belt. The horizontal axis in Fig. 5 represents an integrated movement amount when the endless belt 26 is rotated a single time by repeatedly moving the endless belt 26 by a predetermined movement amount from a predetermined position (for example, a point of origin position of the marker 81). That is, a maximum value of the horizontal axis in Fig. 5 is equivalent to the length of the endless belt 26. The vertical axis in Fig. 5 represents a difference (hereinafter, also referred to as a transport error) between practical movement amounts, which are calculated from image capturing data that is captured before and after movement of the endless belt 26, with respect to a predetermined (or intended) movement amount.

[0060] As shown in Fig. 5, in the transport error, an error that is expressed periodically in a period of an interval A, and an error, which is shown by an interval B, that is expressed specifically. The length of the interval A is substantially equivalent to the length of the outer periphery of the belt driving roller 25, and it can be understood that the transport error of the interval A is caused by driving of the belt driving roller 25. The reason for this is that the interval A is a so-called transport error that occurs as a result of decentering of the belt driving roller 25, in which the center of the circumference (the outer periphery) of the belt driving roller 25 and the center of the axis of rotation that drives the belt driving roller 25 in a rotational manner, are shifted. The interval B is equivalent to a position of a connection section of the endless belt 26, and it can be understood that the transport error of the interval B is caused by the thickness of the endless belt 26. Additionally, a transport error caused by the thickness of the endless belt 26 in portions other than a connection section of the endless belt 26, are also included in practice.

[0061] Fig. 6 is a view that describes a point of origin of a driving axis of a belt driving roller. The belt driving roller 25 is provided with the driving shaft point of origin sensor 85. In addition, in the present description, the position of the driving shaft point of origin sensor 85 is set as a reference position of the belt driving roller 25. For example, it is possible to use a rotary encoder, which is provided with a marker as a driving shaft point of origin, or the like, as the driving shaft point of origin sensor 85. The position of the driving shaft point of origin moves as a result of rotational driving of the belt driving roller 25. Additionally, in the following description, the position of the driving shaft point of origin represents an angle θ that is formed by a line that connects the center of the belt driving roller 25 and the reference position, and a line that connects the center of the belt driving roller 25 and the driving shaft point of origin. In this way, the point of origin sensor 85 measures how much the driving roller has rotated. Additionally, the driving shaft point of origin of the belt driving roller 25 may be determined using an absolute-type rotary encoder that outputs an absolute position of the driving shaft point of origin that depends on a rotational angle.

[0062] Fig. 7 is a view that shows an example of a roller correction table. The roller correction table represents a relationship between a point of origin position of a driving roller and a movement error of the endless belt. In the present embodiment, a plurality of roller correction tables, which correspond to a plurality of printing conditions, are stored in the storage section 5.

[0063] Positions of the driving shaft point of origin of the belt driving roller 25 are shown using the angles θ in the parameters in the rows of the roller correction table that is shown in Fig. 7, and reference movement amounts Kn are shown as predetermined movement amounts of the endless belt 26 in the parameters of the rows. Further, correction values α of the movement amounts are shown in intersecting positions of the respective parameters (the angles θ and the reference movement amounts Kn).

[0064] A roller correction table acquisition unit, which acquires roller correction tables, calculates correction values α of movement amounts from the reference movement amounts Kn, by which the control section 1 feeds out the endless belt 26 by driving (rotating) the belt driving roller 25, and practical movement amounts of the endless belt 26, which are determined using the movement amount detection sensor 70. Correction values α of at least a single circuit (an amount that is equivalent to 360°) of the belt driving roller 25 are determined as a result of the control section 1 repeating rotation of the belt driving roller 25 and calculation of the correction values α. As a result of this, it is possible to acquire the roller correction tables that are illustrated by way of example in Fig. 7, and correct movement errors caused by decentering of the belt driving roller 25. Additionally, it is preferable that the correction values α are determined in a case in which the connection section of the endless belt 26 is not positioned at the belt rotation roller 24 or the belt driving roller 25. As a result of this, it is possible to eliminate the effects of transport errors caused by the thickness of the endless belt 26.

[0065] Fig. 8 is a view that describes a belt phase of the endless belt. In the present description, the position of the belt point of origin sensor 80 is set as a reference position of the endless belt 26. The position of the marker 81, as the point of origin position of the endless belt 26, moves as a result of rotational driving of the belt driving roller 25. In the following description, a difference between the marker 81, as the point of origin position of the endless belt 26, and a reference position is represented by a belt phase D.

[0066] Fig. 9 is a view that shows an example of a belt correction table. The belt correction table represents a relationship between a point of origin position of an endless belt and a movement error of the endless belt. In the present embodiment, a plurality of belt correction tables, which correspond to a plurality of printing conditions, are stored in the storage section 5.

[0067] Point of origin positions (the positions of the markers 81) of the endless belt 26 are shown using the belt phases D in the parameters in the rows of the belt correction table that is shown in Fig. 9, and reference movement amounts Kn are shown as predetermined movement amounts of the endless belt 26 in the parameters of the rows. Further, correction values σ of the movement amounts are shown in intersecting positions of the respective parameters (the belt phases D and the reference movement amounts Kn).

[0068] A belt correction table acquisition unit, which acquires belt correction tables, calculates correction values σ of movement amounts from the reference movement amounts Kn, by which the control section 1 feeds out the endless belt 26 by driving (rotating) the belt driving roller 25, and practical movement amounts of the endless belt 26, which are determined using the movement amount detection sensor 70. Correction values σ of at least a single circuit (an amount that is equivalent to 360°) of the endless belt 26 are determined as a result of the control section 1 repeating rotation of the belt driving roller 25 and calculation of the correction values σ. As a result of this, it is possible to acquire the belt correction tables that are illustrated by way of example in Fig. 9, and correct movement errors caused by the thickness of the endless belt 26. Additionally, at the time of acquiring the belt correction tables, it is possible to acquire correction values σ in which transport errors caused by decentering of the belt driving roller 25 are eliminated, by determining the position (the angle θ) of the driving shaft point of origin of the belt driving roller 25 and taking the roller correction table into consideration.

[0069] In the present embodiment, a roller correction table and a belt correction table that were acquired by driving the printing apparatus 100 using printing conditions of "clear", "medium type A" and "tension mode" are illustrated by way of example, but the printing conditions are not limited to these printing conditions. For example, the correction values α and σ of the belt correction tables and the roller correction tables differ depending on printing conditions such as the printing quality, which is represented by "clear", "fast", or the like, the medium type to be used as a recording medium 95, a condition relating to the tension when transporting a recording medium 95, which is represented by the "tension mode", the "slack mode", or the like, and the like. Therefore, the printing apparatus 100 of the present embodiment includes roller correction tables and belt correction tables that correspond to printing conditions that are stipulated at the time of printing. To explain in more detail, a plurality of roller correction tables and a plurality of belt correction tables, which are acquired by driving the printing apparatus 100 on the basis of these printing conditions, are included in the storage section 5.

[0070] The control section 1 of the printing apparatus 100 selects a roller correction table and a belt correction table that match the printing conditions stipulated at the time of printing.

[0071] To explain in more detail, in a case in which printing conditions that include printing quality are stipulated at the time of printing, the control section 1 selects a roller correction table and a belt correction table that match the printing conditions including the stipulated printing quality, from the plurality of roller correction tables and the plurality of belt correction tables that are saved in the storage section 5 by performing acquisition including the printing quality as a parameter. As a result of this, it is possible to obtain correction values α and σ that include movement errors of the endless belt 26 caused by differences in the printing velocity, which depends on the printing quality.

[0072] In a case in which printing conditions that include the medium type are stipulated at the time of printing, the control section 1 selects a roller correction table and a belt correction table that match the printing conditions including the stipulated medium type, from the plurality of roller correction tables and the plurality of belt correction tables that are saved in the storage section 5 by performing acquisition including the medium type of a recording medium 95 as a parameter. As a result of this, it is possible to obtain correction values α and σ that include movement errors of the endless belt 26 caused by differences in the type of recording medium 95.

[0073] In a case in which printing conditions that include the condition relating to the tension when transporting a recording medium 95 are stipulated at the time of printing, the control section 1 selects a roller correction table and a belt correction table that match the printing conditions including the stipulated condition relating to the tension, from the plurality of roller correction tables and the plurality of belt correction tables that are saved in the storage section 5 by performing acquisition including the condition relating to the tension as a parameter. As a result of this, it is possible to obtain correction values α and σ that include movement errors of the endless belt 26 caused by differences in the condition relating to the amount of tension of a recording medium 95.

Printing Operation of Printing Apparatus

[0074] Fig. 10 is a flowchart that describes a printing operation of the printing apparatus. A printing operation of the printing apparatus 100 will be described with reference to Figs. 4 and 10.

[0075] In Step S1, printing data is received. The CPU 3 receives printing data to record an image on a recording medium 95 and stipulated conditions from the external apparatus 6, and saves the printing data and printing conditions in the storage section 5.

[0076] In Step S2, the selection of correction tables is performed. The CPU 3 selects a roller correction table and a belt correction table that match the printing conditions received in Step S1 from a plurality of roller correction tables and a plurality of belt correction tables, which are saved in the storage section 5 and are acquired by setting various printing conditions as parameters. For example, the printing quality, which is represented by "clear", "fast", or the like, the medium type to be used as a recording medium 95, the tension when transporting the recording medium, which is represented by a "tension mode", a "slack mode", or the like, are included as the printing conditions. For example, in a case in which the received printing conditions are "clear", "medium type A" and "tension mode", the CPU 3 selects the roller correction table that is shown in Fig. 7 and the belt correction table that is shown in Fig. 9.

[0077] In Step S3, a feeding amount of the belt driving roller 25 is calculated. The control section 1 (the CPU 3) calculates a rotation amount of the belt driving roller 25 on the basis of the roller correction table and the belt correction table. To explain in more detail, the CPU 3 calculates a point of origin position (an angle θ) of the belt driving roller 25 and a point of origin position (a belt phase D) of the endless belt 26 by receiving signals that are output from the belt point of origin sensor 80 and the driving shaft point of origin sensor 85. Further, a feed out amount (a rotation amount) of the belt driving roller 25 is calculated by referring to the roller correction table and the belt correction table that were selected in Step S2. The feed out amount is a value in which a correction value α that is determined from the angle θ and a reference movement amount Kn, and a correction value σ that is determined from the belt phase D and the reference movement amount Kn, are added to the reference movement amount Kn.

[0078] In Step S4, the recording medium 95 is transported and ink is discharged. The control section 1 moves the endless belt 26 by rotating the belt driving roller 25 by the feed out amount that was calculated in Step S3, as a result of controlling the driving of the belt driving roller 25. As a result of this, the recording medium 95, which is mounted on the endless belt 26, is transported in the transport direction. Further, the control section 1 discharges ink from the discharge head 42 toward the recording medium 95 while moving the carriage 43 in a direction that intersects the transport direction of the recording medium 95, by controlling the carriage movement section 41 and the discharge head 42.

[0079] In Step S5, it is determined whether or not there is subsequent line of printing data. The CPU 3 determines whether or not there is a subsequent line of printing data by referring to the printing data that is saved in the storage section 5. In a case in which there is a subsequent line of printing data (Step S5: Yes), the process returns to Step S3 and the processes from Step S3 to Step S5 are repeated. In a case in which there is not a subsequent line of printing data (Step S5: No), the control section 1 finishes the printing operation of the printing apparatus 100.

[0080] As a result of the above-mentioned steps, since the movement accuracy of the endless belt 26 and the transport accuracy of a recording medium 95, which is mounted on the endless belt 26, is improved, it is possible to improve the printing quality of an image that is formed on the recording medium 95.

[0081] In the abovementioned manner, according to the printing apparatus 100 of the present embodiment, it is possible to obtain the following effects.

[0082] The printing apparatus 100 includes a roller correction table acquisition unit that acquires a roller correction table that corrects a movement error caused by decentering of the belt driving roller 25, and a belt correction table acquisition unit that acquires a belt correction table that corrects a movement error caused by the thickness of the endless belt 26. The control section 1 drives the belt driving roller 25 by calculating a rotation amount of the belt driving roller 25 on the basis of the roller correction tables and the belt correction tables that are saved in the storage section 5. As a result of this, it is possible to correct a movement error of the endless belt 26 caused by decentering of the belt driving roller 25 in addition to a movement error caused by variations in the thickness of the endless belt 26. Accordingly, it is possible to provide a printing apparatus 100 that includes a unit that acquires a movement error of the endless belt 26 caused by decentering of the belt driving roller 25, and is capable of correcting the movement error.

[0083] Since the printing apparatus 100 includes the roller correction table acquisition unit and the belt correction table acquisition unit, it is possible to acquire roller correction tables and belt correction tables based on various printing conditions that the printing apparatus 100 is provided with, and include the roller correction tables and the belt correction tables in the storage section 5. The control section 1 selects a roller correction table and a belt correction table that match printing conditions stipulated at the time of printing, and corrects the movement errors of the endless belt 26 on the basis of these tables. As a result of this, it is possible to correct movement errors of the endless belt 26 caused by printing conditions.

[0084] Since the printing apparatus 100 includes roller correction tables and belt correction tables that are acquired on the basis of printing quality, it is possible to perform correction that includes a movement error of the endless belt 26 caused by differences in the printing velocity, which depends on the printing quality.

[0085] Since the printing apparatus 100 includes roller correction tables and belt correction tables that are acquired on the basis of the type of recording medium 95, it is possible to perform correction that includes a movement error of the endless belt 26 caused by differences in the type of recording medium 95.

[0086] Since the printing apparatus 100 includes roller correction tables and belt correction tables that are acquired on the basis of the condition relating to the tension when transporting a recording medium 95, it is possible to perform correction that includes a movement error of the endless belt 26 caused by differences in the condition relating to the amount of tension of a recording medium 95.

[0087] According to the printing apparatus 100, since the movement accuracy of the endless belt 26 and the transport accuracy of a recording medium 95, which is mounted on the endless belt 26, is improved, it is possible to improve the printing quality of an image that is formed on the recording medium 95.

Embodiment 2

[0088] Fig. 11 is a schematic diagram that schematically shows an overall configuration of a printing apparatus according to Embodiment 2. Fig. 12 is an enlarged view of a tension measurement section. A printing apparatus 200 according to the present embodiment will be described with reference to these drawings. Additionally, constituent sites that are the same as those of Embodiment 1 will be given the same reference numerals, and overlapping descriptions thereof will be omitted. The printing apparatus 200 includes tension measurement sections 110 and 130 that measure an amount of tension that is applied to a recording medium 95 on at least one of an upstream side and a downstream side of the endless belt 26 in the movement direction of the recording medium 95. The printing apparatus 200 of the present embodiment includes the tension measurement sections 110 and 130 on both the upstream side and the downstream side.

[0089] The recording medium transport section 20 includes a transport roller 21, a movable roller 122, a transport roller 23, a belt rotation roller 24, a belt driving roller 25, an endless belt 26, a transport roller 27, a movable roller 128 and a transport roller 29. The transport rollers 21 and 23, and the movable roller 122 relay a recording medium 95 from the recording medium supply section 10 to the endless belt 26. The movable roller 122 is provided between the transport roller 21 and the transport roller 23, and is configured so as to be movable in the vertical direction (the Z axis direction). The movable roller 122 is a constituent component of the tension measurement section 110, which measures an amount of tension of a recording medium 95 that is supplied to the endless belt 26 from the recording medium supply section 10.

[0090] The transport rollers 27 and 29, and the movable roller 128 relay a recording medium 95 from the endless belt 26 to the recording medium recovery section 30. The movable roller 128 is provided between the transport roller 27 and the transport roller 29, and is configured so as to be movable in the vertical direction (the Z axis direction). The movable roller 128 is a constituent component of the tension measurement section 130, which measures an amount of tension of a recording medium 95 that is recovered by the recording medium recovery section 30 from the endless belt 26.

[0091] Next, the tension measurement section 130 will be described. Additionally, since the tension measurement section 110 has the same configuration as the tension measurement section 130, description thereof will be omitted.

[0092] The tension measurement section 130 is provided with the movable roller 128 and an optical sensor 140. The movable roller 128 has a predetermined mass, and the position of the movable roller 128 moves along the vertical direction (the Z axis direction) as a result of the amount of tension that is applied to a recording medium 95. That is, the movable roller 128 is positioned in the +Z axis direction in a case in which the amount of tension of a recording medium 95 is high, and the movable roller 128 is positioned in the -Z axis direction in a case in which the amount of tension of a recording medium 95 is low.

[0093] A plurality of optical sensors 140 are provided along the Z axis direction in which the movable roller 128 moves. In the present embodiment, three optical sensors 140a, 140b and 140c are provided from the +Z axis direction toward the -Z axis direction. The optical sensors 140a, 140b and 140c detect the position of a lower end of the movable roller 128. The optical sensors 140a, 140b and 140c are configured to include a light emission section, which includes a light emitting element, or the like, that emits light, and a light reception section, which includes a light receiving element, or the like, that receives light emitted from the light emission section. Optical axes of the light emission sections are directed toward the movable roller 128, which is movable in the Z axis direction.

[0094] Light that is emitted from the light emission sections is received by the light reception sections in a case in of being reflected by a recording medium 95 that is latched onto the movable roller 128. The optical sensors 140a, 140b and 140c output an "ON" signal when reflected light that is reflected by a recording medium 95 is received, and an "OFF" signal when it is not possible to receive reflected light. For example, in a case in which the movable roller 128 is positioned in a first position 128a, the optical sensor 140a outputs the "ON" signal, and the optical sensors 140b and 140c output the "OFF" signal. In addition, in a case in which the movable roller 128 is positioned in a third position 128c, the optical sensors 140a, 140b and 140c output the "ON" signal.

[0095] The control section 1 can determine the position of the movable roller 128 in the Z axis direction by analyzing the signals that are output from the optical sensors 140a, 140b and 140c. In addition, since the position of the movable roller 128 in the Z axis direction is proportionate to the amount of tension that is applied to a recording medium 95, the control section 1 can detect the amount of tension that is being applied to a recording medium 95 by determining the position of the movable roller 128 in the Z axis direction. Additionally, in the present embodiment, a configuration example that uses three optical sensors is shown, but configurations that use one or two optical sensors or four or more optical sensors, may also be used. It is possible to reduce the cost of the tension measurement sections in a case of a configuration using one or two optical sensors. It is possible to improve the measuring accuracy of the amount of tension that is applied to a recording medium 95 in a case of a configuration using four or more optical sensors. In addition, a method that uses the optical sensors 140 is illustrated by way of example as a method for determining the position of the movable roller 128 in the Z axis direction, but a method that uses a laser length measurement machine may also be used. For example, it is possible to determine the position of the movable roller 128 in the Z axis direction by providing a laser length measurement machine, which emits laser light toward the movable roller 128 from vertically above or vertically below the movable roller 128.

[0096] The printing apparatus 200 includes a roller correction table acquisition unit that acquires a roller correction table, and a belt correction table acquisition unit that acquires a belt correction table. Roller correction tables and belt correction tables that are acquired using the acquisition units by including amounts of tension that can be measured by the tension measurement sections 110 and 130 as a parameter, are saved in the storage section 5.

[0097] The control section 1 of the printing apparatus 200 selects a roller correction table and a belt correction table that match amounts of tension that are measured by the tension measurement sections 110 and 130 at the time of printing.

[0098] To explain in more detail, in a case in which amounts of tension that are measured by the tension measurement sections 110 and 130 fluctuate at the time of printing, the control section 1 selects a roller correction table and a belt correction table that match the amounts of tension that are measured by the tension measurement sections 110 and 130, from the plurality of roller correction tables and the plurality of belt correction tables that are saved in the storage section 5 by performing acquisition including the tension as a parameter. As a result of this, it is also possible to obtain correction values α and σ that include movement errors of the endless belt 26 caused by amounts of tension of a recording medium 95 in a case in which there are fluctuations in the amount of tension of a recording medium 95 at the time of printing. The control section 1 calculates a feed out amount (a rotation amount) of the belt driving roller 25 using the correction values α and σ.

[0099] The control section 1 moves the endless belt 26 by rotating the belt driving roller 25 by the calculated feed out amount, as a result of controlling the belt driving roller 25. As a result of this, a recording medium 95, which is mounted on the endless belt 26, is transported in the transport direction.

[0100] In the abovementioned manner, according to the printing apparatus 200 of the present embodiment, it is possible to obtain the following effects.

[0101] The printing apparatus 200 is provided with the tension measurement sections 110 and 130 that measure the amount of tension of a recording medium 95. Since the control section 1 selects a roller correction table and a belt correction table that match the amount of tension that is measured by the tension measurement sections 110 and 130, it is even possible to obtain correction values α and σ that include a movement error of the endless belt 26 caused by amounts of tension of a recording medium 95 in a case in which there are fluctuations in the amount of tension of a recording medium 95 during printing. As a result of this, since the movement accuracy of the endless belt 26 and the transport accuracy of a recording medium 95, which is mounted on the endless belt 26, is improved, it is possible to improve the printing quality of an image that is formed on the recording medium 95.

[0102] Where there are two tension measurement sections 110 and 130 provided, their outputs may be used as separate tension parameters for the tables or as a combined tension parameter.

[0103] Once the correction tables have been acquired and stored, it is no longer necessary to use or retain the acquisition unit or the movement amount detection sensor 70 unless the tables are to be updated or new tables are to be added. It is sufficient just to store the tables.

[0104] The foregoing description has been given by way of example only and it will be appreciated by a person skilled in the art that modifications can be made without departing from the scope of the present invention as defined by the claims.

Claims

1. A printing apparatus (100) comprising:

   a driving roller (25);
   an endless belt (26) for transporting a recording medium (95) using rotation of the driving roller;
   a roller correction table acquisition unit configured to acquire a roller correction table, which represents a relationship between a point of origin position of the driving roller and a movement error of the endless belt;
   a belt correction table acquisition unit configured to acquire a belt correction table, which represents a relationship between a point of origin position (81) of the endless belt and a movement error of the endless belt; and
   a control section (1) configured to control driving of the driving roller by calculating a rotation amount of the driving roller on the basis of the roller correction table and the belt correction table.

2. A printing apparatus (100) comprising:

   a driving roller (25);
   an endless belt (26) for transporting a recording medium (95) using rotation of the driving roller;
   storage means storing

      a roller correction table acquisition unit configured to acquire a roller correction table, which represents a relationship between a point of origin position of the driving roller and a movement error of the endless belt; and
      a belt correction table, which represents a relationship between a point of origin position (81) of the endless belt and a movement error of the endless belt; and

   a control section (1) configured to control driving of the driving roller by calculating a rotation amount of the driving roller on the basis of the roller correction table and the belt correction table.

3. The printing apparatus according to Claim 1 or Claim 2, further comprising:

   roller correction tables and belt correction tables that correspond to printing conditions that are stipulated at a time of printing;
   wherein the control section is configured to select a roller correction table and a belt correction table that match the stipulated printing conditions.

4. The printing apparatus according to Claim 3, wherein the printing conditions include printing quality.

5. The printing apparatus according to Claim 3 or claim 4,
   wherein the printing conditions include a medium type of the recording medium.

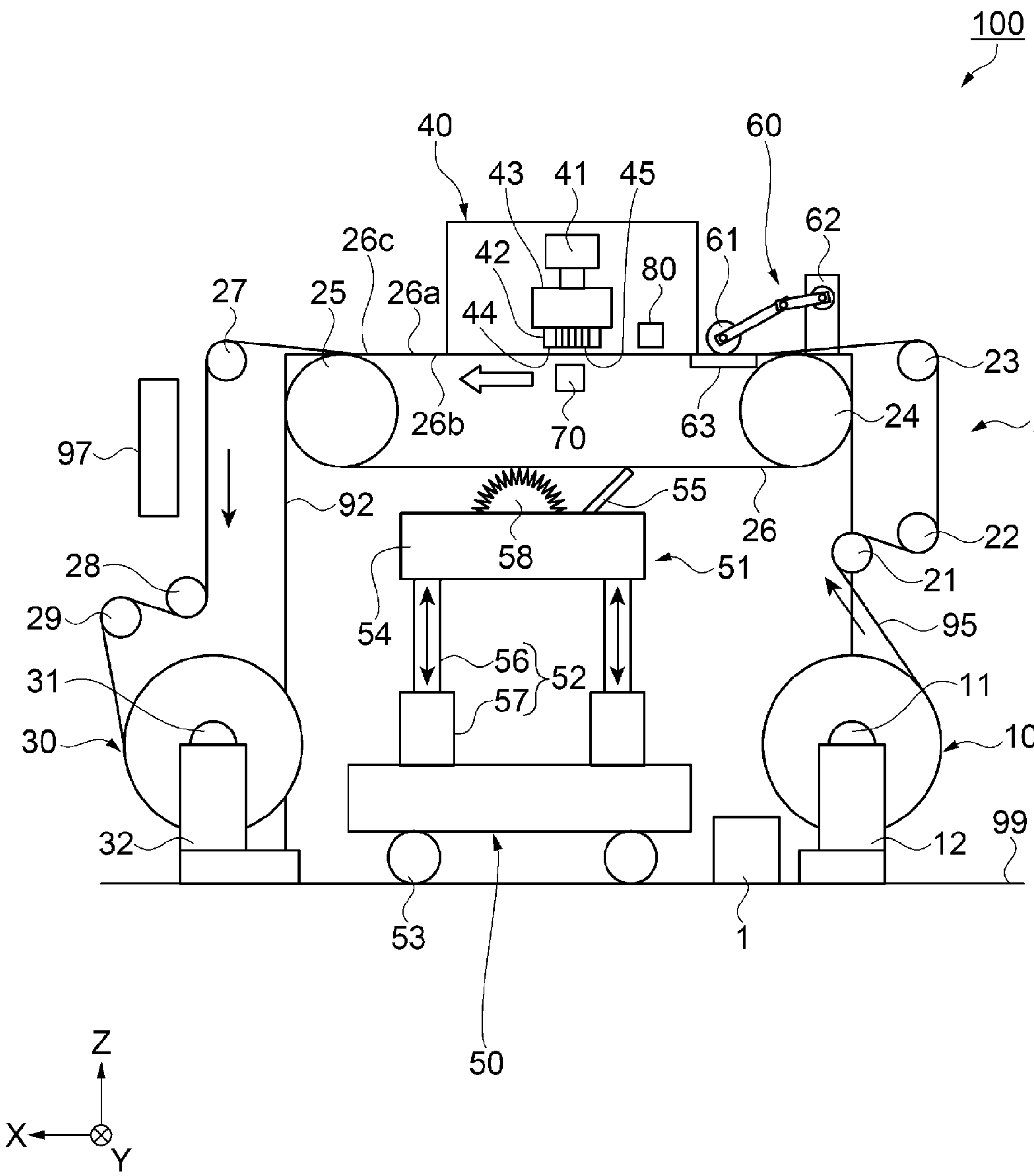
6. The printing apparatus according to any one of claims 3 to 5,
   wherein the printing conditions include a condition relating to a tension at a time of transporting the recording medium.

7. The printing apparatus according to any one of the preceding claims, further comprising:

   a tension measurement section (110, 130) configured to measure an amount of tension that is applied to the recording medium on at least one of an upstream side and a downstream side of the endless belt in a movement direction of the recording medium; and
   roller correction tables and belt correction tables that correspond to amounts of tension that can be measured by the tension measurement section;

   wherein the control section is configured to select a roller correction table and a belt correction table that match the tension that is measured by the tension measurement section.

FIG. 1


100
40
60
43
41
45
62
26c
42
80
61
27
25
26a
44
23
26b
70
63
24
20
97
92
55
26
22
28
58
51
21
29
54
95
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57
11
31
30
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32
12
99
53
1
50
Z
X
Y

FIG. 2

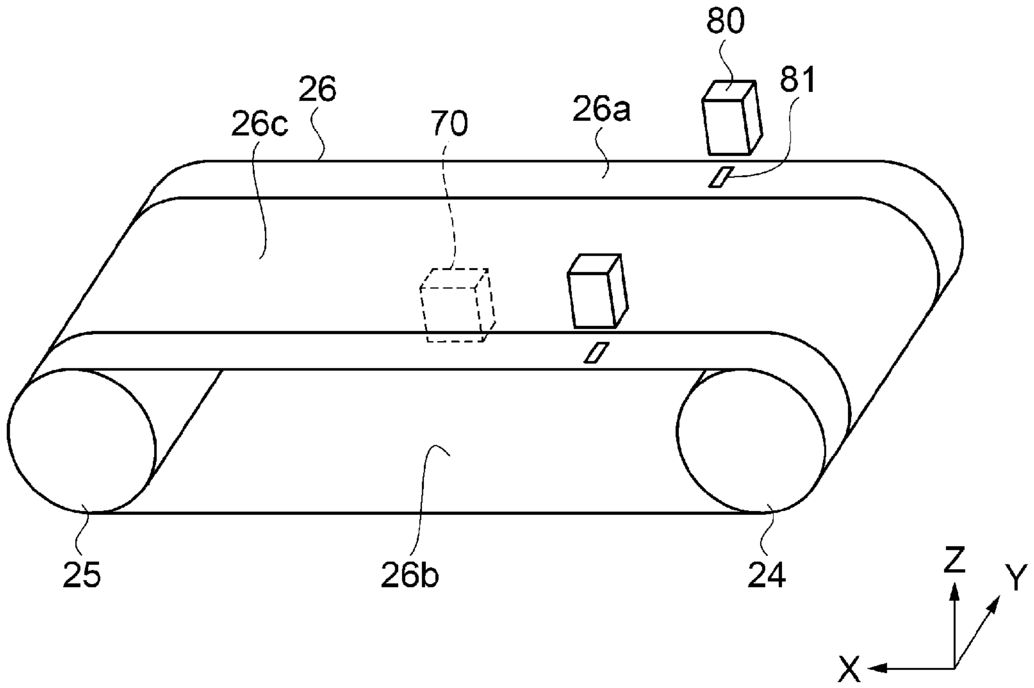


FIG. 3

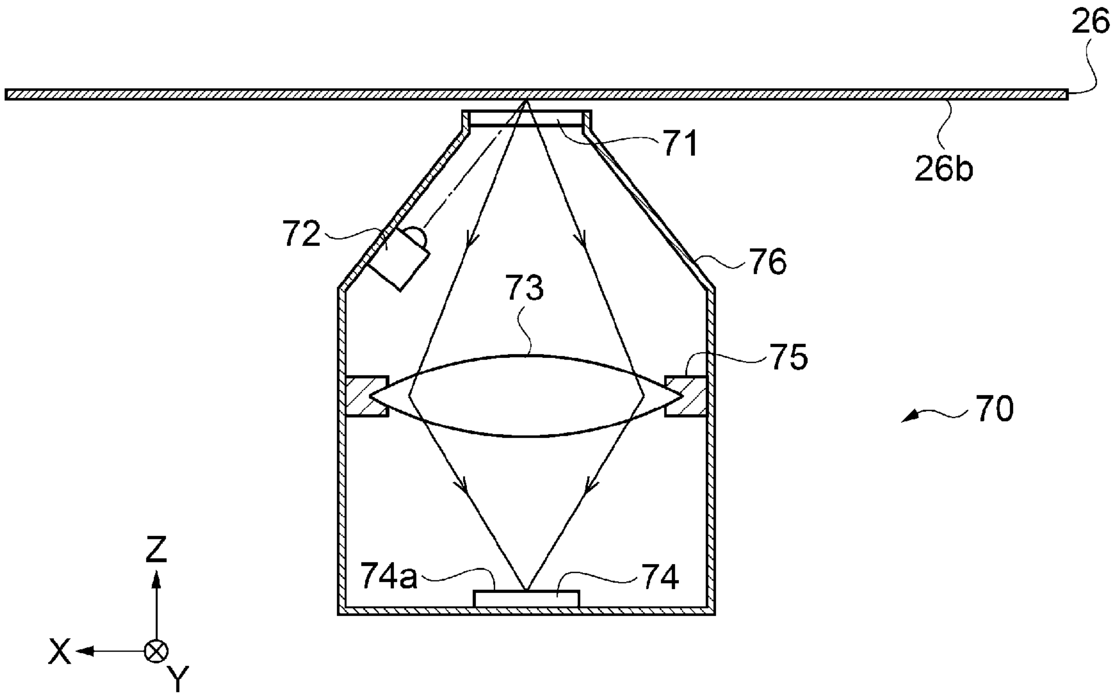


FIG. 4

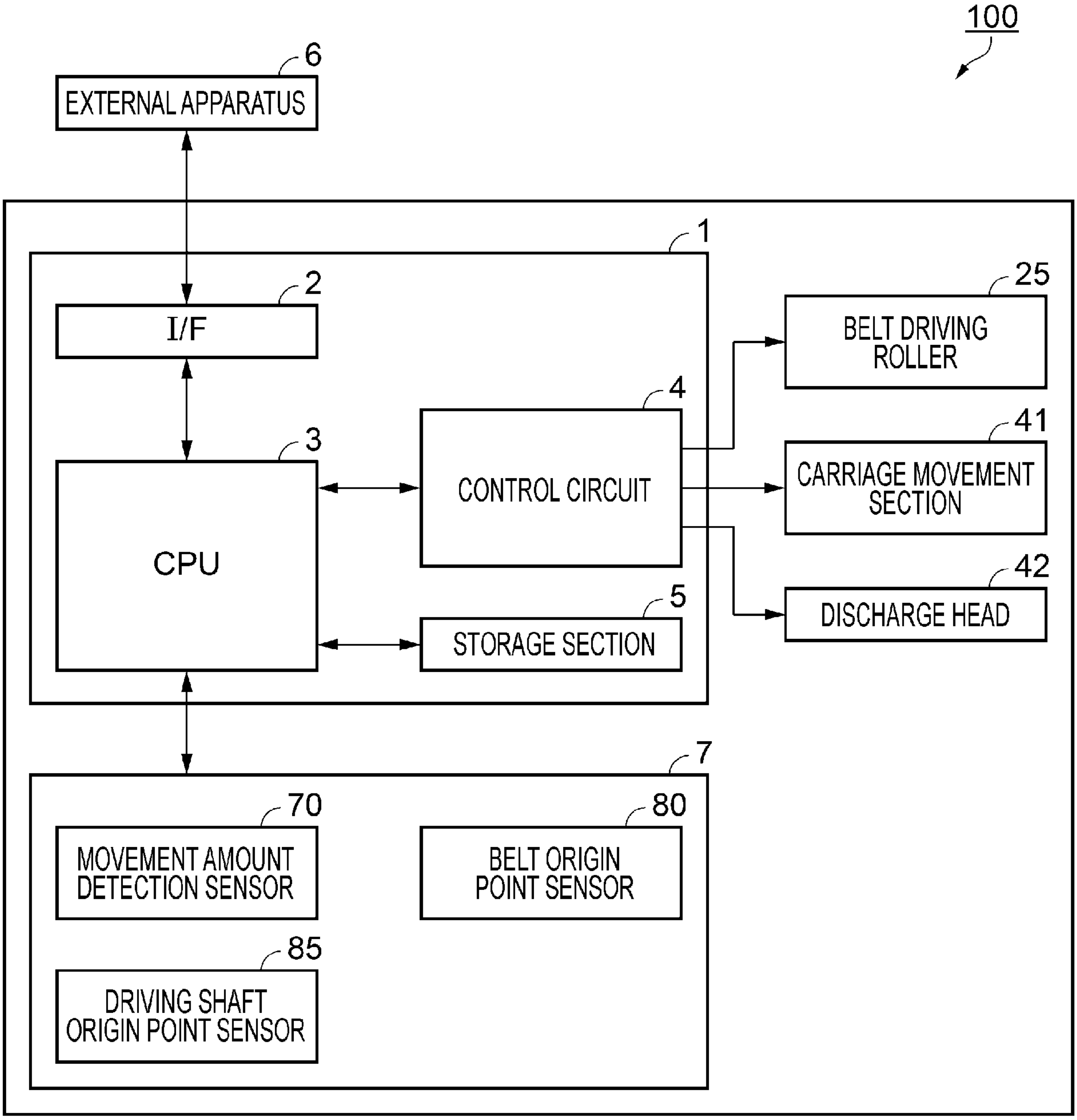

100
6
EXTERNAL APPARATUS
1
2
I/F
3
CPU
4
CONTROL CIRCUIT
5
STORAGE SECTION
25
BELT DRIVING ROLLER
41
CARRIAGE MOVEMENT SECTION
42
DISCHARGE HEAD
7
70
MOVEMENT AMOUNT DETECTION SENSOR
80
BELT ORIGIN POINT SENSOR
85
DRIVING SHAFT ORIGIN POINT SENSOR

FIG. 5

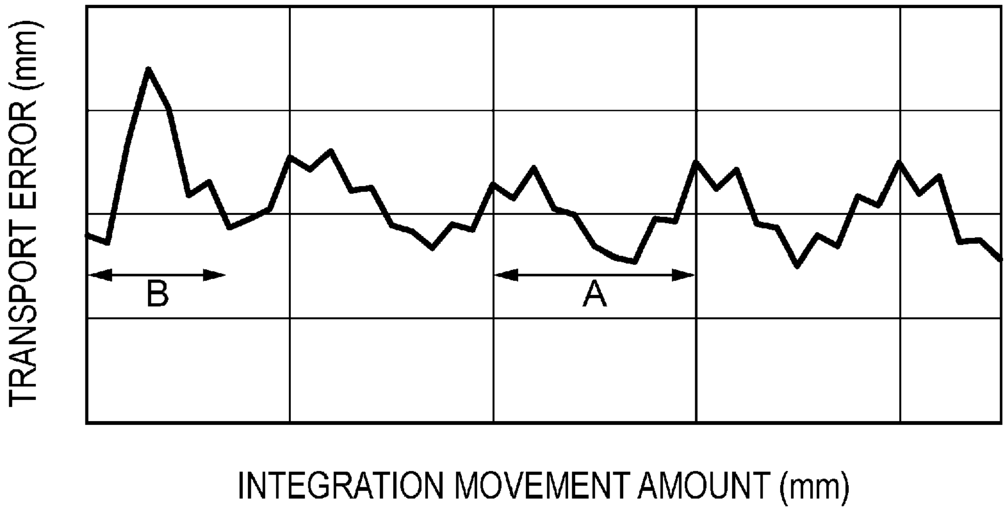

TRANSPORT ERROR (mm)
B
A
INTEGRATION MOVEMENT AMOUNT (mm)

FIG. 6

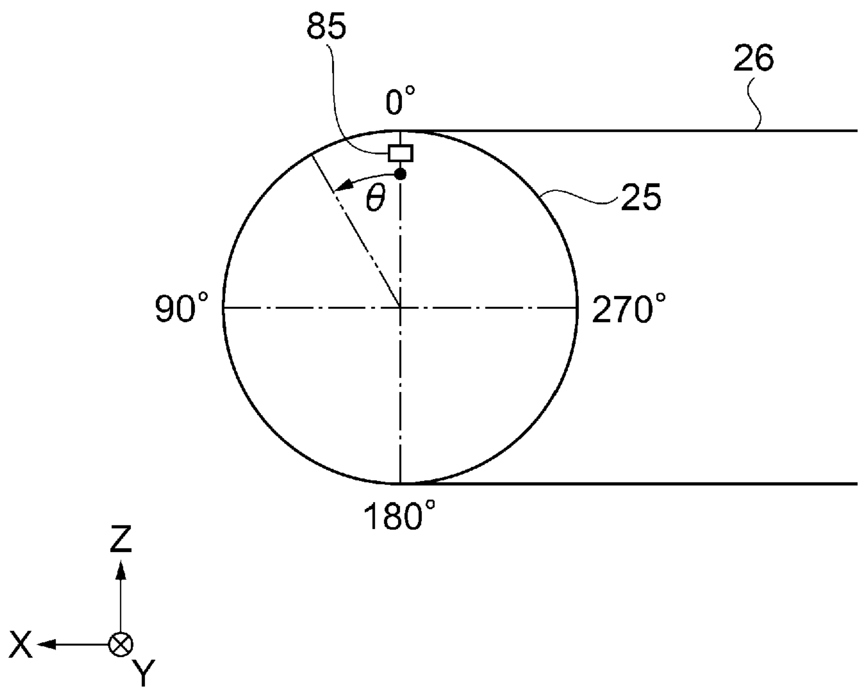

85
26
0°
25
θ
90°
270°
180°
Z
X
Y

FIG. 7

PRINTING CONDITIONS: "CLEAR", "MEDIUM TYPE A", "TENSION MODE"

PRINTING CONDITIONS: "CLEAR", "MEDIUM TYPE A", "TENSION MODE"

PRINTING CONDITIONS: "CLEAR", "MEDIUM TYPE A", "TENSION MODE"

PRINTING CONDITIONS: "CLEAR", "MEDIUM TYPE A", "TENSION MODE"						
ANGLE θ (°)		REFERENCE MOVEMENT AMOUNT Kn (mm)				
		0 OR MORE	8 OR MORE	16 OR MORE	24 OR MORE	...
OR MORE	LESS THAN	LESS THAN 8	LESS THAN 16	LESS THAN 24	LESS THAN 32	...
0	30	$\alpha = 0.023$	$\alpha = -0.026$	$\alpha = 0.037$	$\alpha = 0.032$	...
30	60	$\alpha = -0.018$	$\alpha = 0.046$	$\alpha = 0.031$	$\alpha = 0.036$	...
⋮	⋮	⋮	⋮	⋮	⋮	... ...
330	360	$\alpha = 0.042$	$\alpha = -0.033$	$\alpha = -0.029$	$\alpha = -0.038$	...

FIG. 8

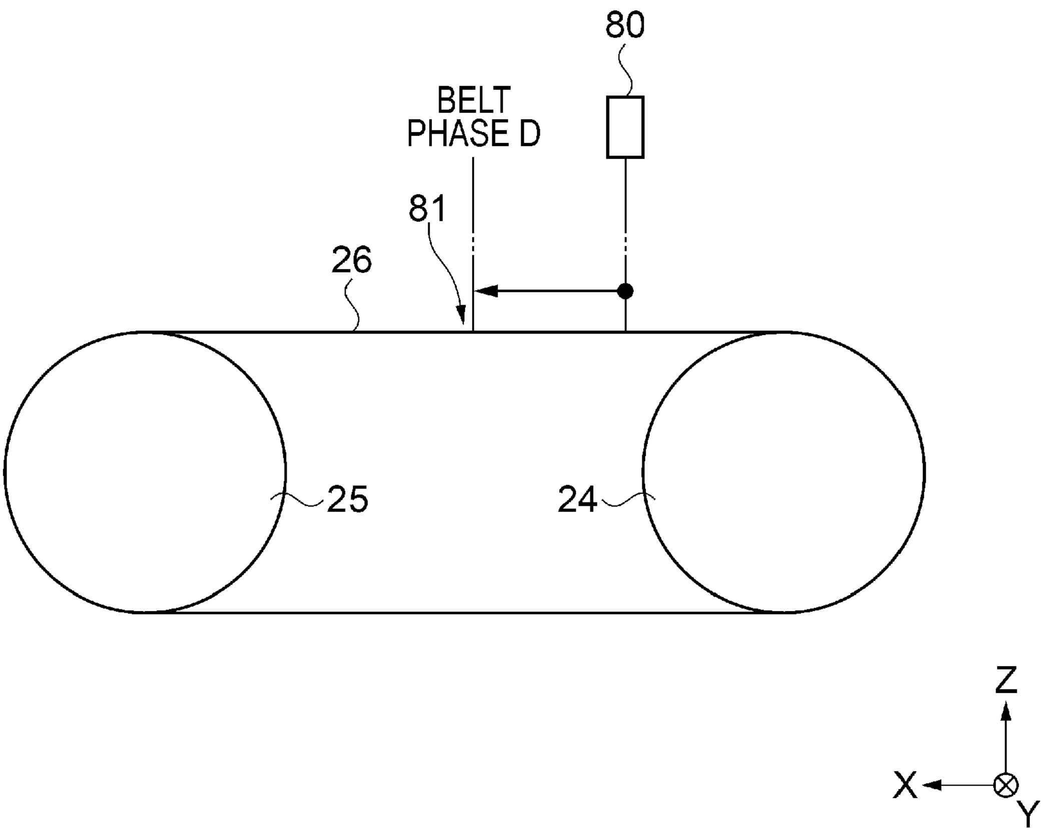


FIG. 9

PRINTING CONDITIONS: "CLEAR", "MEDIUM TYPE A", "TENSION MODE"
PRINTING CONDITIONS: "CLEAR", "MEDIUM TYPE A", "TENSION MODE"
PRINTING CONDITIONS: "CLEAR", "MEDIUM TYPE A", "TENSION MODE"

PRINTING CONDITIONS: "CLEAR", "MEDIUM TYPE A", "TENSION MODE"						
BELT PHASE D (mm)		REFERENCE MOVEMENT AMOUNT Kn (mm)				
		0 OR MORE	8 OR MORE	16 OR MORE	24 OR MORE	...
OR MORE	LESS THAN	LESS THAN 8	LESS THAN 16	LESS THAN 24	LESS THAN 32	...
0	10	δ = -0.078	δ = -0.082	δ = -0.067	δ = -0.118	...
10	20	δ = -0.143	δ = -0.146	δ = -0.161	δ = -0.154	...
⋮	⋮	⋮	⋮	⋮	⋮	... ...
4490	4500	δ = 0.042	δ = 0.064	δ = 0.055	δ = 0.072	...

FIG. 10

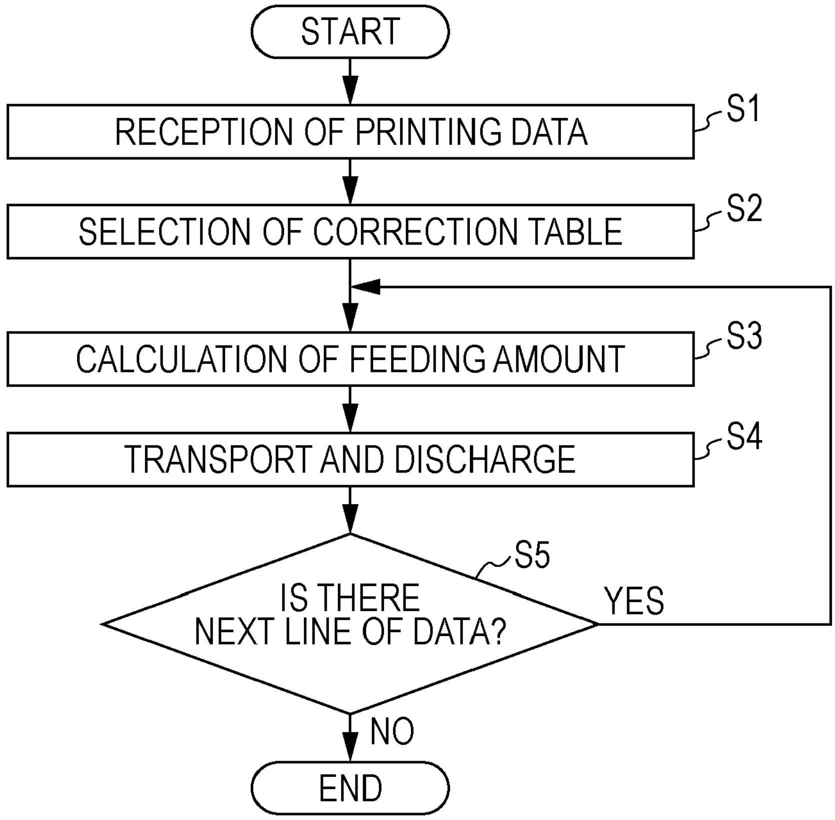

START
RECEPTION OF PRINTING DATA
S1
SELECTION OF CORRECTION TABLE
S2
CALCULATION OF FEEDING AMOUNT
S3
TRANSPORT AND DISCHARGE
S4
IS THERE NEXT LINE OF DATA?
S5
YES
NO
END

FIG. 11

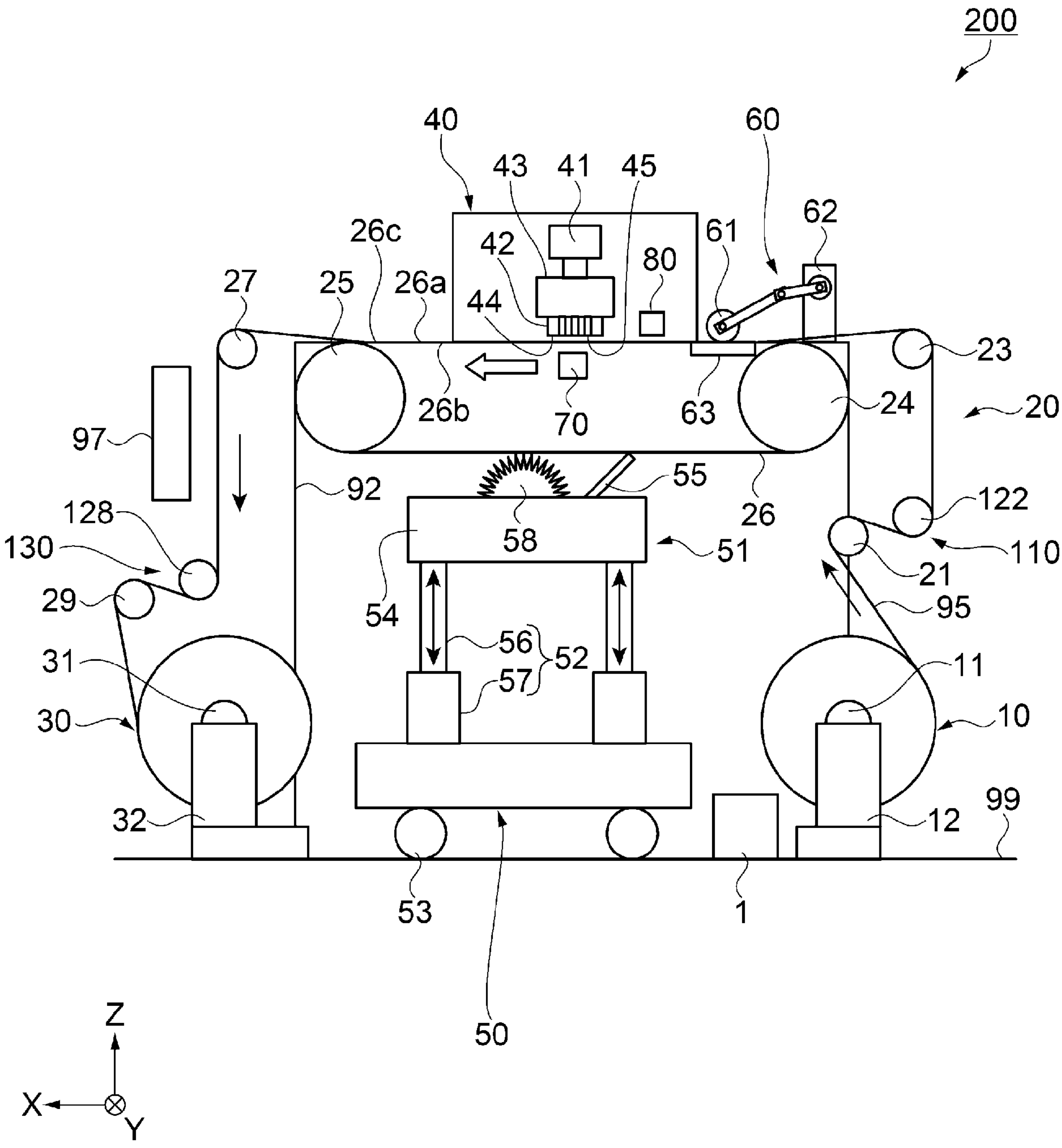
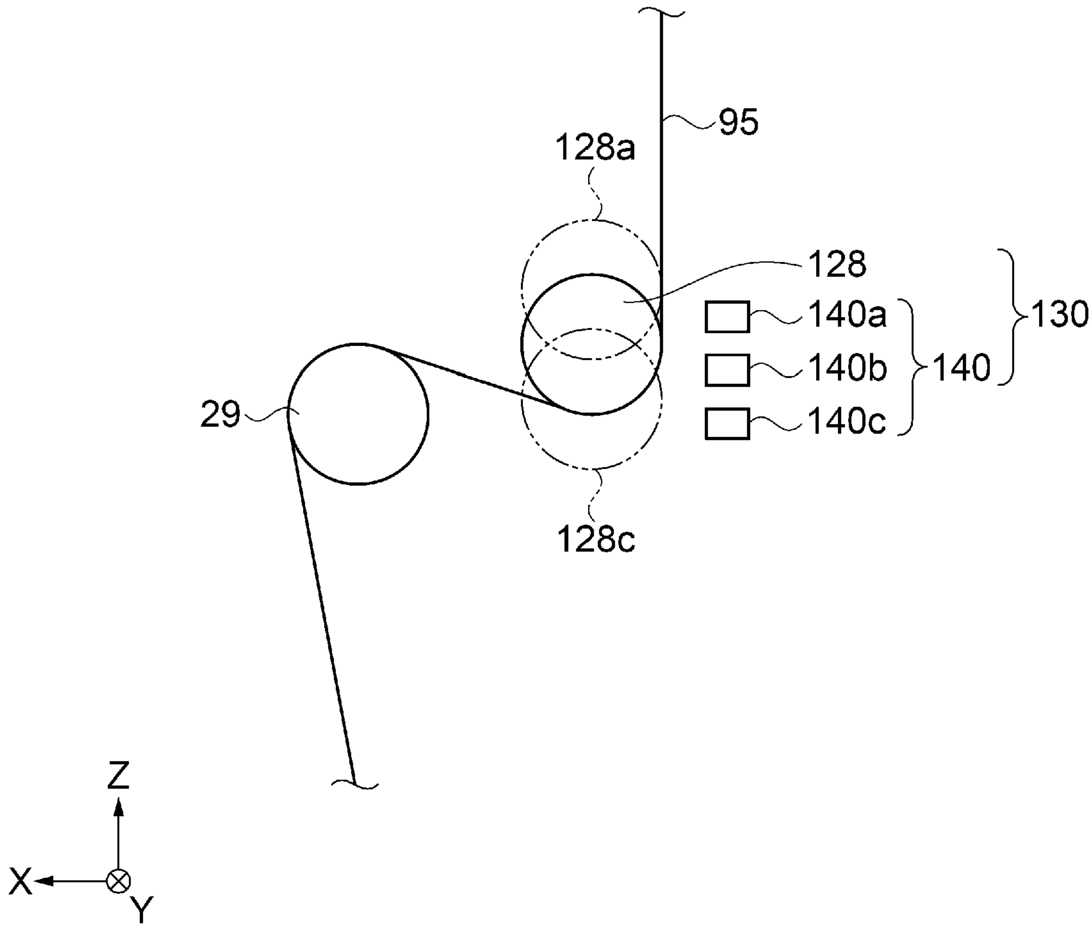

200
40
43
41
45
60
62
61
42
80
26c
27
25
26a
44
23
26b
70
63
24
20
97
92
55
26
122
128
58
51
110
130
21
29
54
95
56
52
57
11
31
30
10
99
32
12
53
1
50
Z
X
Y

FIG. 12



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 5332884 B **[0002] [0003]**