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Tanaka et al.

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(54) **FIXING DEVICE INCLUDING AN ENDLESS BELT MEMBER AND A STEERING ROLLER PROVIDING LUBRICATION TO THE ENDLESS BELT MEMBER**

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(52) **U.S. Cl.**
CPC ***G03G 15/2025*** (2013.01); ***G03G 15/2064*** (2013.01); *G03G 2215/2038* (2013.01)

(58) **Field of Classification Search**
USPC 399/320
See application file for complete search history.

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(57) **ABSTRACT**

A fixing device includes an endless belt member, a rotary member, a nip portion forming member and a steering roller. The steering roller is disposed inside the belt member and configured to be swung to control a position of the belt member in a width direction of the belt member. The steering roller includes a lubricant impregnated portion impregnated with a lubricant and contacting an inner peripheral surface of the belt member.

7 Claims, 8 Drawing Sheets

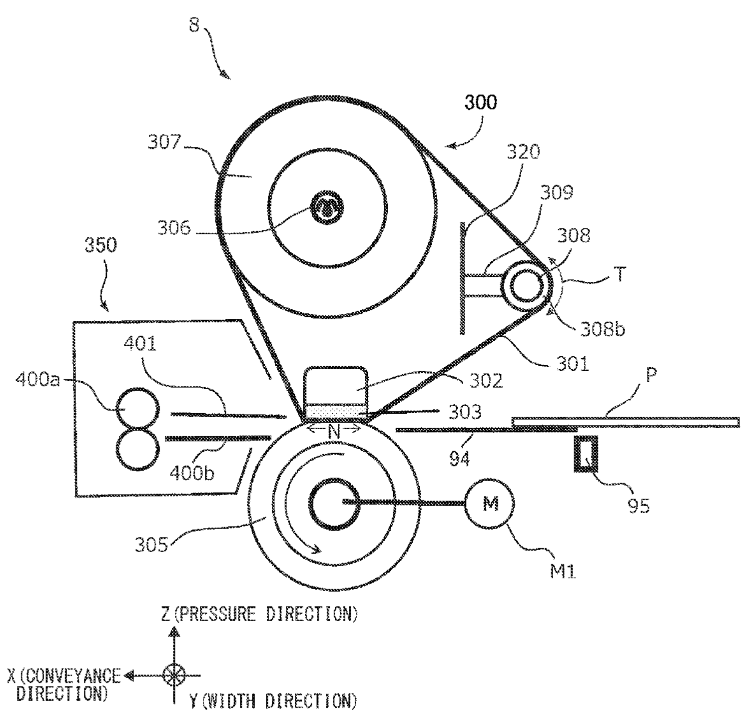
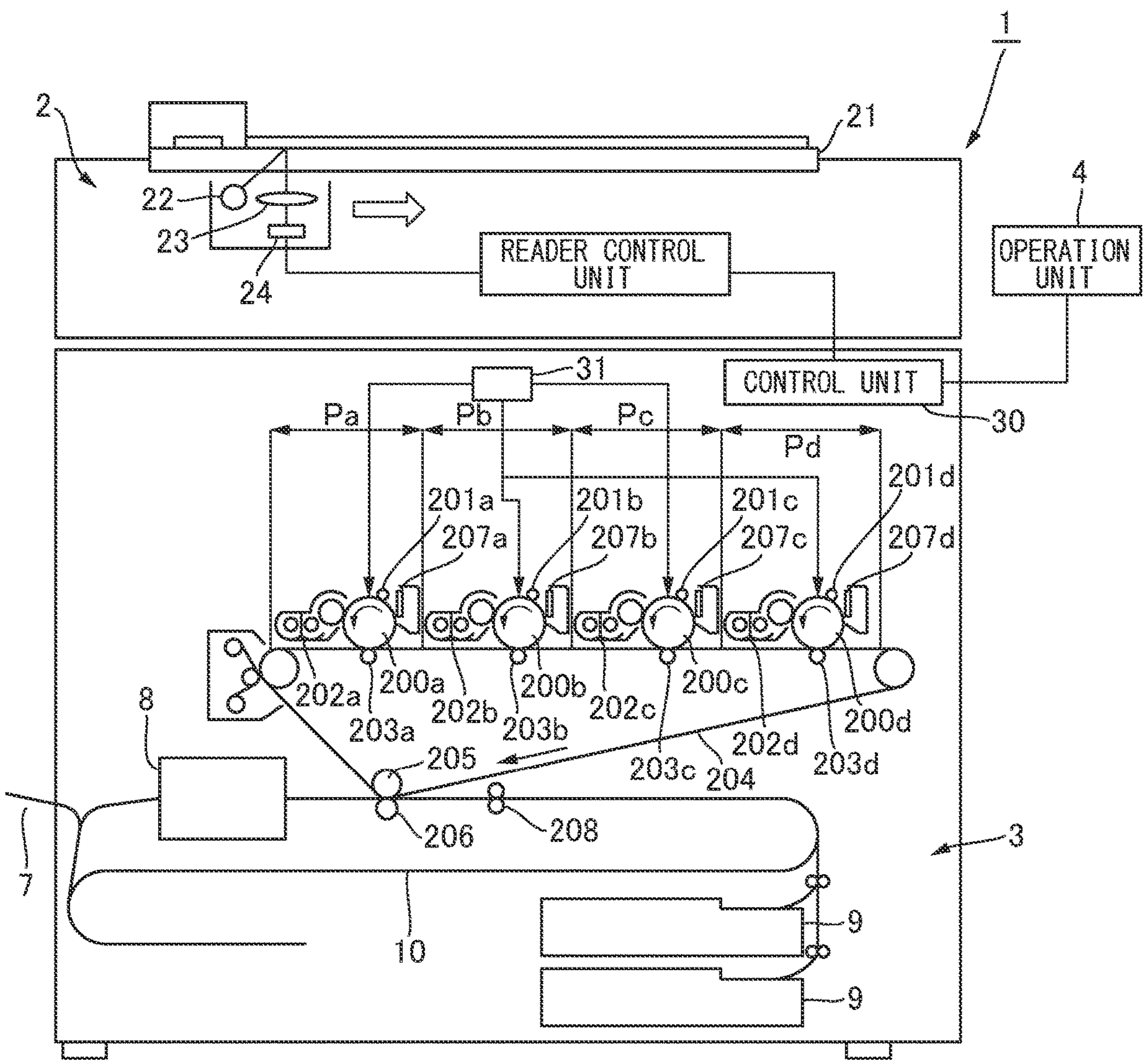


FIG.1


1
2
21
22
23
24
READER CONTROL UNIT
4
OPERATION UNIT
31
CONTROL UNIT
30
Pa
Pb
Pc
Pd
201a
207a
201b
207b
201c
207c
201d
207d
202a
200a
203a
202b
200b
203b
202c
200c
203c
202d
200d
203d
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205
206
208
8
7
10
3
9
9

FIG.2

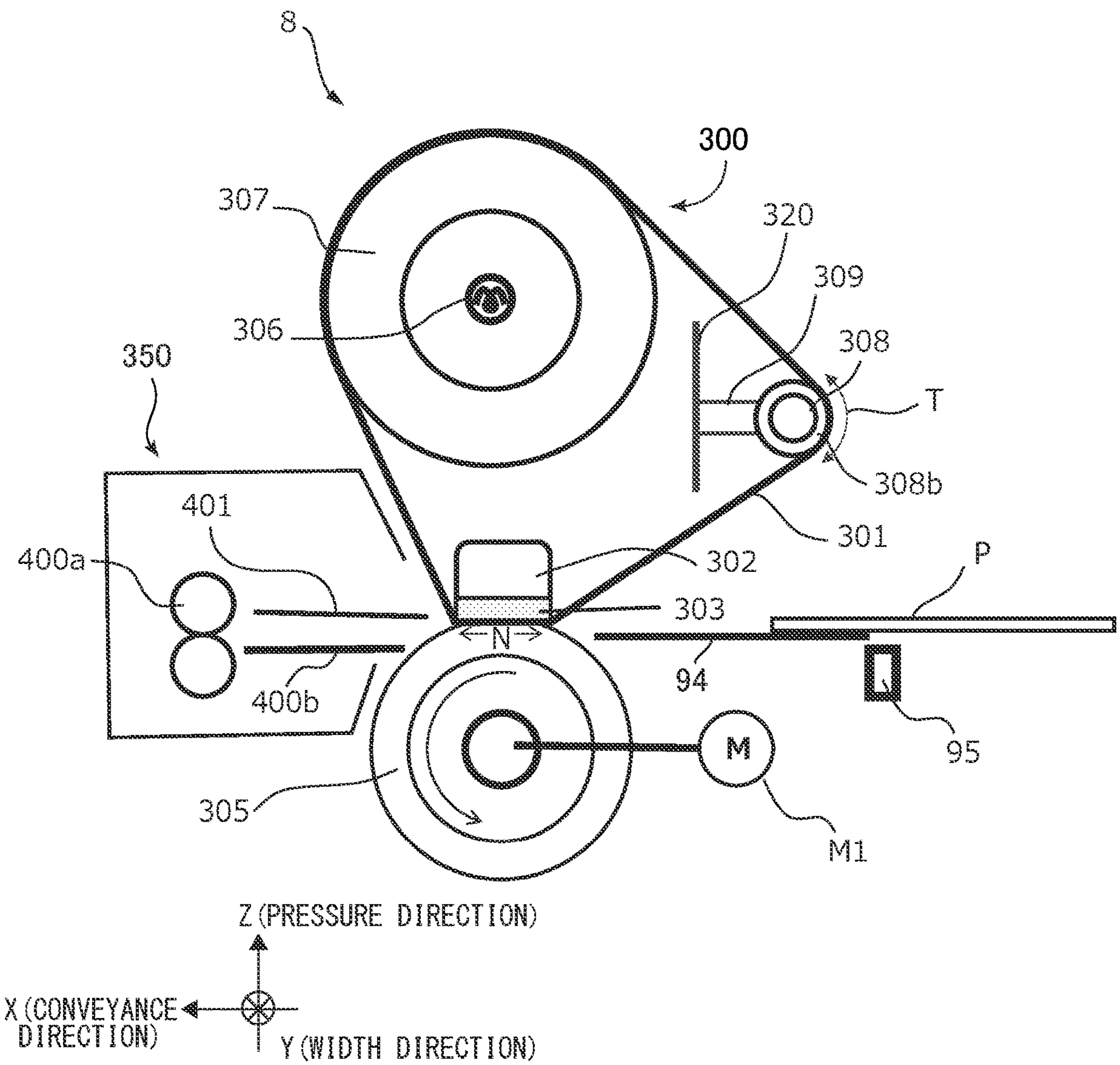

8
300
307
320
309
306
308
350
T
308b
401
301
400a
302
303
P
N
94
400b
95
M
305
M1
Z (PRESSURE DIRECTION)
X (CONVEYANCE DIRECTION)
Y (WIDTH DIRECTION)

FIG.3

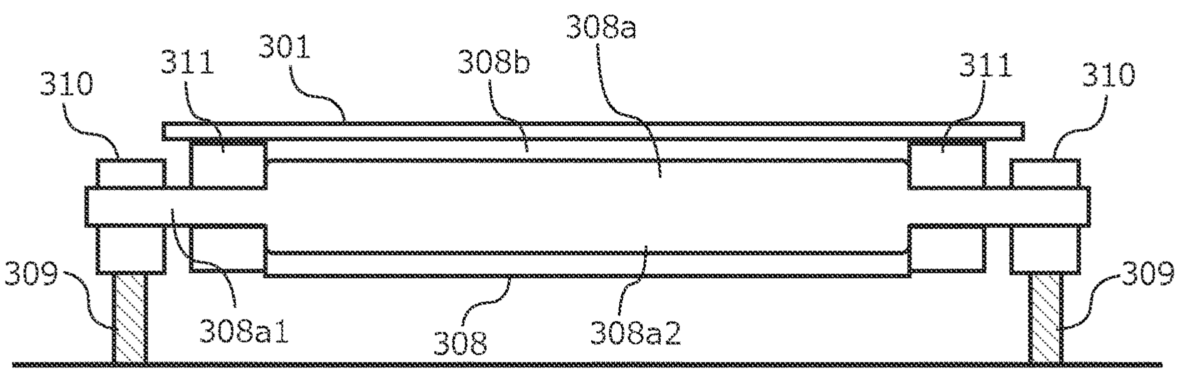


FIG.4

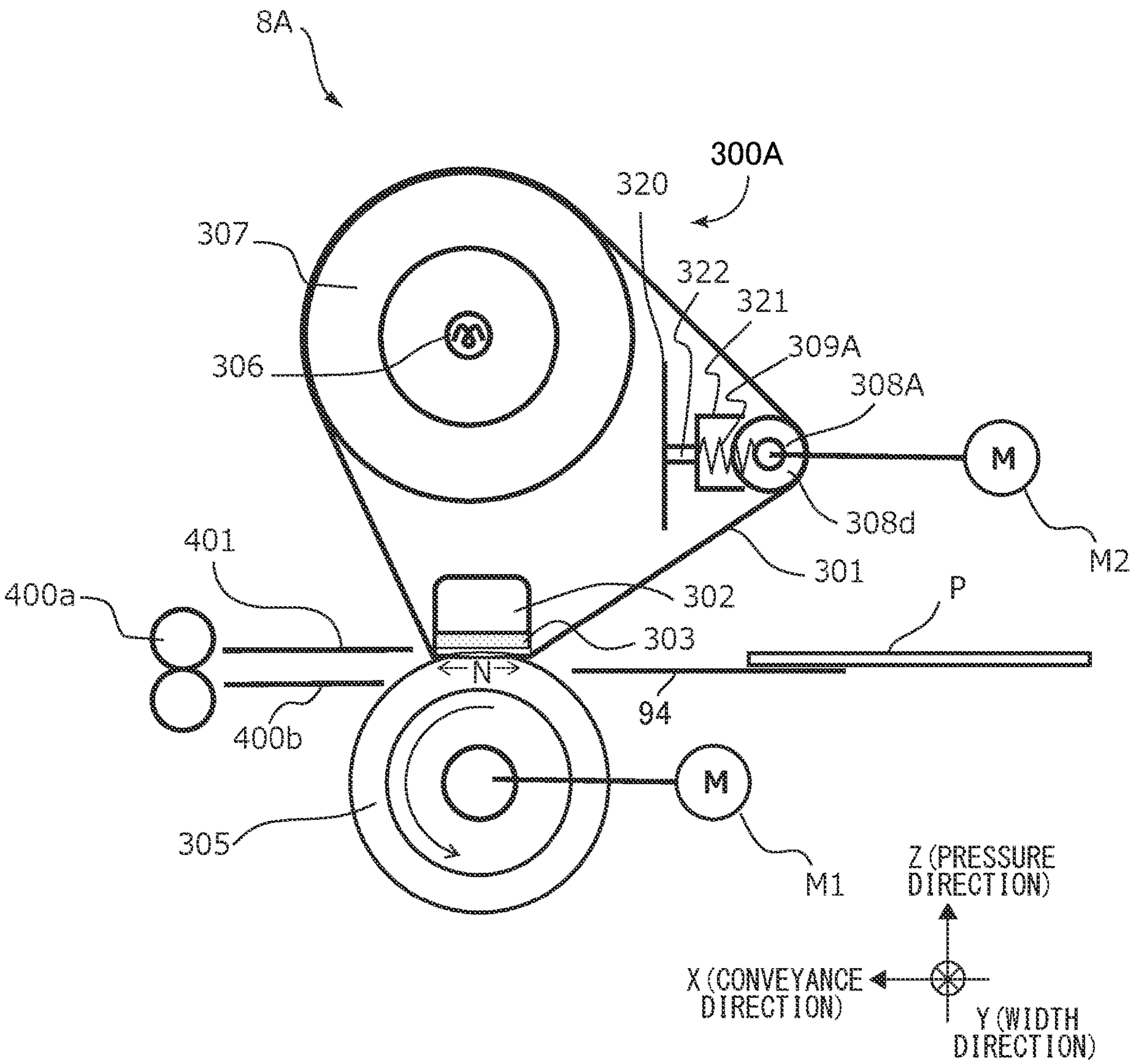

8A
300A
320
307
322
321
309A
306
308A
M
308d
301
M2
401
302
400a
303
P
N
94
400b
M
305
M1
Z (PRESSURE DIRECTION)
X (CONVEYANCE DIRECTION)
Y (WIDTH DIRECTION)

FIG.5B

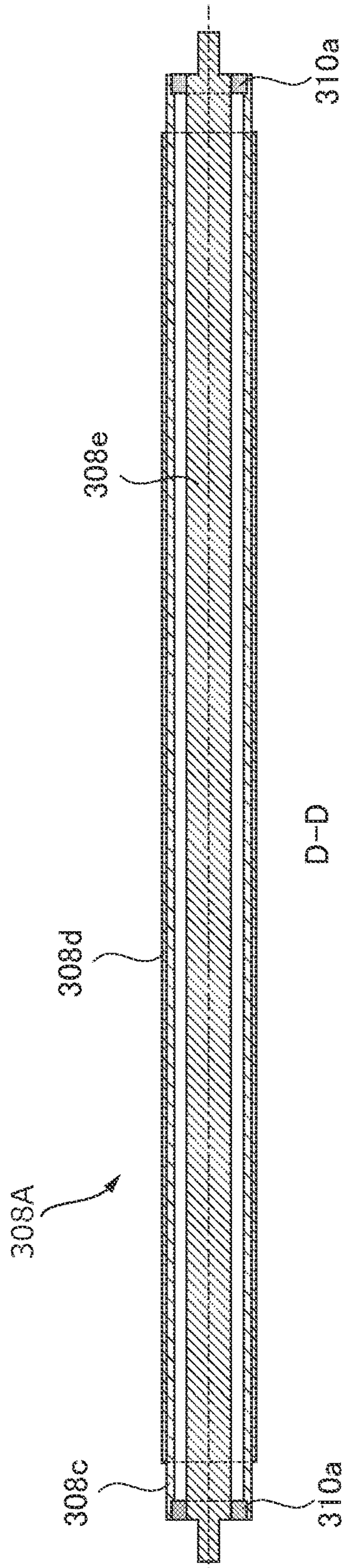


FIG.5A

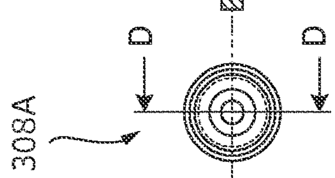


FIG.6A

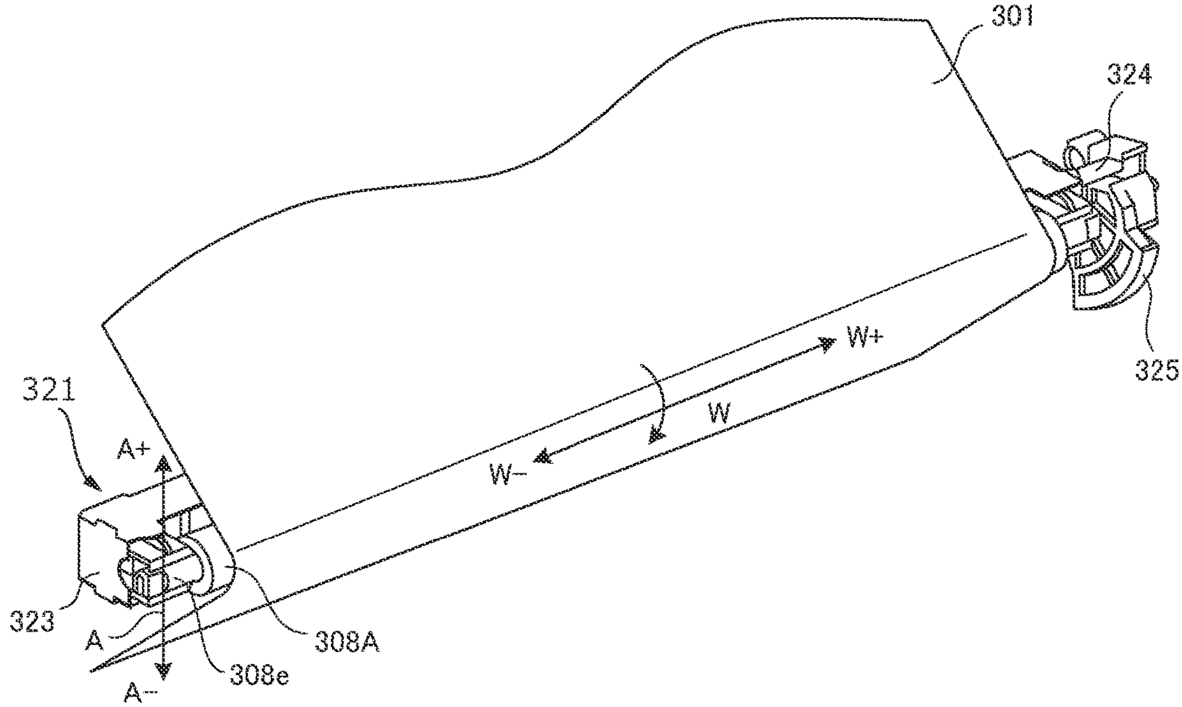

301
324
325
W+
W
W−
321
A+
323
A
A−
308e
308A

FIG.6B

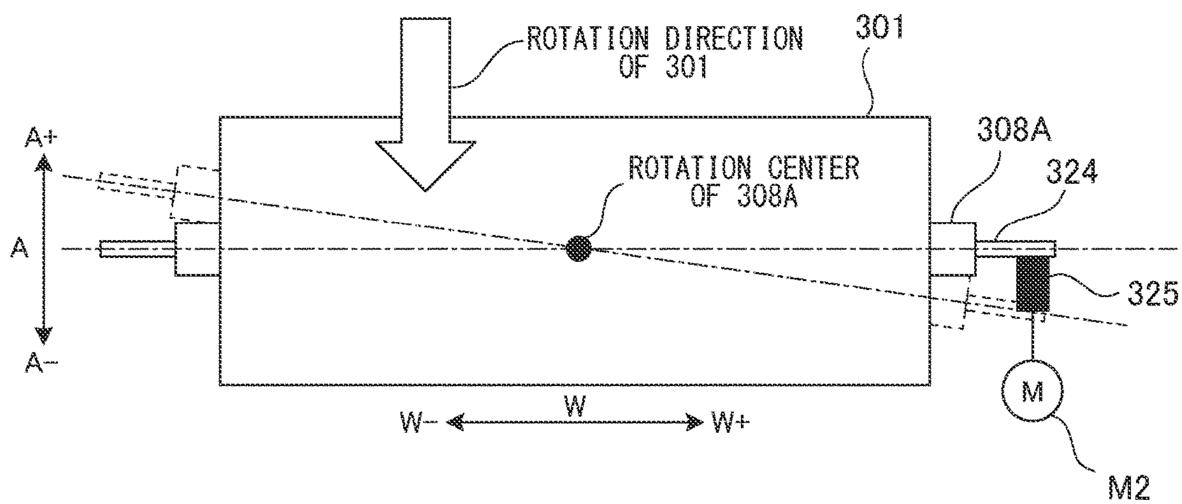

ROTATION DIRECTION
OF 301
301
308A
324
ROTATION CENTER
OF 308A
325
A+
A
A−
W
W−
W+
M
M2

FIG. 7

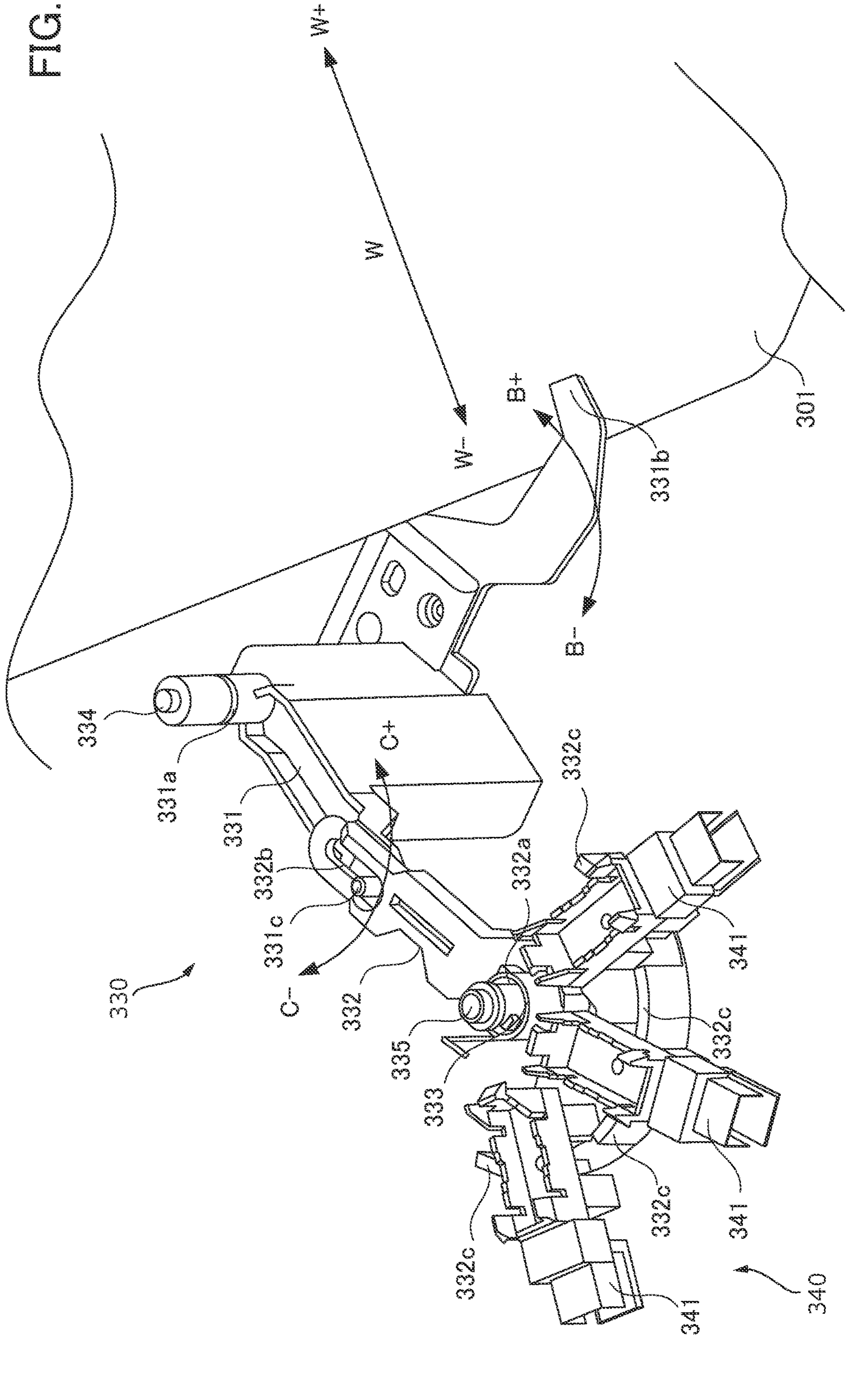

W+
W
W−
B+
B−
301
331b
334
331a
331
C+
C−
332b
331c
332
330
335
333
332a
332c
341
340

FIG.8A

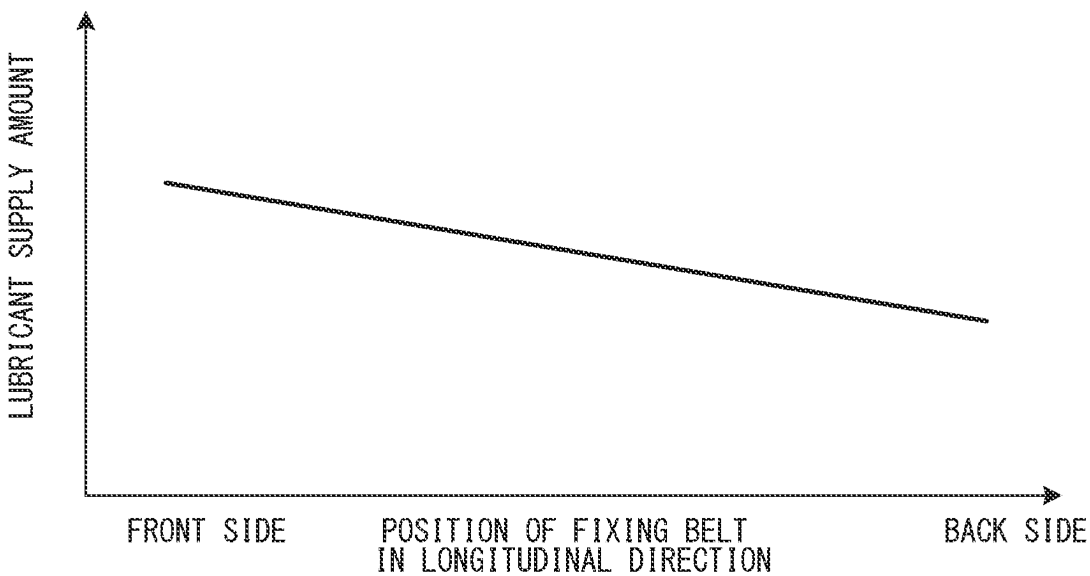
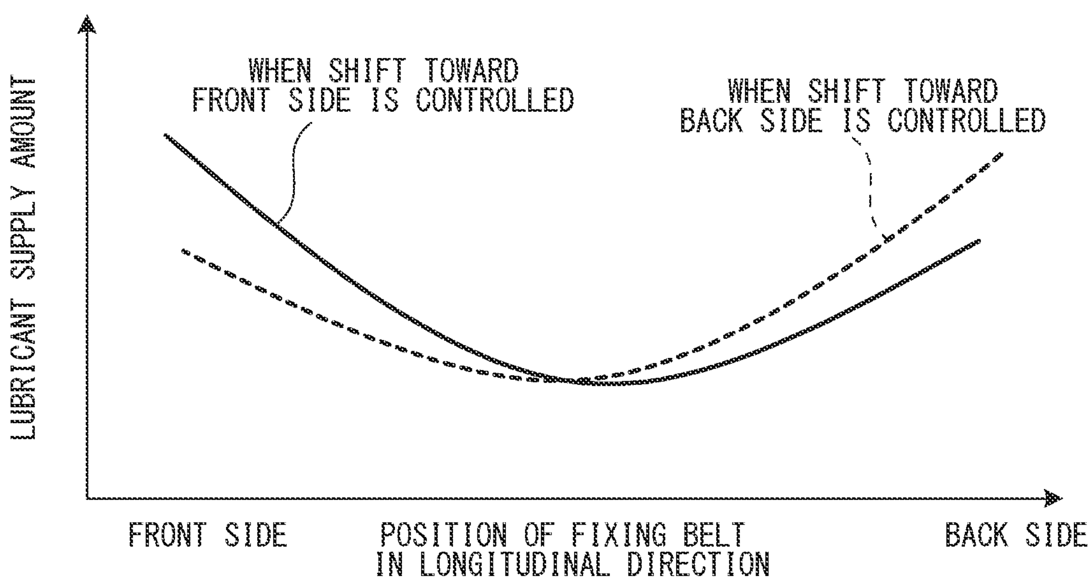

LUBRICANT SUPPLY AMOUNT
FRONT SIDE
POSITION OF FIXING BELT
IN LONGITUDINAL DIRECTION
BACK SIDE

FIG.8B


LUBRICANT SUPPLY AMOUNT
WHEN SHIFT TOWARD
FRONT SIDE IS CONTROLLED
WHEN SHIFT TOWARD
BACK SIDE IS CONTROLLED
FRONT SIDE
POSITION OF FIXING BELT
IN LONGITUDINAL DIRECTION
BACK SIDE

FIXING DEVICE INCLUDING AN ENDLESS BELT MEMBER AND A STEERING ROLLER PROVIDING LUBRICATION TO THE ENDLESS BELT MEMBER

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a fixing device that fixes a toner image to a recording material by heating the toner image borne on the recording material.

Description of the Related Art

An image forming apparatus such as a copying machine, a printer, a facsimile, or a multifunction peripheral having a plurality of functions thereof includes a fixing device that fixes a toner image borne on a recording material to the recording material. As a configuration of a fixing device, it has been hitherto known that a toner image on a recording material is conveyed while being heated in a nip portion formed by an endless belt member and a rotary member. In such a fixing device including a belt member, a lubricant application member for applying a lubricant to an inner peripheral surface of the belt member has been hitherto provided in order to improve durability of the belt member (for example, JP 2010-217270 A and JP 2011-123296 A).

In the above-described conventional configuration, since the lubricant application member is provided separately from a stretching roller that stretches the belt member, the number of members disposed inside the belt member increases, making it difficult to reduce the size of the device.

SUMMARY OF THE INVENTION

The present invention provides a configuration for easily achieving a reduction in size of a device while applying a lubricant to an inner peripheral surface of a belt member.

According to one aspect of the present invention, a fixing device fixes a toner image to a recording material by heating the toner image borne on the recording material. The fixing device includes an endless belt member, a rotary member configured to rotate in contact with an outer peripheral surface of the belt member, a nip portion forming member disposed inside the belt member and configured to form a nip portion for nipping and conveying the recording material between the belt member and the rotary member, and, a steering roller disposed inside the belt member and configured to be swung to control a position of the belt member in a width direction of the belt member. The steering roller includes a lubricant impregnated portion impregnated with a lubricant and contacting an inner peripheral surface of the belt member.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic cross-sectional view illustrating a configuration of an image forming apparatus according to a first embodiment.

FIG. **2** is a schematic cross-sectional view illustrating a configuration of a fixing device according to the first embodiment.

FIG. **3** is a schematic cross-sectional view illustrating a configuration of a lubricant application roller according to the first embodiment.

FIG. **4** is a schematic cross-sectional view illustrating a configuration of a fixing device according to a second embodiment.

FIG. **5**A is a schematic cross-sectional view illustrating a configuration of a lubricant application roller according to the second embodiment.

FIG. **5**B is a cross-sectional view taken along line D-D of FIG. **5**A.

FIG. **6**A is a perspective view of the vicinity of the lubricant application roller according to the second embodiment.

FIG. **6**B is a schematic view illustrating how the lubricant application roller is tilted.

FIG. **7** is a perspective view illustrating a configuration for detecting an end surface position of a fixing belt according to the second embodiment.

FIG. **8**A is a graph illustrating a relationship between a position of a fixing belt in a longitudinal direction and a lubricant supply amount in a comparative example.

FIG. **8**B is a graph illustrating a relationship between a position of a fixing belt in a longitudinal direction and a lubricant supply amount in an example.

DESCRIPTION OF THE EMBODIMENTS

First Embodiment

A first embodiment will be described with reference to FIGS. **1** to **3**. First, a schematic configuration of an image forming apparatus according to the present embodiment will be described with reference to FIG. **1**.

Image Forming Apparatus

The image forming apparatus **1** is an electrophotographic full-color printer including four image forming units Pa, Pb, Pc, and Pd provided to correspond to four colors of yellow, magenta, cyan, and black. In the present embodiment, the image forming units Pa, Pb, Pc, and Pd are arranged in a tandem type along a rotation direction of an intermediate transfer belt **204** to be described below. The image forming apparatus **1** forms a toner image (image) on a recording material according to an image signal from an image reading unit (document reading device) **2** connected to an image forming apparatus body **3** or a host device such as a personal computer communicably connected to the image forming apparatus body **3**. Examples of the recording material include sheet materials such as paper, a plastic film, and cloth.

The image forming apparatus **1** includes an image reading unit **2** and an image forming apparatus body **3**. The image reading unit **2** reads a document placed on a platen glass **21**. Light emitted from a light source **22** is reflected by the document, and an image is formed on a CCD sensor **24** via an optical system member **23** such as a lens. Such an optical system unit converts the document into an electric signal data string for each line by scanning the document in an arrow direction. The image signal obtained by the CCD sensor **24** is sent to the image forming apparatus body **3**, and a control unit **30** performs image processing in accordance with each image forming unit to be described below. The control unit **30** also receives an external input from an external host device such as a print server as an image signal.

The image forming apparatus body **3** includes a plurality of image forming units Pa, Pb, Pc, and Pd, and each of the image forming unit forms an image based on the above-described image signal. That is, the image signal is converted into a laser beam subjected to pulse width modulation (PWM) by the control unit **30**. A polygon scanner **31** serving as an exposing unit scans the laser beam corresponding to the image signal. Then, photosensitive drums **200***a* to **200***d* which serve as image bearing members of the image forming units Pa to Pd are irradiated with a laser beam.

Note that Pa, Pb, Pc, and Pd, which denote an image forming unit for yellow (Y), an image forming unit for magenta (M), an image forming unit for cyan (C), and an image forming unit for black (Bk), respectively, form images of corresponding colors. Since the image forming units Pa to Pd are substantially the same, the image forming unit Pa for Y will be described in detail below, and the description of the other image forming units will be omitted. In the image forming unit Pa, a toner image is formed on a surface of the photosensitive drum **200***a* based on the image signal as will be described below.

A charging roller **201***a* serving as a primary charger charges the surface of the photosensitive drum **200***a* to a predetermined potential to prepare for forming an electrostatic latent image. An electrostatic latent image is formed on the surface of the photosensitive drum **200***a* charged to the predetermined potential by a laser beam from the polygon scanner **31**. A developing unit **202***a* develops the electrostatic latent image on the photosensitive drum **200***a* to form a toner image. A primary transfer roller **203***a* performs discharging from a back surface of the intermediate transfer belt **204**, applies a primary transfer bias having a polarity opposite to that of the toner, and transfers the toner image on the photosensitive drum **200***a* onto the intermediate transfer belt **204**. After the transfer, the surface of the photosensitive drum **200***a* is cleaned by a cleaner **207***a*.

In addition, the toner image on the intermediate transfer belt **204** is conveyed to the next image forming unit, and toner images for the respective colors formed by the respective image forming units are sequentially transferred in the order of Y, M, C, and Bk, and images of four colors are formed on the surface thereof. Then, the toner image having passed through the image forming unit Pd for Bk located on the most downstream side in the rotation direction of the intermediate transfer belt **204** is conveyed to a secondary transfer portion including a pair of secondary transfer rollers **205** and **206**. Then, in the secondary transfer portion, a secondary transfer electric field having a polarity opposite to that of the toner images on the intermediate transfer belt **204** is applied, thereby secondarily transferring the toner images to the recording material.

The recording material is accommodated in a cassette **9**, and the recording material fed from the cassette **9** is conveyed to, for example, a registration portion **208** including a pair of registration rollers, and stands by at the registration portion **208**. Thereafter, the registration portion **208** conveys the recording material to the secondary transfer portion at a timing controlled to align the toner images on the intermediate transfer belt **204** and the paper.

The recording material to which the toner images have been transferred by the secondary transfer portion is conveyed to a fixing device **8**, and the toner images bome on the recording material are fixed to the recording material by being heat-pressurized in the fixing device **8**. The recording material having passed through the fixing device **8** is discharged to a sheet discharge tray **7**. Note that, in a case where images are formed on both surfaces of the recording material, when toner images are transferred and fixed to a first surface (front surface) of the recording material, the front and back surfaces of the recording material are reversed via a reverse conveyance portion **10**, toner images are transferred and fixed to a second surface (back surface) of the recording material, and the recording material is placed on the sheet discharge tray **7**.

Note that the control unit **30** controls the entire image forming apparatus **1** as described above. Furthermore, the control unit **30** can perform various settings and the like based on an input from an operation unit **4** included in the image forming apparatus **1**. The control unit **30** includes a central processing unit (CPU), a read only memory (ROM), and a random access memory (RAM). The CPU controls each unit while reading a program corresponding to the control procedure stored in the ROM. In addition, work data and input data are stored in the RAM, and the CPU performs control with reference to the data stored in the RAM based on the above-described program or the like.

Fixing Device

Next, a configuration of the fixing device **8** according to the present embodiment will be described with reference to FIG. **2**. FIG. **2** is a cross-sectional view schematically illustrating a schematic configuration of the fixing device **8**. In the present embodiment, a belt heating type fixing device using an endless belt is adopted. In FIG. **2**, an X direction represents a conveyance direction of the recording material P, a Y direction represents a width direction intersecting (in the present embodiment, orthogonal to) the conveyance direction of the recording material P, and a Z direction represents a pressure direction of a pressure roller **305** to be described below. These directions are orthogonal to each other. Further, one side in the width direction (Y direction) is a front side of the image forming apparatus **1**, for example, a side on which the operation unit **4** is disposed and operated by a user. On the other hand, the other side in the width direction is a back side of the image forming apparatus **1**.

The fixing device **8** includes a heating unit **300** having a fixing belt **301** serving as an endless rotatable belt member, and a pressure roller **305** serving as a rotary member that contacts the fixing belt **301** and forms a nip portion N together with the fixing belt **301**.

The heating unit **300** includes the fixing belt **301** described above, a fixing pad **303** serving as a nip portion forming member and a pad member, a lubricant application roller **308** serving as a stretching roller and a first stretching roller, and a heating roller **307** serving as a second stretching roller. The pressure roller **305** is also a driving rotary member that rotates in contact with an outer peripheral surface of the fixing belt **301** to apply a driving force to the fixing belt **301**.

The fixing belt **301** serving as a fixing member and a rotary member has thermal conductivity, heat resistance, and the like, and has a thin cylindrical shape. In the present embodiment, the fixing belt **301** has a three-layer structure in which a base layer, an elastic layer on the outer periphery of the base layer, and a release layer on the outer periphery of the elastic layer are formed. Further, a polyimide resin (PI) is used as a material for the base layer having a thickness of 80 μm, a silicone rubber is used for the elastic layer having a thickness of 300 μm, and PFA (tetrafluoroethylene/perfluoroalkoxyethylene copolymer resin) is used as a fluororesin for the release layer having a thickness of 30 μm. The fixing belt **301** is stretched by the fixing pad **303**, the heating roller **307**, and the lubricant application roller **308**.

The fixing pad **303** is disposed inside the fixing belt **301** in a non-rotating manner so as to face the pressure roller **305** with the fixing belt **301** interposed therebetween. The fixing pad **303** forms the nip portion N for nipping and conveying the recording material between the fixing belt **301** and the pressure roller **305**. In the present embodiment, the fixing pad **303** is a substantially plate-like member that is long along the width direction of the fixing belt **301** (a longitudinal direction intersecting with the rotation direction of the fixing belt **301** and a rotation axis direction of the heating roller **307**). The nip portion N is formed by pressing the fixing pad **303** against the pressure roller **305** with the fixing belt **301** interposed therebetween. As a material for the fixing pad **303**, a liquid crystal polymer (LCP) resin is used.

The fixing pad **303** is supported by a stay **302** serving as a support member disposed inside the fixing belt **301**. That is, the stay **302** is disposed on a side of the fixing pad **303** opposite to the pressure roller **305** to support the fixing pad **303**. The stay **302**, which is a reinforcing member having rigidness and a long length along the longitudinal direction of the fixing belt **301**, contacts the fixing pad **303** to support the fixing pad **303** from the back. That is, when the fixing pad **303** is pressed against the pressure roller **305**, the stay **302** imparts strength to the fixing pad **303** to secure the pressurizing force in the nip portion N.

A sliding member, which is not illustrated, is interposed between the fixing pad **303** and the fixing belt **301**. A lubricant is applied to an inner peripheral surface of the fixing belt **301** in advance, so that the fixing belt **301** smoothly slides with respect to the fixing pad **303** covered with the sliding member. As the lubricant, oil is used. Silicone oil is suitable for this oil from the viewpoint of heat resistance and the like. In addition, oils having various viscosities are applicable depending on the use conditions, but an oil having an excessively high viscosity is inferior in fluidity at the time of application, and therefore, an oil having a viscosity of 30,000 cSt or less is usually preferable. Specific examples of the oil include, but are not particularly limited to, dimethyl silicone oil, amino-modified silicone oil, and fluorine-modified silicone oil.

The heating roller **307** is disposed inside the fixing belt **301** to stretch the fixing belt **301** together with the fixing pad **303** and the lubricant application roller **308**. The heating roller **307** is formed of metal such as aluminum or stainless steel in a cylindrical shape, and a halogen heater **306** serving as a heating portion for heating the fixing belt **301** is disposed inside the heating roller **307**. Then, the heating roller **307** is heated to a predetermined temperature by the halogen heater **306**.

In the present embodiment, the heating roller **307** is formed of, for example, a stainless steel pipe having a thickness of 1 mm. One or more halogen heaters **306** may be installed. Note that the heating unit is not limited to the halogen heater, and may be another heater capable of heating the heating roller **307**, such as a carbon heater. The fixing belt **301** is heated by the heating roller **307** heated by the halogen heater **306**, and is controlled to a predetermined target temperature corresponding to the type of recording material based on a temperature detected by a thermistor, which is not illustrated.

As will be described below, the lubricant application roller **308** is impregnated with a lubricant, is disposed inside the fixing belt **301**, stretches the fixing belt **301** together with the fixing pad **303** and the heating roller **307**, and rotates following the fixing belt **301**. In the present embodiment, the lubricant application roller **308** is also a tension roller biased by a biasing spring **309** serving as a biasing member supported by a frame **320** of the heating unit **300** to apply a predetermined tension to the fixing belt **301**.

The pressure roller **305** rotates in contact with the outer peripheral surface of the fixing belt **301** to apply a driving force to the fixing belt **301**. In the present embodiment, the pressure roller **305** is a roller in which an elastic layer is formed on an outer periphery of a shaft and a releasable layer is formed on an outer periphery of the elastic layer. Further, stainless steel having a diameter of 72 mm is used for the shaft, conductive silicone rubber having a thickness of 8 mm is used for the elastic layer, and PFA (tetrafluoroethylene/perfluoroalkoxyethylene copolymer resin) is used as a fluororesin having a thickness of 100 μm for the releasable layer. The pressure roller **305** is rotatably supported by a fixing frame (not illustrated) of the fixing device **8**, while one end to which a gear is fixed, and is connected to a motor **M1** serving as a pressure roller driving source via the gear to be rotationally driven.

In the fixing device **8** configured as described above, a toner image is heated while the recording material P bearing the toner image is conveyed in a nipped state in the nip portion N formed between the fixing belt **301** and the pressure roller **305**. Then, the toner image is fixed to the recording material P Therefore, the fixing device **8** needs to have both a function of applying heat and pressure and a function of conveying the recording material P The pressure roller **305** is pressed against the fixing pad **303** via the fixing belt **301** by a driving source that is not illustrated. In the present embodiment, the pressurizing force (NF) in the nip portion N for forming an image is set to 1600 N, the length of the nip portion N in the X direction (conveyance direction) is set to 24.5 mm, and the length of the nip portion N in the Y direction (width direction) is set to 326 mm.

Further, a discharge unit **350** for discharging the recording material P having passed through the nip portion N to the outside of the fixing device **8** is disposed downstream of the nip portion N in the conveyance direction of the recording material P In the discharge unit **350**, a separator **401**, a sheet discharge roller pair **400*a***, and a lower separation guide **400*b*** are disposed. The separator **401** is disposed downstream of the nip portion N in the conveyance direction of the recording material and above the nip portion N in the vertical direction, with a distal end facing the fixing belt **301** near the nip portion N. Then, the recording material P having passed through the nip portion N is separated from the fixing belt **301**.

The lower separation guide **400*b*** is disposed downstream of the nip portion N in the conveyance direction of the recording material and below the nip portion N in the vertical direction, with a distal end facing the pressure roller **305** near the nip portion N. Then, when the recording material P sticks to the pressure roller **305**, the lower separation guide **400*b*** separates the recording material P from the pressure roller **305**. Further, the lower separation guide **400*b*** supports a lower surface of the recording material P discharged from the nip portion N and guides the recording material P to the discharge roller pair **400*a***. The sheet discharge roller pair **400*a*** discharges the recording material P discharged from the nip portion N to the outside of the fixing device **8**. In the present embodiment, the sheet discharge roller pair **400*a*** is disposed downstream of the nip portion N by about 40 mm in the conveyance direction.

Further, a guide unit **94** for guiding the recording material P to the nip portion N and a detection sensor **95** for detecting the recording material P immediately before the nip portion N are disposed upstream of the nip portion N of the fixing device **8** in the conveyance direction. The control unit **30** (FIG. **1**) detects a timing at which the recording material P enters the nip portion N using the detection sensor **95**.

Lubricant Application Roller

Next, the lubricant application roller **308** will be described with reference to FIG. **3**. FIG. **3** is a schematic cross-sectional view of the lubricant application roller (oil application tension roller) **308** cut in the longitudinal direction. The lubricant application roller **308** includes a core metal portion **308***a* serving as a rotation shaft portion (core metal) and an oil impregnated layer **308***b* serving as a lubricant impregnated portion disposed around the core metal portion **308***a*. The core metal portion **308***a* is, for example, a roller shaft portion made of aluminum, iron, stainless steel, or the like.

The oil impregnated layer **308***b*, which is a layer impregnated with a lubricant, is provided around the core metal portion **308***a* of the lubricant application roller **308**, and contacts the inner peripheral surface of the fixing belt **301**. The oil impregnated layer **308***b* is formed by winding a nonwoven fabric around the core metal portion **308***a*, the nonwoven fabric being impregnated with the same lubricant as the above-described lubricant (in the present embodiment, silicone oil) applied in advance to the inner peripheral surface of the fixing belt **301**. However, the oil impregnated layer **308***b* is not limited thereto. The oil impregnated layer **308***b* may be made of, for example, an organic or inorganic porous material such as a sponge or a porous ceramic body, woven fabrics of organic or inorganic fibers such as cloth and polyester fibers, or the like.

In the present embodiment, the core metal portion **308***a* of the lubricant application roller **308** includes a shaft portion **308***a***1** supported by a bearing **310** to be described below, and a body portion **308***a***2** provided around the center of the shaft portion **308***a***1** in the longitudinal direction (rotation axis direction). The body portion **308***a***2** may be formed integrally with the shaft portion **308***a***1**, or may be formed by fixing a separate cylindrical member to the shaft portion **308***a***1**. The oil impregnated layer **308***b* is formed by, for example, winding a nonwoven fabric impregnated with silicone oil around the body portion **308***a***2** a plurality of times.

As described above, the lubricant application roller **308** is a tension roller, and is disposed inside the fixing belt **301**. Both ends of the core metal portion **308***a* in the longitudinal direction (rotation axis direction) are rotatably supported by bearings **310**, respectively. The biasing spring **309** biases the lubricant application roller **308** toward the fixing belt **301** via the bearings **310** at both ends thereof. In the present embodiment, the biasing spring **309** biases the lubricant application roller **308** to the fixing belt **301** at about 60 N or more and 100 N or less to apply tension to the fixing belt **301**.

As illustrated in FIG. **2**, the lubricant application roller **308** contacts the fixing belt **301** at a certain winding angle in an oil-applied region T. In the present embodiment, the winding angle is secured to about 100°, and the length of contact between the fixing belt **301** and the lubricant application roller **308** is secured to about 15 mm.

Here, for example, if a lubricant application member is brought into contact with the fixing belt **301** from an inner surface of a tensioned flat portion of the belt, separately from the tension roller that applies tension to the fixing belt, it is necessary to secure a space for arranging the lubricant application member inside the belt, and it is difficult to achieve a reduction in size of the device.

In contrast, according to the configuration of the present embodiment, since the lubricant application roller **308** serves as both a tension roller and a lubricant application member, space saving inside the belt can be achieved. Furthermore, since the oil impregnated layer **308***b* of the lubricant application roller **308** contacts the inner peripheral surface of the fixing belt **301** with a sufficient biasing force over a sufficient contact area, stable lubricant application can be realized. As a result, the reduction in size of the device can be easily achieved while applying the lubricant to the inner peripheral surface of the fixing belt **301**.

Roller Portion

In the present embodiment, as illustrated in FIG. **3**, the lubricant application roller **308** includes a roller portion **311** of which an outer peripheral surface is a cylindrical surface. The roller portion **311** serving as a metal portion is disposed at a position outside the oil impregnated layer **308***b* in the rotation axis direction of the lubricant application roller **308** while facing the inner peripheral surface of the fixing belt **301**, and has a smaller outer diameter than the oil impregnated layer **308***b*. The roller portion **311** and the oil impregnated layer **308***b* contacts the inner peripheral surface of the fixing belt **301**. A length from a first end of a roller portion **311** disposed on a first end side in the rotation axis direction (width direction) to a second end of a roller portion **311** disposed on a second end side opposite to the first end in the rotation axis direction is shorter than a length of the fixing belt **301** in the width direction. The roller portion **311** in the present embodiment has a cylindrical shape, and made of, for example, aluminum, iron, stainless steel, or the like. The roller portions **311** are disposed on both sides of the oil impregnated layer **308***b*, respectively, in the rotation axis direction of the lubricant application roller **308**.

Specifically, the roller portion **311** is fitted on and supported by the core metal portion **308***a* separately from the core metal portion **308***a*, which is a support member of the lubricant application roller **308**. The roller portions **311** are disposed on both sides of the oil impregnated layer **308***b*, respectively, in the rotation axis direction of the lubricant application roller **308**. In addition, the roller portion **311** is disposed between the bearing **310** and the oil impregnated layer **308***b* in the rotation axis direction of the lubricant application roller **308**. In the present embodiment, the roller portion **311** is disposed to contact an end portion of the oil impregnated layer **308***b*.

The outer diameter of the roller portion **311** is smaller than the outer diameter of the oil impregnated layer **308***b* in a state where the lubricant application roller **308** is biased by the biasing spring **309** to come into contact with the inner peripheral surface of the fixing belt **301** and the oil impregnated layer **308***b* is elastically deformed. Note that the outer diameter of the roller portion **311** is smaller than the outer diameter of the oil impregnated layer **308***b* in a free state of the lubricant application roller **308** that is not in contact with the fixing belt **301**. In other words, in a state where the lubricant application roller **308** is not in contact with the fixing belt **301**, the outer diameter of the oil impregnated layer **308***b* is larger than the outer diameter of the roller portion **311**.

In addition, a difference between the outer diameter of the oil impregnated layer **308***b* and the outer diameter of the roller portion **311** in a state where the lubricant application roller **308** is not in contact with the fixing belt **301** is 0.1 mm or more and 1.0 mm or less. In the present embodiment, although the roller portion **311** is made of aluminum, iron, stainless steel, or the like, but the material thereof is not limited thereto. In addition, although the roller portion **311** is a member separate from the core metal portion **308***a*, the roller portion **311** and the core metal portion **308***a* may be integrally formed. The roller portion **311** and the core metal portion **308***a* may be separate from or integrated with each other as long as they can rotate following the rotation of the fixing belt **301**.

When the roller portion **311** and the core metal portion **308***a* are separate from each other, the roller portion **311** can be detached from the core metal portion **308***a*. When the fixing device **8** is continuously used, the oil is depleted. Therefore, the oil impregnated layer **308***b* needs to be replaced at a high frequency. In a case where the roller portion **311** can be detached from the core metal portion **308***a*, the oil impregnated layer **308***b* can be easily replaced. Therefore, it is preferable that the roller portion **311** and the core metal portion **308***a* are separate from each other. In a case where the roller portion **311** and the core metal portion **308***a* are separate from each other, the roller portion **311** is configured to be rotatable with respect to the core metal portion **308***a*.

Since the roller portion **311** is included in the lubricant application roller **308** as described above, the oil impregnated layer **308***b* is deformed by a biasing force with which the lubricant application roller **311** is biased by the biasing spring **309** as much as a difference between the outer diameters of the oil impregnated layer **308***b* and the roller portion **308**, and the oil oozes out from the oil impregnated layer **308***b* to the fixing belt **301**, whereby the lubricant is applied.

In the present embodiment, in order to realize space saving, even though the lubricant application roller **308** is configured to serve as both a tension roller and a lubricant application member, the amount of deformation of the oil impregnated layer **308***b* caused when the lubricant application roller **308** is biased by the tension of the fixing belt **301** can be restricted to the outer diameter of the roller portion **311** provided at the end portion. Therefore, even if the tension applied to the lubricant application roller **308** is high, a leakage of the lubricant from the oil impregnated layer **308***b* can be suppressed, and the lubricant can be applied by the lubricant application roller **308** for a long period of time.

Second Embodiment

A second embodiment will be described with reference to FIGS. **4** to **8**A and **8**B. In the first embodiment described above, the lubricant application roller **308** is a tension roller. On the other hand, in the present embodiment, a lubricant application roller **308**A serves as a steering roller as well as the tension roller. Since the other configurations and operations are similar to those in the first embodiment described above, the same configurations are denoted by the same reference signs, description and illustration thereof are omitted or simplified, and hereinafter, differences of the second embodiment from the first embodiment will be mainly described.

In a fixing device **8**A according to the present embodiment, a lubricant application roller **308**A is disposed in such a manner that a rotation axis thereof is tiltable with respect to a direction parallel to the rotation axis direction (width direction and longitudinal direction) of the heating roller **307**. By tilting the lubricant application roller **308**A, the position (shifted position) of the fixing belt **301** with respect to the rotation axis direction of the heating roller **307** is controlled. That is, the lubricant application roller **308**A has a rotation center at the center or one end of the lubricant application roller **308**A in the rotation axis direction (longitudinal direction), and swings about the rotation center to tilt with respect to the longitudinal direction of the heating roller **307**. As a result, a tension difference is generated between one side and the other side of the fixing belt **301** in the longitudinal direction, thereby moving the fixing belt **301** in the longitudinal direction.

The fixing belt **301** is shifted toward one end portion during rotation depending on the accuracy in the outer diameter of the roller stretching the fixing belt **301**, the accuracy in the alignment between the rollers, and the like. Therefore, such a shift is controlled by the lubricant application roller **308**A that also serves as a steering roller. The lubricant application roller **308**A may be swung by a drive source such as a motor, or may be configured to swing by self-alignment.

The lubricant application roller **308**A according to the present embodiment will be described in more detail. As illustrated in FIG. **4**, the lubricant application roller **308**A is disposed inside the fixing belt **301**. The lubricant application roller **308**A stretches the fixing belt **301**, and is supported by a steering unit **321**. The steering unit **321** rotates with respect to a frame **320** of a heating unit **300**A with a rotating shaft **322** as a fulcrum, so that the lubricant application roller **308**A is supported in such a manner as to change an angle of contact with the fixing belt **301**.

Both ends of the lubricant application roller **308**A are biased to one side of the fixing belt **301** at 50 N by a biasing spring **309**A supported by the steering unit **321**, and the lubricant application roller **308**A also serves as a tension roller that applies a predetermined tension to the fixing belt **301**. That is, the lubricant application roller **308**A according to the present embodiment has both a function as a steering roller and a function as a tension roller.

FIGS. **5**A and **5**B are cross-sectional views of the lubricant application roller **308**A. FIG. **5**A is a cross-sectional view of the lubricant application roller **308**A taken along a direction orthogonal to the rotation axis direction, and FIG. **5**B is a cross-sectional view of the lubricant application roller **308**A taken along the rotation axis direction. The lubricant application roller **308**A includes a cylindrical member **308***c* serving as a rotation shaft portion, and an oil impregnated layer **308***d* serving as a lubricant impregnated layer disposed around the cylindrical member **308***c*.

In the present embodiment, the lubricant application roller **308**A is supported around a rotation support shaft **308***e* via bearings **310***a*. For example, the cylindrical member **308***c* is a stainless steel pipe having an outer diameter of 20 mm and a thickness of 1 mm. The oil impregnated layer **308***d* is formed by, for example, winding a nonwoven fabric having a thickness of 100 μm and impregnated with silicone oil around the cylindrical member **308***c* a plurality of times. The oil impregnated layer **308***d* is impregnated with, for example, 4 g of silicone oil.

As illustrated in FIG. **5**B, both ends of the lubricant application roller **308**A in the longitudinal direction (rotation axis direction) are rotatably supported by the respective bearings **310***a*. That is, the bearings **310***a* are disposed at both ends of the rotation support shaft **308***e* in the longitudinal direction, and the cylindrical member **308***c* is rotatably supported by the rotation support shaft **308***e* via the bearings **310***a* at both ends thereof. Therefore, the lubricant application roller **308**A rotates following the fixing belt **301** in a state where it is supported by the rotation support shaft **308***e* via the bearings **310***a*.

Steering Operation

A steering operation of the lubricant application roller **308**A will be described with reference to FIGS. **6**A and **6**B. FIG. **6**A is a perspective view of the vicinity of the lubricant application roller **308**A stretching the fixing belt **301**, and

FIG. **6**B is a schematic view illustrating how the lubricant application roller **308**A is tilted together with the fixing belt **301**.

As described above, the lubricant application roller **308**A is supported to be rotatable with respect to the frame **320** of the heating unit **300**A via the steering unit **321**. The steering unit **321** includes a steering body portion **323** that supports the lubricant application roller **308**A via the rotation support shaft **308***e*, a steering shaft **324** provided at an end portion of the steering body portion **323**, and a steering arm **325**. The steering arm **325** is driven by a motor M2 to swing the steering shaft **324** in a direction indicated by an arrow A in FIGS. **6**A and **6**B. As a result, the steering body portion **323** rotates about the rotation shaft **322** (FIG. **4**) via the steering shaft **324**, so that the lubricant application roller **308**A can change the angle with respect to the fixing belt **301**.

By changing the angle of the lubricant application roller **308**A as described above, the fixing belt **301** stretched thereby moves along the width direction (longitudinal direction) W In a case where the lubricant application roller **308**A is tilted in a direction indicated by an arrow A+ in FIGS. **6**A and **6**B, the fixing belt **301** is moved in a direction indicated by an arrow W− in FIGS. **6**A and **6**B toward a front side of the fixing device **8**A (a control of a forward shift of the belt). On the other hand, in a case where the lubricant application roller **308**A is tilted in a direction indicated by an arrow A− in FIGS. **6**A and **6**B, the fixing belt **301** is moved in a direction indicated by an arrow W+ in FIGS. **6**A and **6**B toward a back side of the fixing device **8**A (a control of a backward shift of the belt). By repeating this operation, the fixing belt **301** reciprocates in a predetermined region in the width direction W The position of the fixing belt **301** in the width direction W, that is, the shifted position, is detected by a shifted position detection unit **330** to be described below.

Detection of Shifted Position of Fixing Belt

Next, the shifted position detection unit **330** will be described with reference to FIG. **7**. The shifted position detection unit **330** includes a belt position detection arm **331**, a belt position detection flag **332**, a biasing unit **333**, and a sensor unit **340**. The belt position detection arm **331** is rotatably held in a state where a rotation center hole **331***a* is fitted to a rotation shaft **334**, and the belt position detection flag **332** is provided as a flag member that swings in conjunction with the belt position detection arm **331**. The belt position detection flag **332** is biased to rotate in a direction indicated by an arrow C+ in FIG. **7** by the biasing unit **333** provided on a rotation shaft of the belt position detection flag **332**. As a result, the belt position detection arm **331** is biased to rotate in a direction indicated by an arrow B+ in FIG. **7**. A detection unit **331***b* provided in the belt position detection arm **331** is in contact with an end surface of the fixing belt **301** at a light pressure that does not hinder the movement of the fixing belt **301** in the width direction W with the biasing force. In the present embodiment, this pressure is set to about 1 gf.

The belt position detection flag **332** has a rotation center hole **332***a*, and is rotatably held in a state where the rotation center hole **332***a* is fitted to a rotation shaft **335**. In addition, the belt position detection flag **332** swings in conjunction with the belt position detection arm **331** via a long round hole **332***b* formed in the belt position detection flag **332** and a shaft **331***c* formed in the belt position detection arm **331**.

The sensor unit **340** includes a plurality of optical sensors **341**. The belt position detection flag **332** includes light shielding portions **332***c*, and the plurality of optical sensors **341** are provided near the light shielding portions **332***c*. When the posture angle of the belt position detection flag **332** changes and the light shielding portions **332***c* move, the on/off states of signals returned by the optical sensors **341** also change, so that the position of the fixing belt **301** can be detected by a combination of the signals. By combining the control of the motor M2 of the steering arm **325** described above and the shifted position detection unit **330** using the belt position detection flag **332**, a shift of the fixing belt **301** is controlled.

Effect of Using Lubricant Application Roller as Steering Roller

Next, an effect of the present embodiment in which the lubricant application roller **308**A is used as a steering roller will be described with reference to FIGS. **8**A and **8**B. Here, in a comparative example, the lubricant application roller was brought into contact with the inner peripheral surface of the fixing belt **301**, separately from the steering roller that controlled a shift of the fixing belt **301**. On the other hand, in an example, the lubricant application roller **308**A was used as a steering roller as described above. The other configurations are the same between the comparative example and the example.

FIG. **8**A is a graph illustrating a relationship between a position of the fixing belt **301** in the longitudinal direction and a lubricant supply amount in the comparative example, and FIG. **8**B is a graph illustrating a relationship between a position of the fixing belt **301** in the longitudinal direction and a lubricant supply amount in the example. In FIGS. **8**A and **8**B, the horizontal axis represents a position of the fixing belt **301** in the longitudinal direction, and the vertical axis represents a lubricant supply amount.

In the comparative example, when there is a difference in the pressurizing force of the lubricant application roller to the fixing belt **301** between the front side and the back side of the device (for example, in a case where the pressurizing force of the lubricant application roller on the front side is 55 N and the pressurizing force of the lubricant application roller on the back side is 45 N), the pressure of contact with the fixing belt **301** is always larger on the front side. For this reason, as illustrated in FIG. **8**A, the lubricant supply amount on the front side is always larger than that on the back side, and causing unevenness in lubricant supply amount in the longitudinal direction of the inner peripheral surface of the fixing belt **301**.

On the other hand, in the configuration of the present example, even when there is a difference in the pressurizing force of the lubricant application roller **308**A to the fixing belt **301** between the front side and the back side of the device (for example, in a case where the pressurizing force of the lubricant application roller **308**A on the front side is 55 N and the pressurizing force of the lubricant application roller on the back side is 45 N), it is possible to suppress an occurrence of unevenness in lubricant supply amount in the longitudinal direction of the inner peripheral surface of the fixing belt **301**, because a shift of the fixing belt **301** is controlled.

That is, the lubricant application roller **308**A swings according to the control of the shift, and the posture angle of the lubricant application roller **308**A with respect to the fixing belt **301** changes. Therefore, in a case where the lubricant application roller **308**A is tilted in the direction indicated by the arrow A+ to control the fixing belt **301** to be shifted to the front side as illustrated in FIGS. **6**A and **6**B, the pressure of contact and the lubricant supply amount increase on the front side of the fixing belt **301** (a solid line in FIG. **8**B). On the other hand, in a case where the lubricant application roller **308**A is tilted in the direction indicated by the arrow A- to control the fixing belt **301** to be shifted to the back side, the pressure of contact and the lubricant supply amount increase on the back side of the fixing belt **301** (a broken line in FIG. **8**B). As a result, it is possible to reduce the difference in lubricant supply amount between the front side and the back side of the inner peripheral surface of the fixing belt **301**.

In addition, by controlling a shift of the fixing belt **301** using the lubricant application roller **308**A, it is possible to cope with the supply of the lubricant to the inner peripheral surface of the fixing belt **301** and the control of the shift of the fixing belt **301** in a space-saving manner. Therefore, according to the configuration of the present embodiment, it is possible to stably supply the lubricant to the inner peripheral surface of the fixing belt **301** and control a shift of the fixing belt **301**, and it is also possible to achieve both size reduction and long life of the fixing belt **301**.

Furthermore, according to the configuration of the present embodiment, since the lubricant application roller **308**A serves as a steering roller, a tension roller, and a lubricant application member, space saving inside the belt can be achieved. In addition, since the oil impregnated layer **308***d* of the lubricant application roller **308**A contacts the inner peripheral surface of the fixing belt **301** with a sufficient biasing force over a sufficient contact area, stable lubricant application can be realized. As a result, the reduction in size of the device can be easily achieved while applying the lubricant to the inner peripheral surface of the fixing belt **301**.

In the present embodiment as well, similarly to the first embodiment, a roller portion may be provided, the roller portion being disposed at a position outside the oil impregnated layer **308***d* in the rotation axis direction of the lubricant application roller **308**A while facing the inner peripheral surface of the fixing belt **301**, and having a smaller outer diameter than the oil impregnated layer **308***d*.

Other Embodiments

In each of the above-described embodiments, the halogen heater is provided as a heating portion for heating the fixing belt on the heating roller. However, the heating portion may be provided on another stretching member, rather than the heating roller. In addition, the heating portion may be provided on the pad member. For example, a plate-shaped heat generating member such as a ceramic heater may be provided on a side of the pad member facing the fixing belt. The fixing belt may be heated by electromagnetic induction (IH). Further, in each of the above-described embodiments, instead of the heating portion disposed inside the roller, an external heating system in which another heating member is brought into contact with the belt or the roller from the outside for heating may be adopted.

In each of the above-described embodiments, the pressure roller is used as a driving rotary member. However, the driving rotary member may be an endless belt stretched by a plurality of stretching rollers and driven by any stretching roller. In each of the above-described embodiments, the pressure roller as a driving rotary member is pressurized against the belt to form a nip portion, but the belt may be pressurized against the driving rotary member. Furthermore, in each of the above-described embodiments, the fixing pad is used as a nip portion forming member, but the nip portion forming member may be a roller.

Other Embodiments

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2023-032951, filed Mar. 3, 2023, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A fixing device that fixes a toner image to a recording material by heating the toner image borne on the recording material, the fixing device comprising:
- an endless belt member;
- a rotary member configured to rotate in contact with an outer peripheral surface of the belt member;
- a nip portion forming member disposed inside the belt member and configured to form a nip portion for nipping and conveying the recording material between the belt member and the rotary member; and
- a steering roller disposed inside the belt member and configured to be swung to control a position of the belt member in a width direction of the belt member,
- wherein the steering roller includes:
  - a lubricant impregnated portion impregnated with a lubricant and contacting an inner peripheral surface of the belt member; and
  - metal portions made of metal and contacting the inner peripheral surface of the belt member outside of the lubricant impregnated portion in the width direction,
- wherein the metal portions include:
  - a first metal portion disposed on a first end side in the width direction; and
  - a second metal portion disposed on a second side opposite to the first end side in the width direction, and
- wherein a length from a first end of the first metal portion to a second end of the second metal portion in the width direction is shorter than a length of the belt member in the width direction.

2. The fixing device according to claim **1**, wherein the steering roller includes a core metal disposed inside the lubricant impregnated portion and the metal portions.

3. The fixing device according to claim **1**, wherein, in a state where the steering roller is not in contact with the belt member, the lubricant impregnated portion has a larger outer diameter than the metal portions.

4. The fixing device according to claim **1**, wherein the lubricant impregnated portion is formed of a nonwoven fabric.

5. The fixing device according to claim **1**, wherein the lubricant impregnated portion is formed of a porous material.

6. The fixing device according to claim **1**, wherein the nip portion forming member is a pad member.

7. The fixing device according to claim **1**, further comprising a heating roller disposed inside the belt member and configured to heat the belt member.

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