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Yokoyama

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(54) **IMAGE FORMING APPARATUS THAT DETECTS ATTACHED STATE TO MAIN BODY OF CASSETTE ACCOMMODATING SHEET**

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B65H 1/26 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/5062*** (2013.01); ***B65H 1/266*** (2013.01); ***G03G 15/6502*** (2013.01); ***G03G 15/6558*** (2013.01); *B65H 2403/72* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/5062; G03G 15/6502; G03G 15/6558; B65H 1/266; B65H 2403/72
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

9,975,717	B2 *	5/2018	Fujinuma	B65H 1/04
10,294,053	B2 *	5/2019	Kawamura	G03G 15/6511
2011/0233846	A1	9/2011	Miwa	
2019/0389678	A1 *	12/2019	Ota	B65H 1/08

FOREIGN PATENT DOCUMENTS

JP	H05155445	A	6/1993
JP	2005096943	A	4/2005
JP	2010058954	A	3/2010
JP	2011195319	A	10/2011

* cited by examiner

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(57) **ABSTRACT**

An image forming apparatus includes: a detection unit configured to detect whether a cassette accommodating a sheet is in an attached state or in a non-attached state; a transfer roller configured to transfer an image to the sheet in a transfer region; a conveyance roller configured to convey, to the transfer region, a first sheet; a drive unit configured not to transmit the driving force to the conveyance roller in the non-attached state; and a determination unit configured to determine that an image defect has occurred when the detection unit detects that a state of the cassette has transitioned to the non-attached state, in a monitoring period including a period from a first timing at which the first sheet starts to be conveyed by the transfer roller, to a second timing.

11 Claims, 8 Drawing Sheets

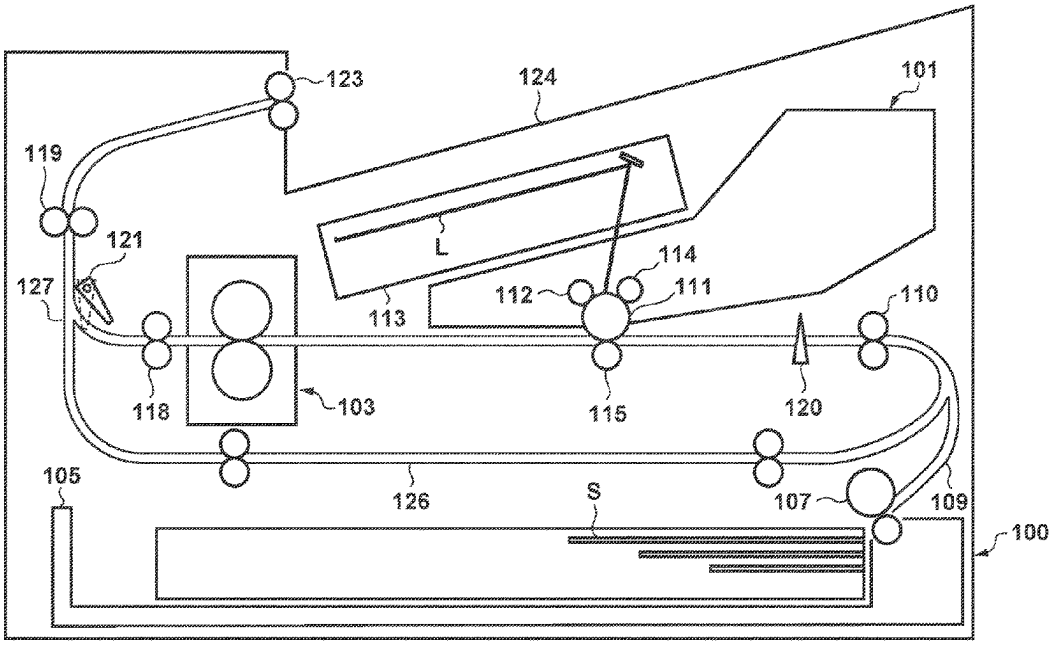


FIG. 1

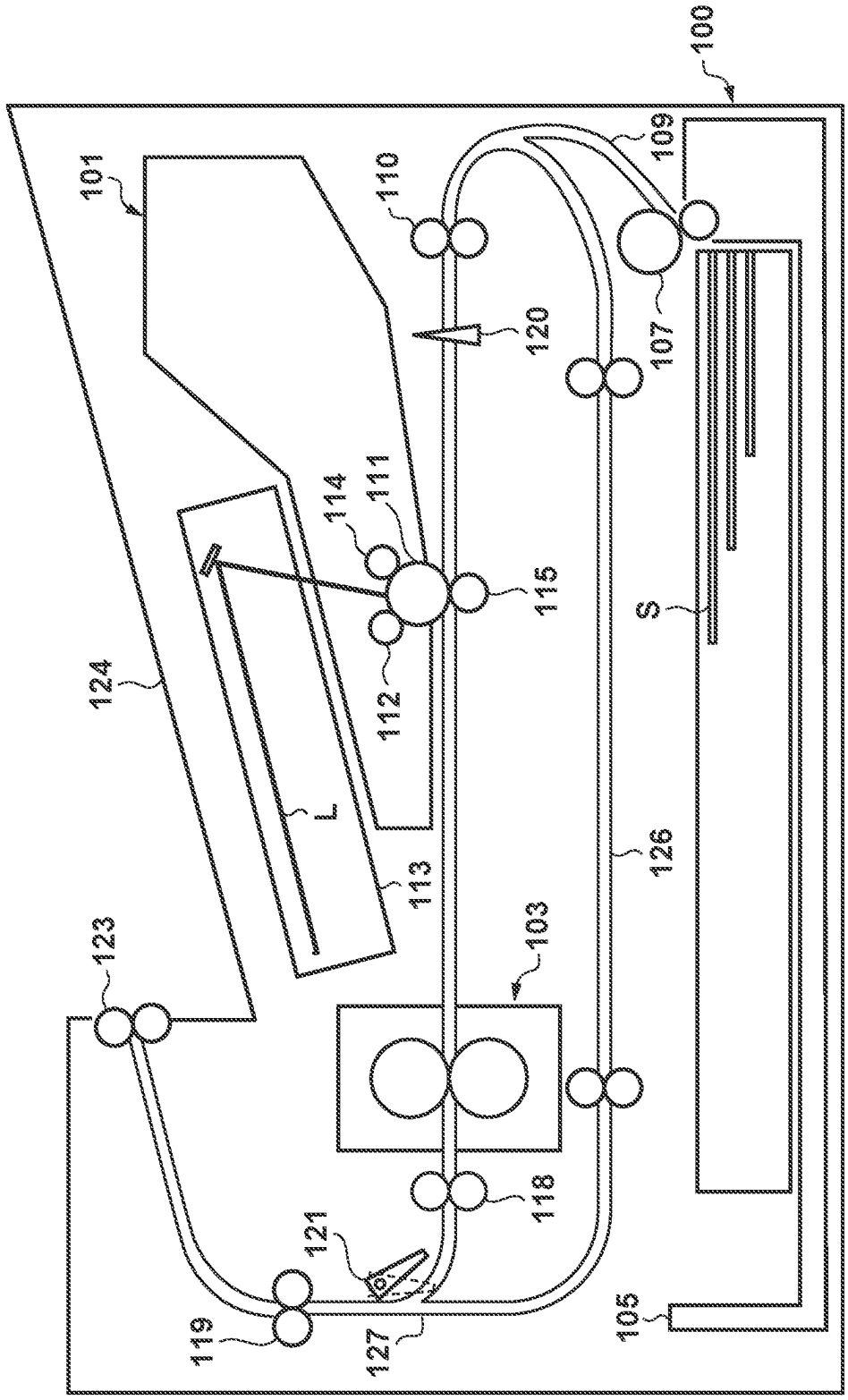

100
101
109
110
120
107
114
111
115
S
124
112
L
113
126
123
103
118
121
119
127
105

FIG. 2A

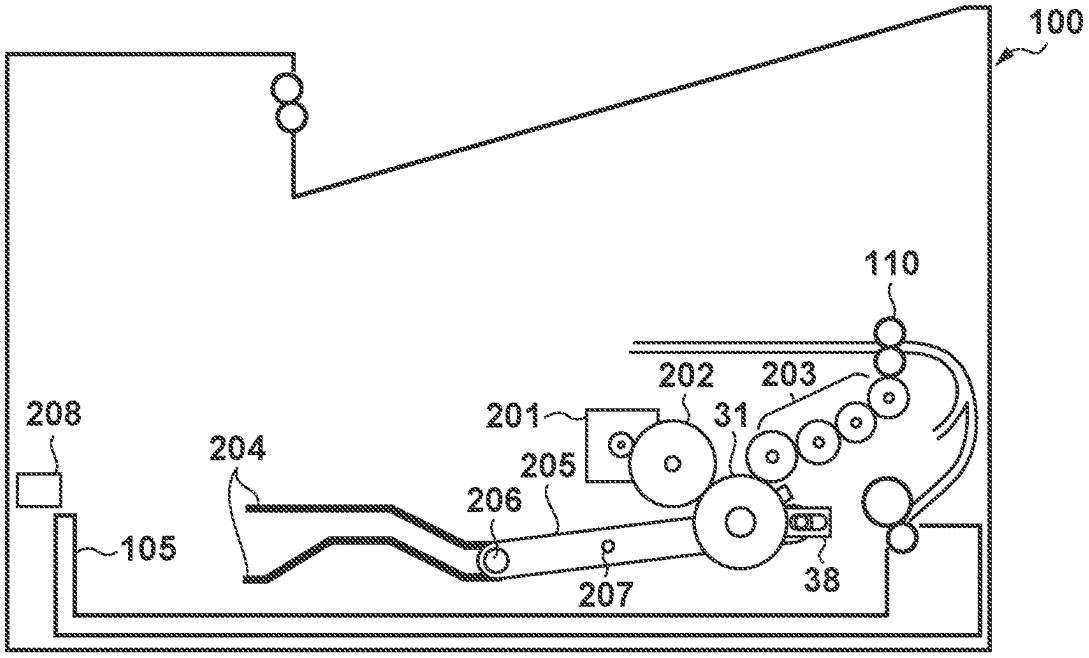

100
110
202
203
208
201
31
204
205
206
105
207
38

FIG. 2B

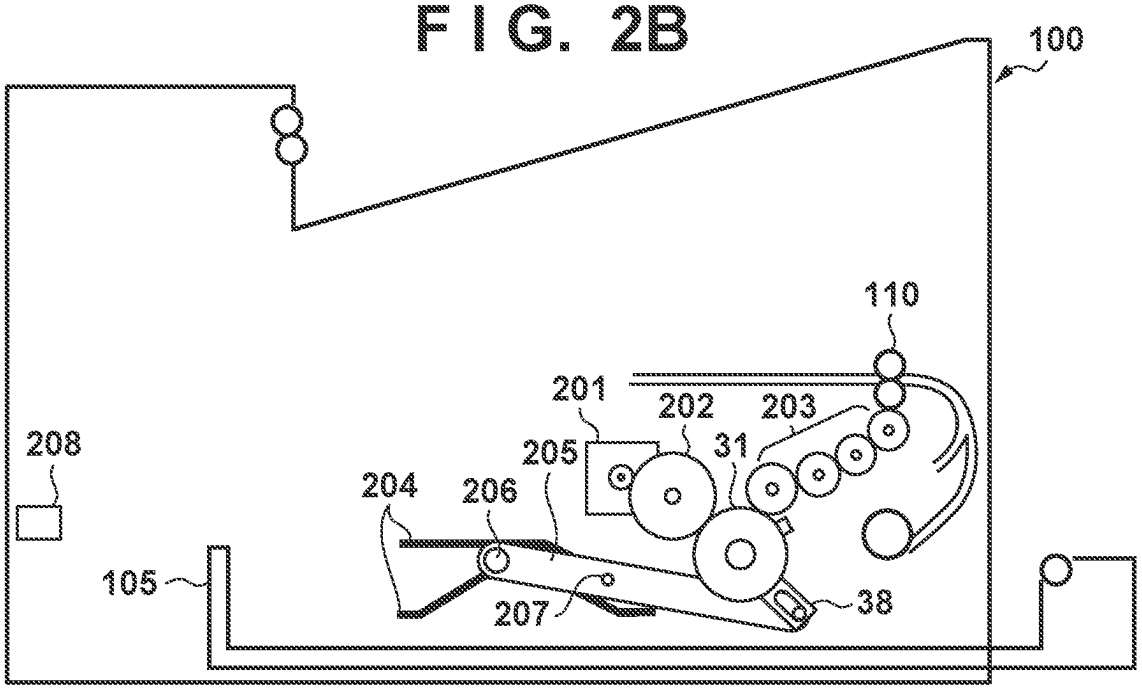

100
110
201
202
203
208
205
31
204
206
105
207
38

FIG. 3A

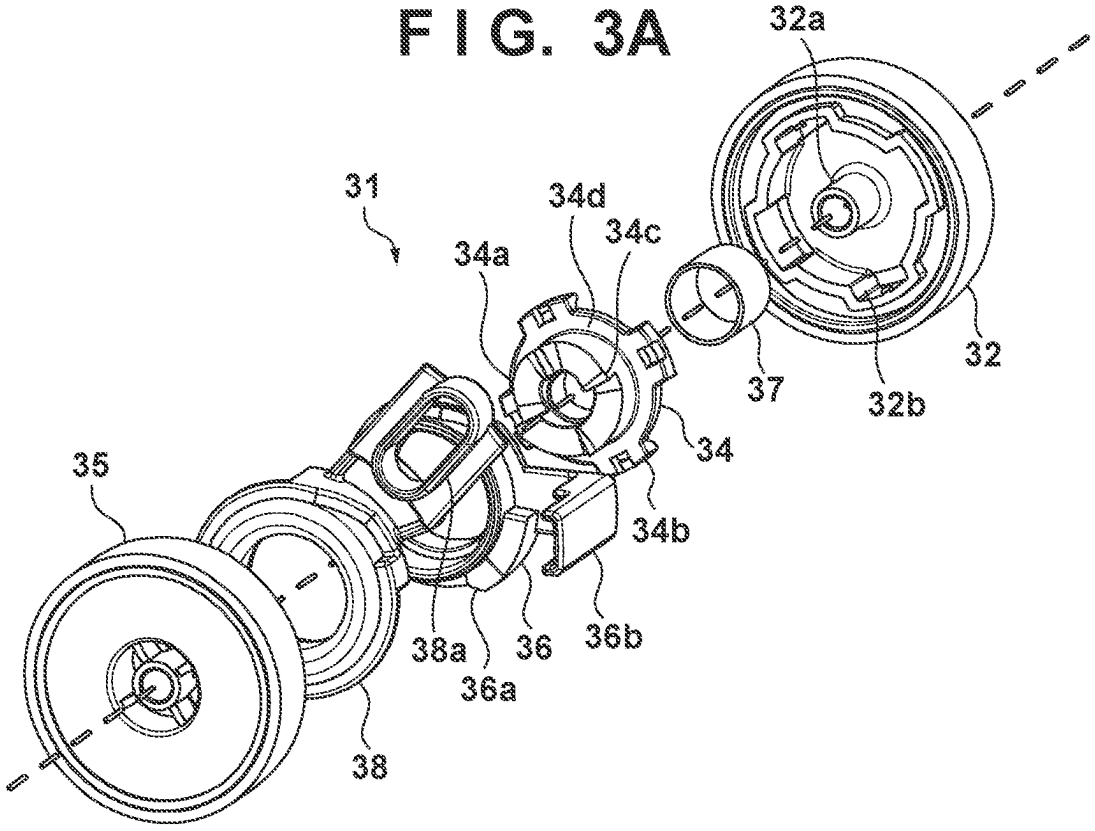

32a
31
34d
34c
34a
32
37
32b
34
35
34b
38a
36
36b
36a
38

FIG. 3B

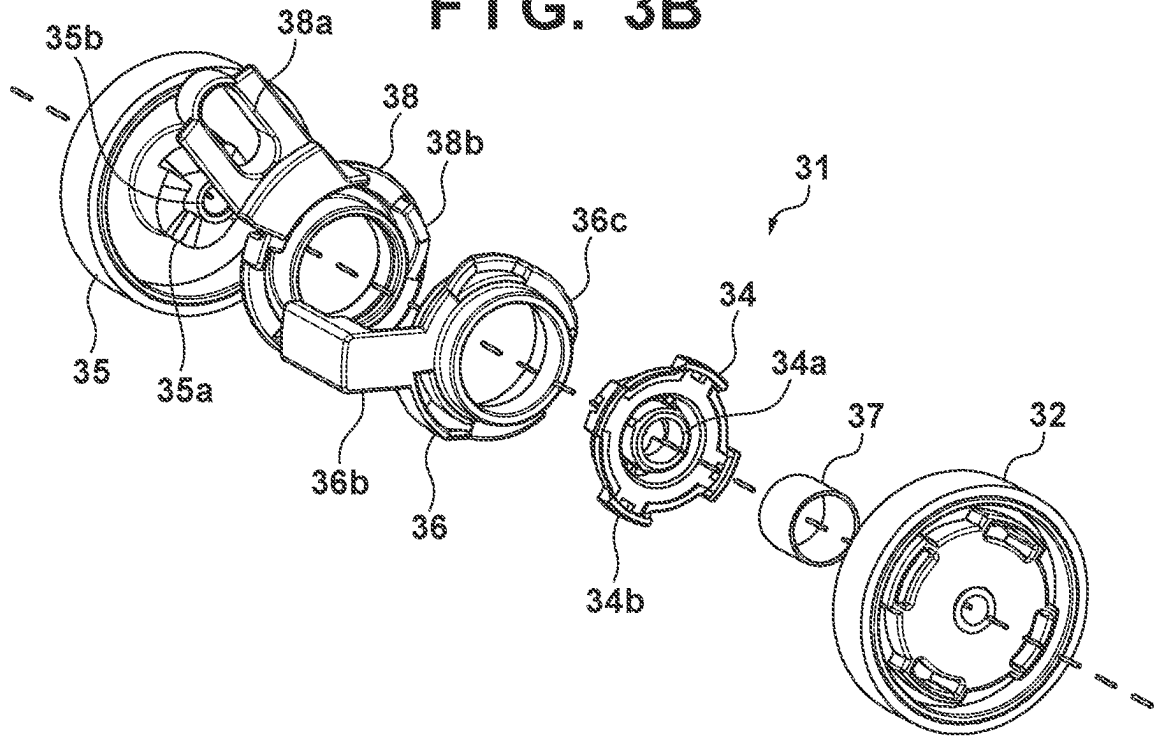

35b
38a
38
38b
31
36c
34
34a
35
35a
37
32
36b
36
34b

FIG. 4A

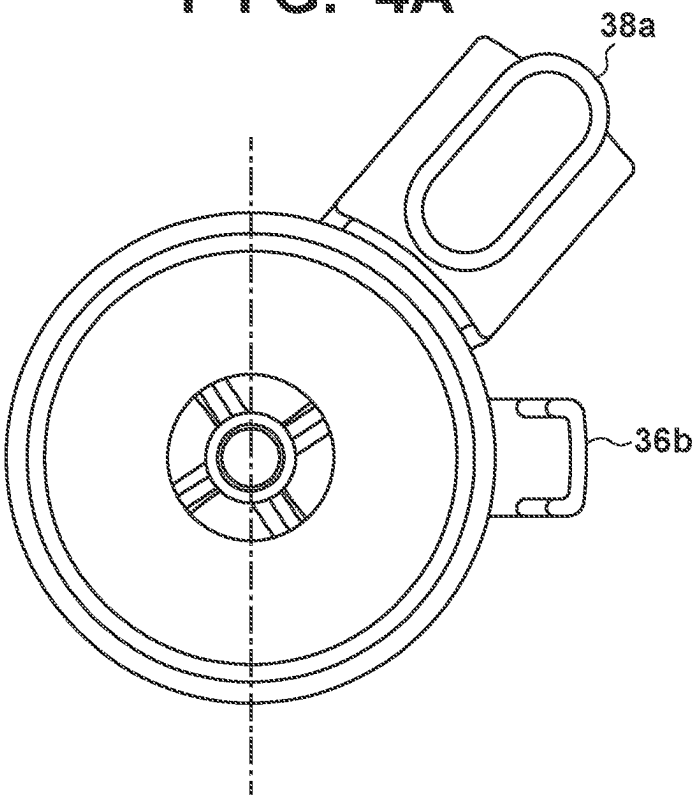
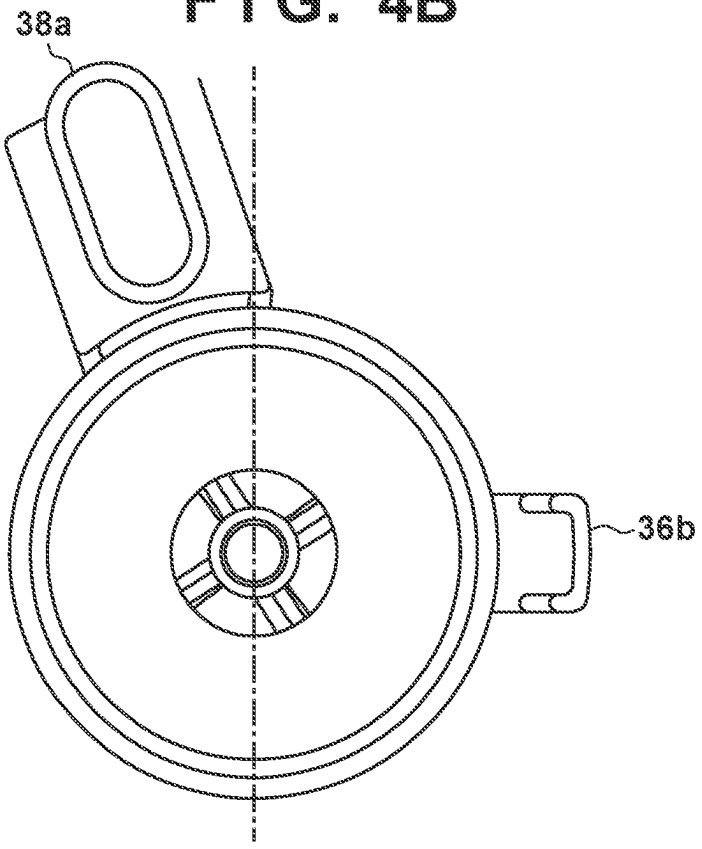


FIG. 4B



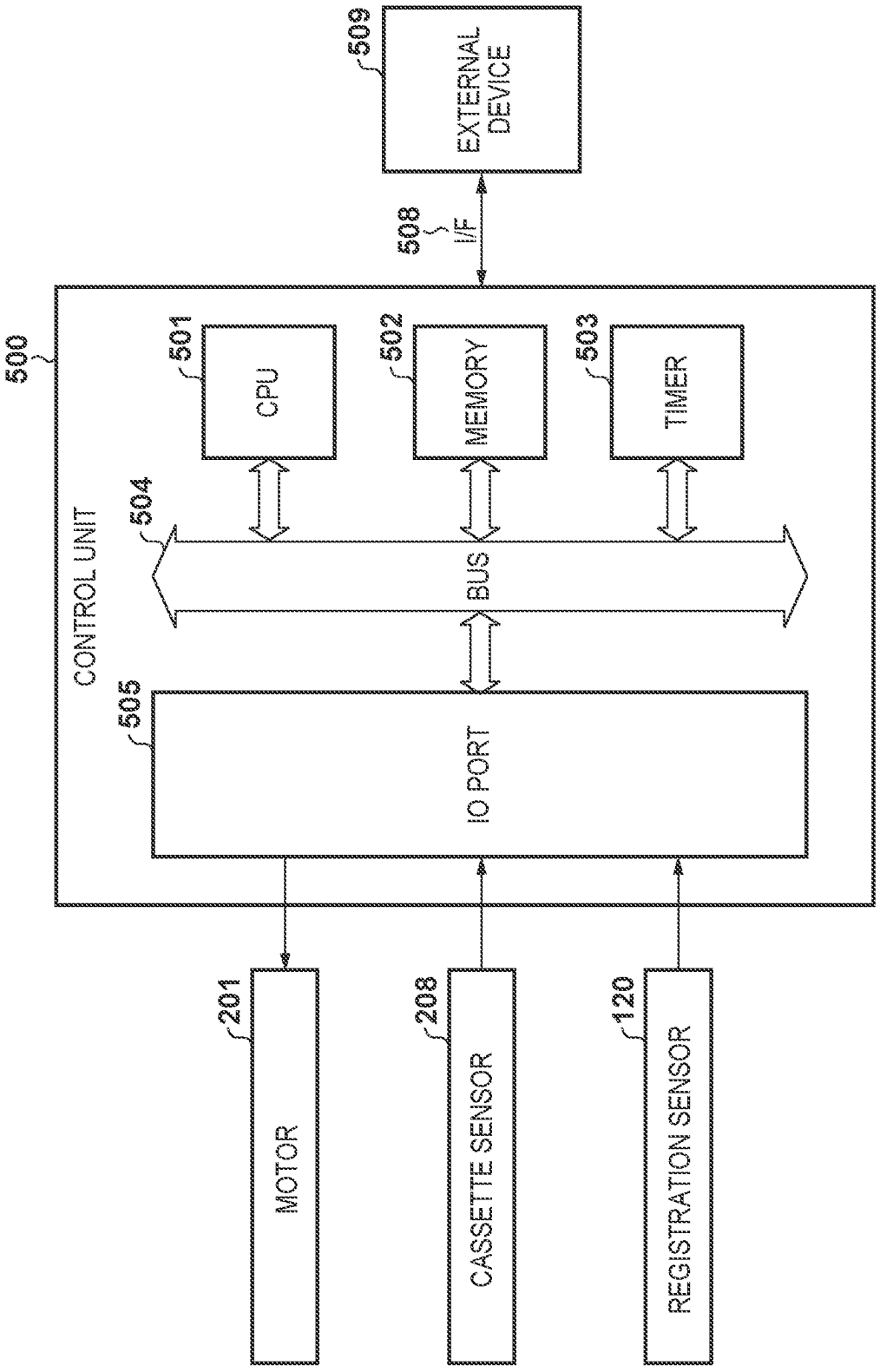

509
EXTERNAL DEVICE
508
I/F
500
CONTROL UNIT
501
CPU
502
MEMORY
503
TIMER
504
BUS
505
IO PORT
201
MOTOR
208
CASSETTE SENSOR
120
REGISTRATION SENSOR

FIG. 5

FIG. 6

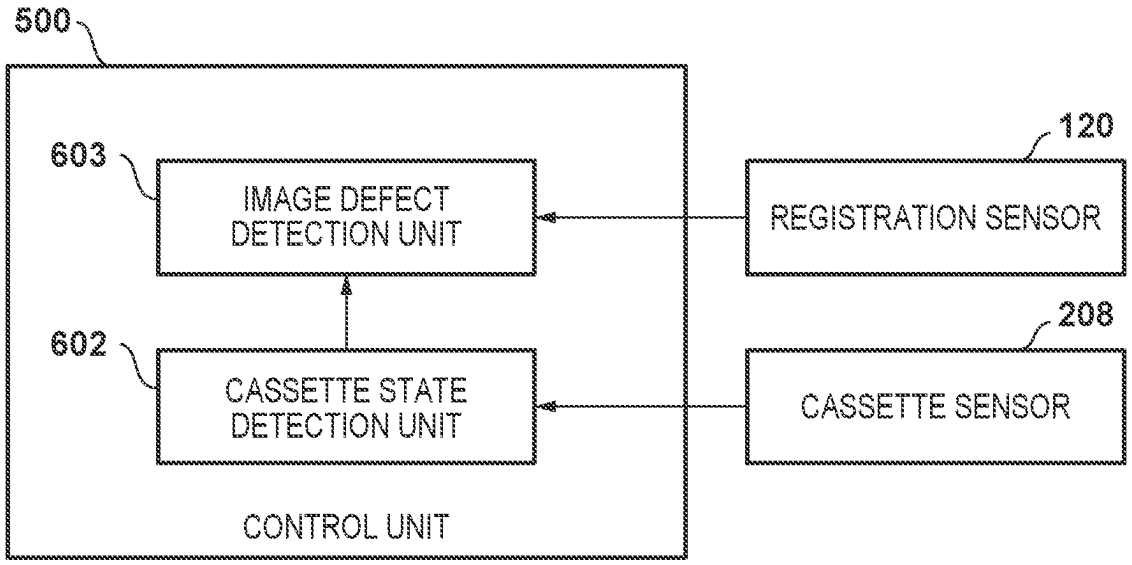

500
603
IMAGE DEFECT DETECTION UNIT
120
REGISTRATION SENSOR
602
CASSETTE STATE DETECTION UNIT
208
CASSETTE SENSOR
CONTROL UNIT

FIG. 7

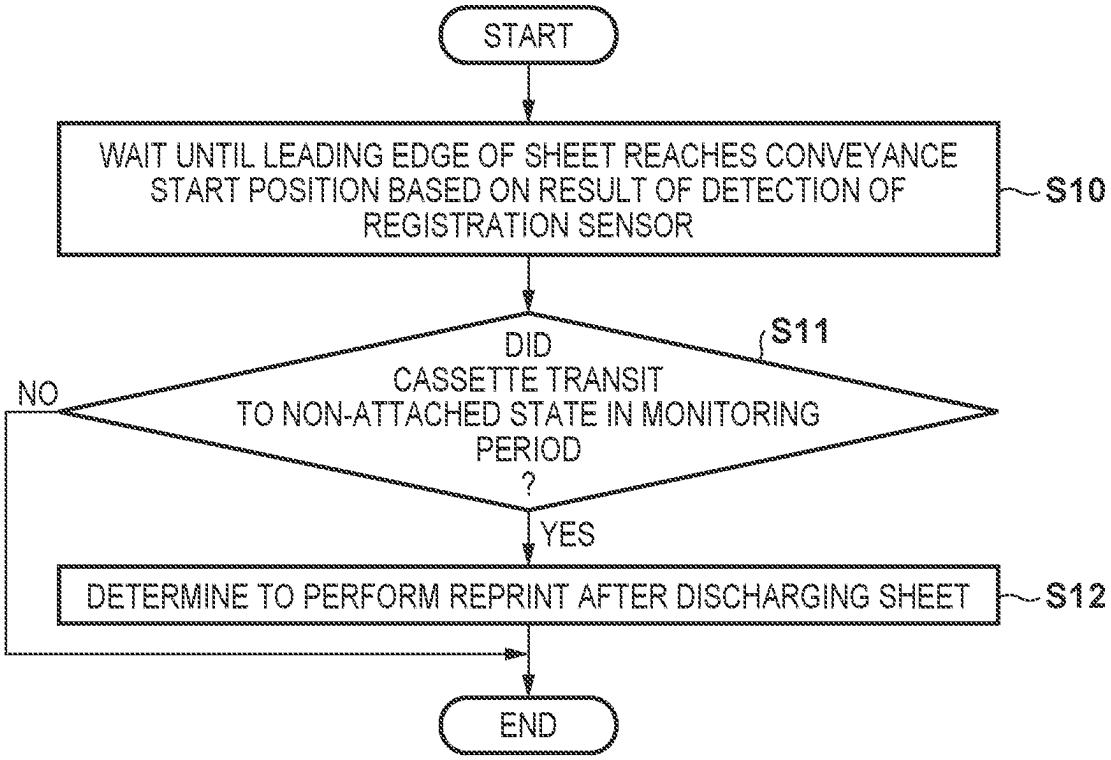

START
WAIT UNTIL LEADING EDGE OF SHEET REACHES CONVEYANCE START POSITION BASED ON RESULT OF DETECTION OF REGISTRATION SENSOR
S10
DID CASSETTE TRANSIT TO NON-ATTACHED STATE IN MONITORING PERIOD ?
S11
NO
YES
DETERMINE TO PERFORM REPRINT AFTER DISCHARGING SHEET
S12
END

FIG. 8

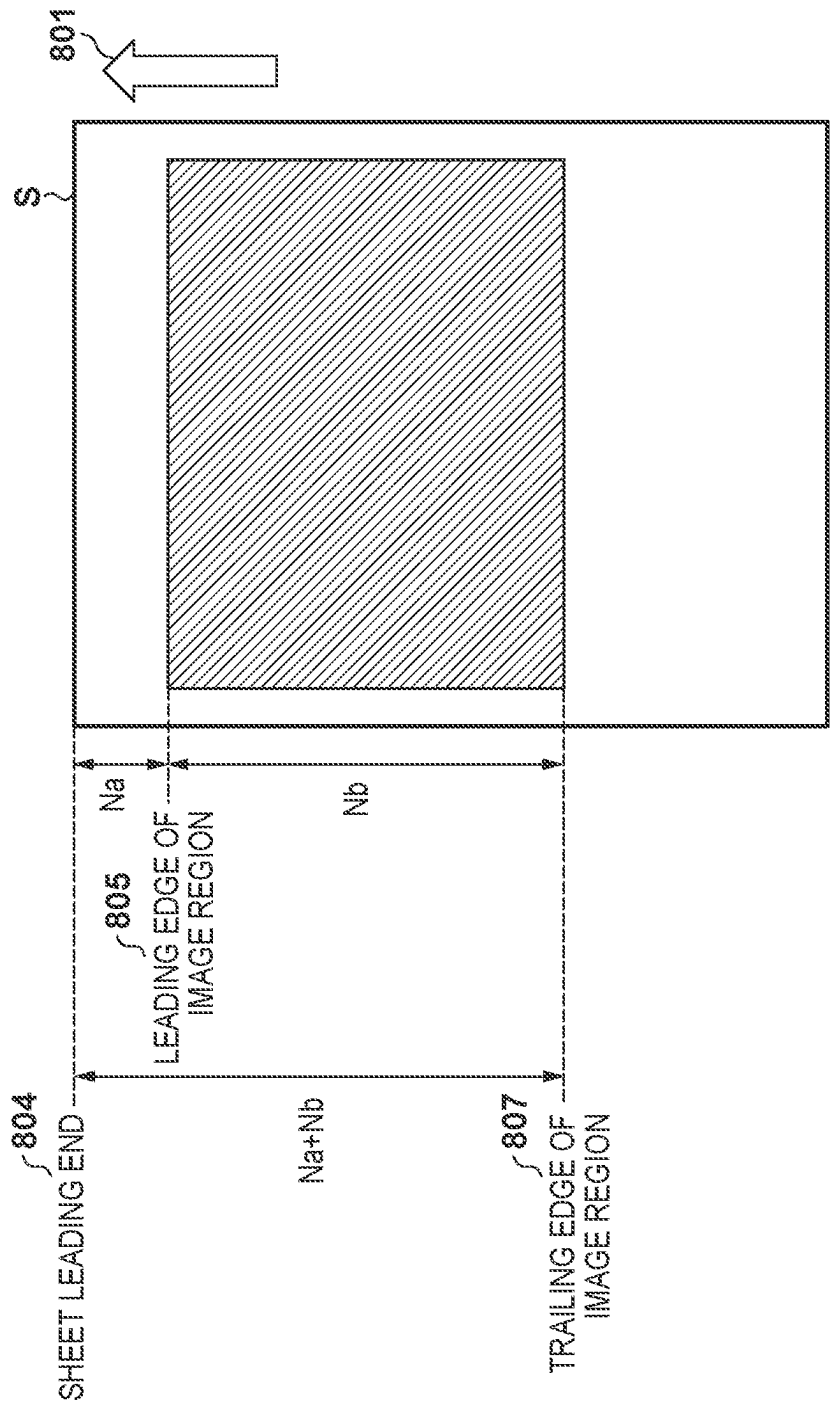

801
S
Na
Nb
805
LEADING EDGE OF IMAGE REGION
804
SHEET LEADING END
Na+Nb
807
TRAILING EDGE OF IMAGE REGION

FIG. 9

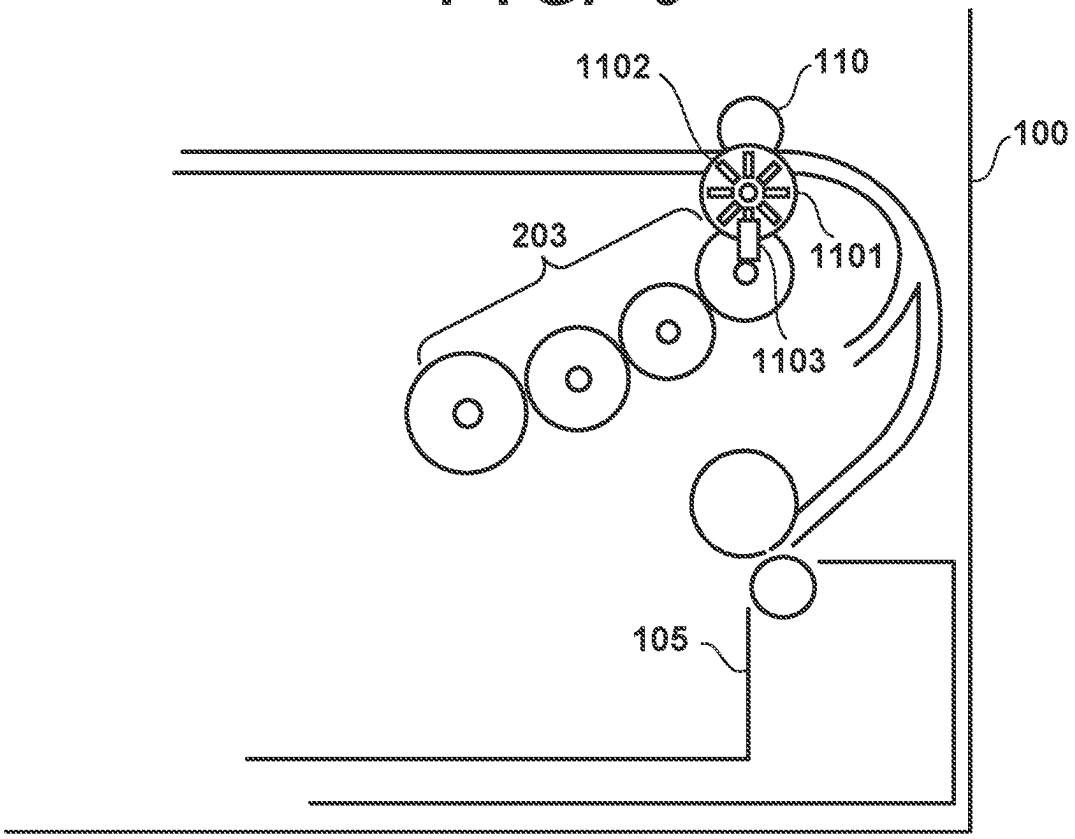

1102
110
100
203
1101
1103
105

FIG. 10

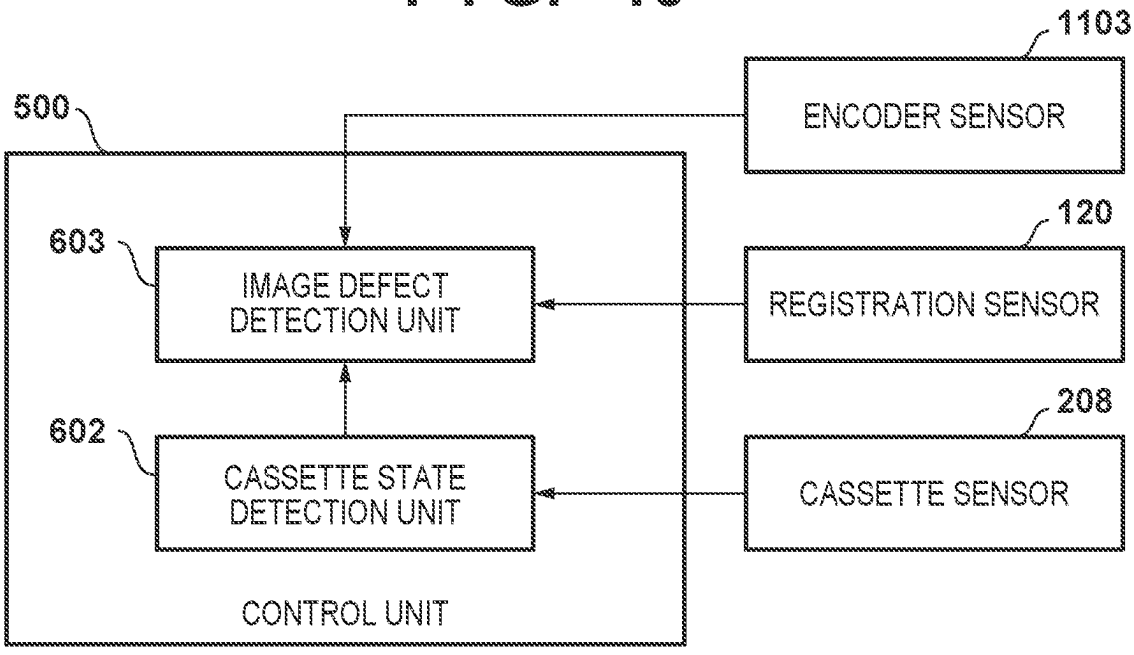

1103
ENCODER SENSOR
500
603
IMAGE DEFECT DETECTION UNIT
120
REGISTRATION SENSOR
602
CASSETTE STATE DETECTION UNIT
208
CASSETTE SENSOR
CONTROL UNIT

IMAGE FORMING APPARATUS THAT DETECTS ATTACHED STATE TO MAIN BODY OF CASSETTE ACCOMMODATING SHEET

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image forming apparatus.

Description of the Related Art

Image forming apparatuses, in which a cassette that is accommodating sheets is configured to be attachable to and detachable from the main body of the apparatuses, are usually used. US-2011-0233846 discloses a configuration in which driving force to a conveyance roller that conveys sheets is disconnected when a cassette is removed from a main body of an apparatus.

Even if the driving of the conveyance roller is stopped when the cassette is removed during image formation, a transfer roller and the like located on a downstream side of the conveyance roller continue to be driven. Therefore, depending on the timing of removing the cassette, a situation may happen in which the transfer roller pulls out a sheet from the conveyance roller that is stopped. In such a case, a failure in transferring an image to the sheet, i.e., image defect of the image to be formed on the sheet may occur. Furthermore, the sheet may be directly discharged to the outside of the image forming apparatus and provided to the user.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, an image forming apparatus includes: a first detection unit configured to detect whether a cassette accommodating a sheet is in an attached state in which the cassette is attached to a main body of the image forming apparatus, or in a non-attached state in which the cassette is not attached to the main body; a transfer roller configured to transfer an image to the sheet in a transfer region; a conveyance roller configured to convey, to the transfer region, a first sheet that is fed from the cassette to a conveyance path; a drive unit configured to transmit a driving force of a motor to the conveyance roller in the attached state, and not to transmit the driving force of the motor to the conveyance roller in the non-attached state; and a determination unit configured to determine that an image defect has occurred in forming a first image on the first sheet when the first detection unit detects that a state of the cassette has transitioned from the attached state to the non-attached state, in a monitoring period including a period from a first timing at which the first sheet starts to be conveyed by the transfer roller, to a second timing.

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 configuration diagram of an image forming apparatus according to some embodiments;

FIG. **2**A and FIG. **2**B are explanatory diagrams of a transmission configuration of driving force to a registration roller, according to some embodiments;

FIG. **3**A and FIG. **3**B are perspective diagrams of a drive clutch, according to some embodiments;

FIG. **4**A is a diagram illustrating a drive clutch in a driving state, according to some embodiments;

FIG. **4**B is a diagram illustrating a drive clutch in a disconnected state, according to some embodiments;

FIG. **5** is a control configuration diagram of the image forming apparatus, according to some embodiments;

FIG. **6** is a functional block diagram of a control unit, according to some embodiments;

FIG. **7** is a flowchart of processing executed by the control unit, according to some embodiments;

FIG. **8** is an explanatory diagram of a monitoring period, according to some embodiments;

FIG. **9** is a diagram illustrating a detection configuration for a rotation amount of a registration roller, according to some embodiments; and

FIG. **10** is a functional block diagram of the control unit, according to some embodiments.

DESCRIPTION OF THE EMBODIMENTS

Hereinafter, embodiments will be described in detail with reference to the attached drawings. Note, the following embodiments are not intended to limit the scope of the claimed invention. Multiple features are described in the embodiments, but limitation is not made to an invention that requires all such features, and multiple such features may be combined as appropriate. Furthermore, in the attached drawings, the same reference numerals are given to the same or similar configurations, and redundant description thereof is omitted.

First Embodiment

FIG. **1** is a schematic configuration diagram of an image forming apparatus **100** according to the present embodiment. An image forming unit **101** includes a photoconductor **111** that is rotationally driven in a clockwise direction of the diagram in forming an image. A charge roller **112** charges, by a charging voltage, the surface of the photoconductor **111**, which is rotationally driven, to a uniform potential. An exposure apparatus **113** exposes the charged photoconductor **111** with a light beam L to form an electrostatic latent image on the photoconductor **111**. A developing apparatus **114** develops the electrostatic latent image on the photoconductor **111** with toner to form an image (toner image) on the photoconductor **111**. A transfer roller **115** transfers the image on the photoconductor **111** to a sheet S by a transfer voltage. In the following description, a region where the transfer roller **115** transfers the image on the photoconductor **111** to the sheet S is referred to as a transfer region.

A feed roller **107** feeds the sheet S accommodated in a cassette **105** to a conveyance path **109**. A registration roller **110** feeds the sheet S into the transfer region. The registration roller **110** is a conveyance roller that conveys the sheet S. A registration sensor **120** detects whether or not the sheet S exists at a detection position in the conveyance path **109**. The detection position is at the upstream side from the transfer region in the conveyance direction of the sheet S in the conveyance path **109**. Based on a timing at which the registration sensor **120** detects a leading edge of the sheet S, the timing at which the registration roller **110** feeds the sheet S into the transfer region is adjusted.

A fixing unit **103** pressurizes and heats the sheet S, on which an image is transferred by the transfer roller **115**, to fix the image to the sheet S. A conveyance roller **118** conveys the sheet S, on which the image is fixed, to a downstream side in the conveyance direction. When forming an image only on one side of the sheet S, the sheet S is discharged to a tray **124** by a reverse roller **119** and a discharge roller **123**. When forming images on both sides of the sheet S, a flapper **121** is set into a state indicated by the dashed lines in the drawing after the trailing edge of the sheet S has passed a branch point **127**, and then reverses the rotation direction of the reverse roller **119** from the rotation direction before that. And thus, the sheet S is conveyed to the transfer region again via a double-sided conveyance path **126**, and the image formation is performed on the other side of the sheet S.

FIG. **2**A and FIG. **2**B are explanatory diagrams of a configuration of the cassette **105**. In FIG. **2**A, a state is illustrated in which the cassette **105** is attached to the main body of the image forming apparatus **100**. This state will be referred to as an attached state in the following. In FIG. **2**B, a state is illustrated in which the cassette **105** is pulled out from the main body of the image forming apparatus **100**. This will be referred to as a non-attached state. An input gear **202** transmits the driving force of a motor **201** to a drive clutch **31**. The drive clutch **31** is a mechanical clutch, which is set to either a transmission state in which the driving force of the motor **201** is transmitted to a gear group **203** or a disconnected state in which the driving force of the motor **201** is not transmitted to the gear group **203**. The state of the drive clutch **31** is configured to be in conjunction with the state of the cassette **105**, as will be described below. When the drive clutch **31** is in the transmission state, the gear group **203** transmits the driving force from the motor **201** to the registration roller **110**.

Slide guides **204** are provided on an outer side surface of the cassette **105**. A slide boss **206** of a switching member **205** is nipped between the slide guides **204**. When the slide guide **204** moves rightward by moving the cassette **105** rightward in the drawing from the attached state illustrated in FIG. **2**A, the slide boss **206** moves upward in the drawing in accordance with the shape of the slide guides **204**. Accordingly, the switching member **205** pivots about a fulcrum **207**. A lever member **38** changes the state of the drive clutch **31** in conjunction with the pivoting of the switching member **205**. In the present embodiment, the drive clutch **31** is configured such that the drive clutch **31** turns into the transmission state when the cassette **105** is in the attached state, and the drive clutch **31** turns into the disconnected state when the cassette **105** is in the non-attached state. A cassette sensor **208** detects whether or not the cassette **105** is in the attached state.

FIG. **3**A and FIG. **3**B are perspective diagrams of the drive clutch **31**. A clutch input gear **32** is rotatably supported by a fixed supporting shaft (not illustrated). The driving force from the input gear **202** is transmitted to the clutch input gear **32**. The inner periphery of a sliding boss **32***a* near the center of the clutch input gear **32** serves as a sliding surface with respect to the supporting shaft, and the outer periphery serves as a sliding surface with respect to an engagement member **34**. Four rotation stoppers **32***b* are provided inside the clutch input gear **32** closer at the vicinity of the outer periphery of the clutch input gear **32**, as rotation stoppers for the engagement member **34**.

The inner peripheral surface **34***a* of the engagement member **34** is supported to be slidable with respect to the outer peripheral surface of the sliding boss **32***a* of the clutch input gear **32**. In addition, the engagement member **34** rotates together with the clutch input gear **32** by the rotation stopper **34***b* of the engagement member **34** meshing with the rotation stopper **32***b* of the clutch input gear **32**. A protrusion **34***c* is provided at four positions in the engagement member **34**. When the protrusion **34***c* meshes with a protrusion **35***a* of the clutch output gear **35**, the drive clutch **31** turns into the transmission state. A sliding portion **34***d* that rotationally slides with a release member **36** is provided on the engagement member **34** at an edge surface facing the clutch output gear **35** side. The engagement member **34** is always biased toward the protrusion **35***a* of the clutch output gear **35** by a coil spring **37** serving as an elastic member.

The clutch output gear **35** is rotatably supported by a supporting shaft (not illustrated) at an inner peripheral surface **35***b*. In the driving state, the clutch output gear **35** transmits the driving force from the clutch input gear **32** to the gear group **203**. The lever member **38** is rotatably supported with respect to the clutch output gear **35**. A cam portion **38***b* of the lever member **38** abuts a cam portion **36***a* of the release member **36** to control the position in the supporting shaft direction. A lever portion **38***a* of the lever member **38** is connected to the switching member **205**. A rotation restriction unit **36***b* of the release member **36** is engaged with a fixing member (not illustrated) to restrict rotation thereof. A sliding portion **36***c* of the release member **36** abuts the sliding portion **34***d* of the engagement member **34**.

The drive clutch **31** is configured to be in a state in which, for example, a concave-up portion of the cam portion **38***b* of the lever member **38** and a concave-down portion of the cam portion **36***a* of the release member **36** match with each other when the lever portion **38***a* and the rotation restriction unit **36***b* are in a positional relation as illustrated in FIG. **4**A. In this case, the release member **36** moves toward the clutch output gear **35**, and the engagement member **34** is pressed by the elastic force of the coil spring **37** to mesh with the clutch output gear **35**. And thus, the drive clutch **31** turns into the transmission state.

On the other hand, the drive clutch **31** is configured to be in a state in which the concave-up portion of the cam portion **38***b* of the lever member **38** and a concave-up portion of the cam portion **36***a* of the release member **36** match with each other when the lever portion **38***a* and the rotation restriction unit **36***b* are in a positional relation as illustrated in FIG. **4**B. In this case, the release member **36** is pushed out toward the clutch input gear **32**, and the sliding portion **36***c* abuts the sliding portion **34***d* of the engagement member **34**. And thus, the engagement member **34** is separated from the clutch output gear **35** against the biasing force of the coil spring **37**. Therefore, transmission of the driving force to the clutch output gear **35** is disconnected and the drive clutch **31** turns into the disconnected state.

FIG. **5** is a control configuration diagram of the image forming apparatus **100**. A control unit **500** controls the entire image forming apparatus **100**. The control unit **500** includes a Central Processing Unit (CPU) **501**, a memory **502**, a timer **503**, and an Input/Output (IO) port **505**. The CPU **501**, the memory **502**, the timer **503** and the IO port **505** are connected to each other via a bus **504**. The CPU **501** controls the image forming apparatus **100** by executing a program stored in the memory **502**. The memory **502** is a collective term for both a non-volatile memory and a volatile memory. The timer **503** measures time. The CPU **501** controls each member illustrated in FIG. **1** via the IO port **505**. In addition, the control unit **500** is connected to an external device **509** such as a personal computer or a mobile information-processing equipment via an external interface (I/F) **508**.

The external device **509** instructs image formation or the like to the image forming apparatus **100**.

FIG. **6** is a functional block diagram of the control unit **500** according to the present embodiment. The functional blocks illustrated in FIG. **6** can be realized by the CPU **501** executing a program stored in the memory **502**. A cassette state detection unit **602** detects whether the cassette **105** is in the attached state or the non-attached state, based on the result of detection by the cassette sensor **208**. The cassette state detection unit **602** notifies the state of the cassette **105** to an image defect detection unit **603**. The image defect detection unit **603** detects and determines whether or not an image defect caused by removing the cassette **105** has occurred, based on the result of detection by the registration sensor **120** and the detection result from the cassette state detection unit **602**.

FIG. **7** is a flowchart of processing executed by the image defect detection unit **603**, according to the present embodiment. The image defect detection unit **603** executes the processing illustrated in FIG. **7** for each sheet S that is image forming target. When a signal indicating detection of the leading edge of the sheet S is received from the registration sensor **120**, the image defect detection unit **603** determines, at S**10**, an arrival timing at which the leading edge of the sheet S reaches the position of the transfer roller **115**, more specifically, a conveyance start position of conveying the sheet S by the transfer roller **115**. The arrival timing may be determined based on the conveyance distance of the sheet S from the detection position by the registration sensor **120** to the conveyance start position, and the conveyance speed of the sheet S. The image defect detection unit **603** waits until the leading edge of the sheet S reaches the conveyance start position, i.e., until the arrival timing.

The image defect detection unit **603** monitors, from when the arrival timing is reached at S**11**, at least until the timing when the trailing edge of the sheet S passes through the registration roller **110**, whether or not the state of the cassette **105** has transitioned to the non-attached state. In the following description, a period from the arrival timing to a timing at which the trailing edge of the sheet S passes through the registration roller **110** will be denoted as a monitoring period. The monitoring period is a period in which the sheet S is conveyed by both the transfer roller **115** and the registration roller **110**. A value M of the monitoring period is given by $M=(L-D)/Sp$, where L is the length of the sheet S in the conveyance direction, D is the conveyance distance from the registration roller **110** to the conveyance start position, and Sp is the conveyance speed of the sheet S. When M takes a negative value, M is set to M=0.

When the state of the cassette **105** has not transitioned to the non-attached state in the monitoring period, the image defect detection unit **603** determines that image defect has not occurred, and terminates the processing of FIG. **7**. When, on the other hand, the state of the cassette **105** has transitioned to the non-attached state in the monitoring period, the image defect detection unit **603** determines that an image defect has occurred. This is because the transmission of the driving force to the registration roller **110** is disconnected by the cassette **105** turning into the non-attached state, whereby the sheet S turns into a state in which the sheet S is pulled by the transfer roller **115** from the registration roller **110** that has stopped the rotation. Upon determining that an image defect has occurred, the image defect detection unit **603** determines to discharge the sheet S to the tray **124** at S**12** and subsequently form the image, which has been formed on the sheet S, again on a next sheet S. In such a case, the image defect detection unit **603** sets, for example, a reprint flag indicating to perform reprinting. When the reprint flag is set, the control unit **500** performs a reprint operation of the image determined to have image defect, after the cassette **105** has turned into the attached state. In FIG. **7**, the monitoring period is a period in which the sheet S is conveyed by both the transfer roller **115** and the registration roller **110**. However, the monitoring period may be a period including at least a period in which the sheet S is conveyed by both the transfer roller **115** and the registration roller **110**.

According to the present embodiment as has been described above, whether or not the cassette **105** has transitioned to the non-attached state is monitored in a monitoring period including the period in which the sheet S is conveyed by both the transfer roller **115** and the registration roller **110**. When the cassette **105** turns into the non-attached state in the monitoring period, an image defect caused by a change of the state of the cassette **105** may occur, as has been described above. Therefore, when the cassette **105** turns into the non-attached state in the monitoring period, it is determined that an image defect has occurred, and a reprint operation is performed. When, on the other hand, the cassette **105** has not transitioned to the non-attached state in the monitoring period or the cassette **105** has transitioned to the non-attached state during the image formation but not in the monitoring period, it is determined that the image defect caused by the change of state of the cassette **105** has not occurred. According to the present configuration, whether or not an image defect has occurred on the sheet can be appropriately determined even when the cassette is removed during image formation on a sheet.

Second Embodiment

Next, a second embodiment will be explained mainly on differences from the first embodiment. As illustrated in FIG. **8**, in general, an image is not formed over the entire region of the sheet S, and margins are provided in the leading edge side and the trailing edge side in the conveyance direction **801** of the sheet S. The shading region in FIG. **8** is a region (image forming region) of the sheet S on which an image is formed. In FIG. **8**, a margin of a length Na is provided between a leading edge **804** of the sheet S and a leading edge **805** of the image forming region. The length of the image forming region in the conveying direction, i.e., the length between the leading edge **805** and the trailing edge **807** of the image forming region is Nb.

In the first embodiment, the monitoring period is a period in which the sheet S is conveyed by both the transfer roller **115** and the registration roller **110**, or a period including this period. However, when the trailing edge **807** of the image forming region of the sheet S has passed through the transfer region, the image transferred to the sheet S is not affected even when driving of the registration roller **110** is stopped. Therefore, the monitoring period in the present embodiment may be a period from when the sheet S starts to be conveyed by the transfer roller **115** to when the trailing edge **807** of the image forming region passes through the transfer region.

The flowchart of the processing executed by the image defect detection unit **603** in the present embodiment is similar to that of FIG. **7**. Unlike the first embodiment, however, the monitoring period in the present embodiment is a period from when the leading edge **804** of the sheet S reaches the conveyance start position to when the trailing edge **807** of the image forming region passes through the transfer region. In other words, the monitoring period in the present embodiment is a period from the arrival timing to the timing at which transfer of the image to the sheet S is

completed. When, for example, the length from the leading edge **804** of the sheet S to the trailing edge **807** of the image forming region is Na+Nb, as illustrated in FIG. **8**, the value M of the monitoring period is calculated as M=(Na+Nb)/Sp. Here, the difference between the position at the most downstream side of the transfer region in the conveyance direction and the conveyance start position is small, and therefore in the aforementioned equation, the position at the most downstream side of the transfer region in the conveyance direction is approximated as the conveyance start position. Here, in the present embodiment, the monitoring period may be set to a period including at least a period from when the leading edge **804** of the sheet S reaches the conveyance start position to when the trailing edge **807** of the image forming region passes through the transfer region.

According to the present embodiment as has been described above, whether or not the cassette **105** has transitioned to the non-attached state is monitored in the monitoring period including at least a period from when conveyance of the sheet S by the transfer roller **115** starts to when transfer of an image to the sheet S is completed. When the cassette **105** turns into the non-attached state in the monitoring period, an image defect caused by the state change of the cassette **105** may occur. Therefore, when the cassette **105** turns into the non-attached state in the monitoring period, it is determined that an image defect has occurred, and a reprint operation is performed. When, on the other hand, the cassette **105** has not transitioned to the non-attached state in the monitoring period or the cassette **105** has transitioned to the non-attached state during the image formation but not in the monitoring period, it is determined that the image defect caused by the change of state of the cassette **105** has not occurred. The present configuration allows for appropriately determining whether or not an image defect has occurred on the sheet even when the cassette is removed during image formation on a sheet.

Third Embodiment

Next, a third embodiment will be described focusing on differences from the first and second embodiments. In the first and second embodiments, the image defect detection unit **603** determines the monitoring period, i.e., the arrival timing, the timing at which the trailing edge of the sheet S passes through the registration roller **110**, and the timing when the trailing edge **807** of the image forming region passes through the transfer region, based on the result of detection by the registration sensor **120** and the conveyance speed of the sheet S. In the present embodiment, a rotation amount of the registration roller **110** is used instead of the conveyance speed of the sheet S.

FIG. **9** is a configuration diagram of the vicinity of the registration roller **110**. An encoder **1101** is rotationally driven together with the registration roller **110**. A plurality of slits **1102** are provided in the encoder **1101**. An encoder sensor **1103** detects each of the slits **1102** in the encoder **1101**. As illustrated in FIG. **10**, the encoder sensor **1103** notifies the image defect detection unit **603** of a detection signal indicating whether or not each of the slits **1102** of the encoder **1101** is detected.

The image defect detection unit **603** determines the rotation amount of the registration roller **110**, based on the detection signal from the encoder sensor **1103**. Furthermore, the image defect detection unit **603** determines the conveyance distance (conveyance amount) of the sheet S, based on the rotation amount of the registration roller **110**. The relation between the rotation amount of the registration roller **110** and the conveyance amount of the sheet S is preliminarily set in the image defect detection unit **603**. The image defect detection unit **603** determines the arrival timing, the timing at which the trailing edge of the sheet S passes through the registration roller **110**, and the timing at which the trailing edge **807** of the image forming region passes through the transfer region, based on the conveyance distance of the sheet S.

Other Embodiments

Embodiment(s) of the present invention can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions (e.g., one or more programs) recorded on a storage medium (which may also be referred to more fully as a 'non-transitory computer-readable storage medium') to perform the functions of one or more of the above-described embodiment(s) and/or that includes one or more circuits (e.g., application specific integrated circuit (ASIC)) for performing the functions of one or more of the above-described embodiment(s), and by a method performed by the computer of the system or apparatus by, for example, reading out and executing the computer executable instructions from the storage medium to perform the functions of one or more of the above-described embodiment(s) and/or controlling the one or more circuits to perform the functions of one or more of the above-described embodiment(s). The computer may comprise one or more processors (e.g., central processing unit (CPU), micro processing unit (MPU)) and may include a network of separate computers or separate processors to read out and execute the computer executable instructions. The computer executable instructions may be provided to the computer, for example, from a network or the storage medium. The storage medium may include, for example, one or more of a hard disk, a random-access memory (RAM), a read only memory (ROM), a storage of distributed computing systems, an optical disk (such as a compact disc (CD), digital versatile disc (DVD), or Blu-ray Disc (BD)™), a flash memory device, a memory card, and the like.

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. 2023-064390, filed Apr. 11, 2023, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An image forming apparatus comprising:

a first detection unit configured to detect whether a cassette accommodating a sheet is in an attached state in which the cassette is attached to a main body of the image forming apparatus, or in a non-attached state in which the cassette is not attached to the main body;

a transfer roller configured to transfer an image to the sheet in a transfer region;

a conveyance roller configured to convey, to the transfer region, a first sheet that is fed from the cassette to a conveyance path;

a drive unit configured to transmit a driving force of a motor to the conveyance roller in the attached state, and not to transmit the driving force of the motor to the conveyance roller in the non-attached state; and

a determination unit configured to determine that an image defect has occurred in forming a first image on

the first sheet when the first detection unit detects that a state of the cassette has transitioned from the attached state to the non-attached state, in a monitoring period including a period from a first timing at which the first sheet starts to be conveyed by the transfer roller, to a second timing.

2. The image forming apparatus according to claim **1**, further comprising a second detection unit configured to detect whether or not the sheet exists at a detection position on an upstream side from the transfer region in a conveyance direction of the sheet, wherein

the determination unit determines the first timing and the second timing, based on a timing at which the second detection unit detects the first sheet.

3. The image forming apparatus according to claim **2**, wherein the determination unit determines the first timing and the second timing, based on a timing at which the second detection unit detects a leading edge of the first sheet, and a conveyance speed of the first sheet.

4. The image forming apparatus according to claim **2** further comprising a third detection unit configured to detect a rotation amount of the conveyance roller, wherein

the determination unit determines the first timing and the second timing, based on a timing at which the second detection unit detects a leading edge of the first sheet, and a conveyance amount of the first sheet determined based on the rotation amount of the conveyance roller.

5. The image forming apparatus according to claim **1**, wherein the monitoring period includes a period in which the first sheet is conveyed by both the transfer roller and the conveyance roller.

6. The image forming apparatus according to claim **1**, wherein the monitoring period includes a period in which the first image is transferred to the first sheet by the transfer roller.

7. The image forming apparatus according to claim **1**, wherein the second timing is a timing at which a trailing edge of the first sheet in the conveyance direction of the sheet passed through the conveyance roller.

8. The image forming apparatus according to claim **1**, wherein the second timing is a timing at which transfer of the first image to the first sheet is completed.

9. The image forming apparatus according to claim **1**, wherein the second timing is a timing at which a trailing edge of an image forming region in the conveyance direction of the sheet passes through the transfer region, the image forming region is a region in which the first image is formed on the first sheet.

10. The image forming apparatus according to claim **1**, further comprising a control unit configured to perform control, when the determination unit has determined that the image defect has occurred in forming the first image on the first sheet, to form the first image on the sheet accommodated in the cassette after the cassette transitions from the non-attached state to the attached state.

11. The image forming apparatus according to claim **1**, wherein the drive unit includes a mechanical clutch that operates in conjunction with the state of the cassette.

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