US012393140B2

(12) **United States Patent**
Hayakawa

(10) **Patent No.: US 12,393,140 B2**
(45) **Date of Patent: Aug. 19, 2025**

(54) **IMAGE FORMING APPARATUS AND STORAGE MEDIUM**

(71) Applicant: **Konica Minolta, Inc.**, Tokyo (JP)

(72) Inventor: **Tomoyuki Hayakawa**, Akishima (JP)

(73) Assignee: **KONICA MINOLTA, INC.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **18/667,071**

(22) Filed: **May 17, 2024**

(65) **Prior Publication Data**

US 2024/0393718 A1 Nov. 28, 2024

(30) **Foreign Application Priority Data**

May 24, 2023 (JP) 2023-085294

(51) **Int. Cl.**
G03G 15/16 (2006.01)
G03G 15/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/1675*** (2013.01); ***G03G 15/50*** (2013.01); ***G03G 15/55*** (2013.01); ***G03G 15/6529*** (2013.01); *G03G 2215/0008* (2013.01); *G03G 2215/00455* (2013.01); *G03G 2215/00599* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/164; G03G 15/6517; G03G 15/652; G03G 15/6523; G03G 15/6526; G03G 15/1665; G03G 15/167; G03G 15/1675; G03G 15/50; G03G 15/55; G03G 2215/00455; G03G 2215/00459; G03G 2215/00556; G03G 2215/00599; G03G 2215/00603; G03G 2215/0008
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2013/0266332 A1* 10/2013 Miyazaki G03G 15/0189 399/66
2016/0299463 A1* 10/2016 Furukawa G03G 15/6529
(Continued)

FOREIGN PATENT DOCUMENTS

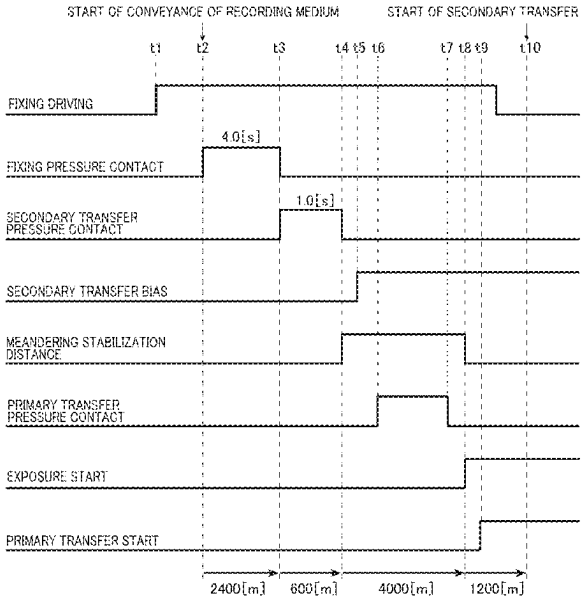
JP 2016109699 A 6/2016
JP 2016198971 A 12/2016

Primary Examiner — Carla J Therrien
(74) *Attorney, Agent, or Firm* — CANTOR COLBURN LLP

(57) **ABSTRACT**

Disclosed is an image forming apparatus including: an image former that includes an intermediate transferer, and a secondary transferer to which a transfer bias for secondarily transferring the toner image on the intermediate transferer to a continuous recording medium is applied; a conveyor that is arranged on a downstream side of the image former and conveys the continuous recording medium; and a hardware processor that controls a speed of the intermediate transferer and a speed of the continuous recording medium conveyed by the conveyor. The hardware processor controls a timing at which the transfer bias is applied to the secondary transferer, performs control such that the speed of the continuous recording medium is higher than the speed of the intermediate transferer, and starts application of the transfer bias after the secondary transferer is pressed against the intermediate transferer and before the primary transfer is started.

10 Claims, 4 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2016/0370740	A1*	12/2016	Kobayashi	G03G 15/505
2018/0088495	A1*	3/2018	Watanabe	G03G 15/161
2020/0272082	A1*	8/2020	Matsuo	G03G 15/50

* cited by examiner

FIG. 1

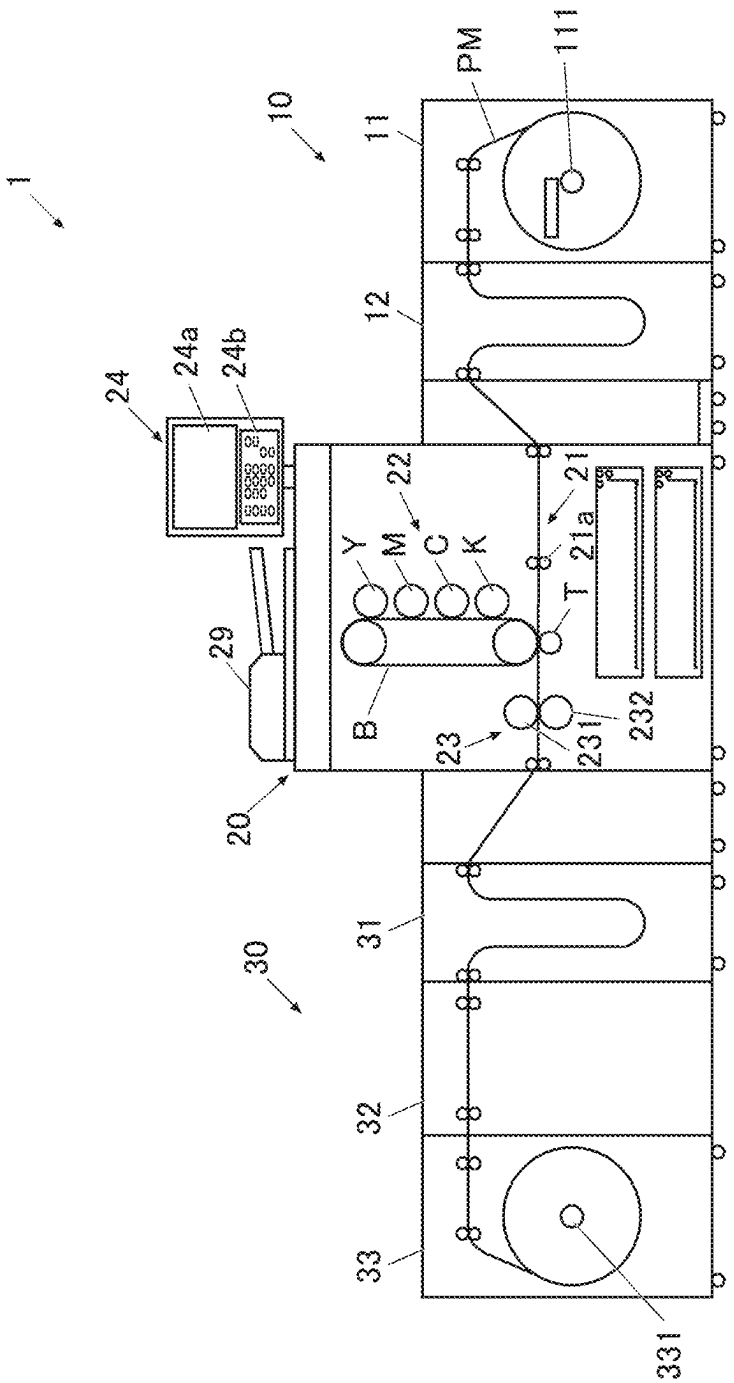

1
10
11
PM
111
12
24
24a
24b
22
21
21a
Y
M
C
K
T
29
B
23
231
232
20
30
31
32
33
331

FIG. 2

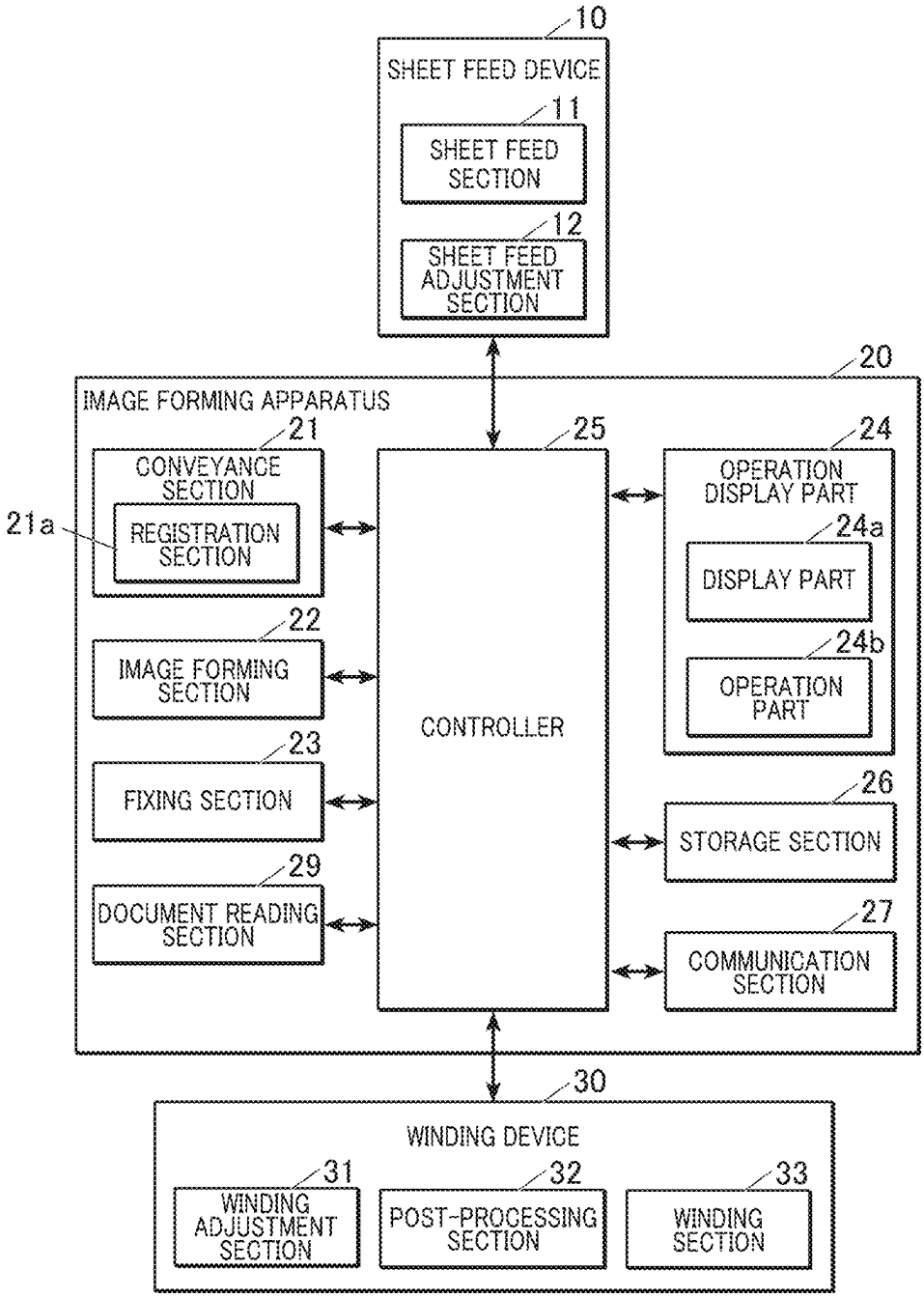

10
SHEET FEED DEVICE
11
SHEET FEED SECTION
12
SHEET FEED ADJUSTMENT SECTION
20
IMAGE FORMING APPARATUS
21
CONVEYANCE SECTION
21a
REGISTRATION SECTION
22
IMAGE FORMING SECTION
23
FIXING SECTION
29
DOCUMENT READING SECTION
25
CONTROLLER
24
OPERATION DISPLAY PART
24a
DISPLAY PART
24b
OPERATION PART
26
STORAGE SECTION
27
COMMUNICATION SECTION
30
WINDING DEVICE
31
WINDING ADJUSTMENT SECTION
32
POST-PROCESSING SECTION
33
WINDING SECTION

FIG. 3

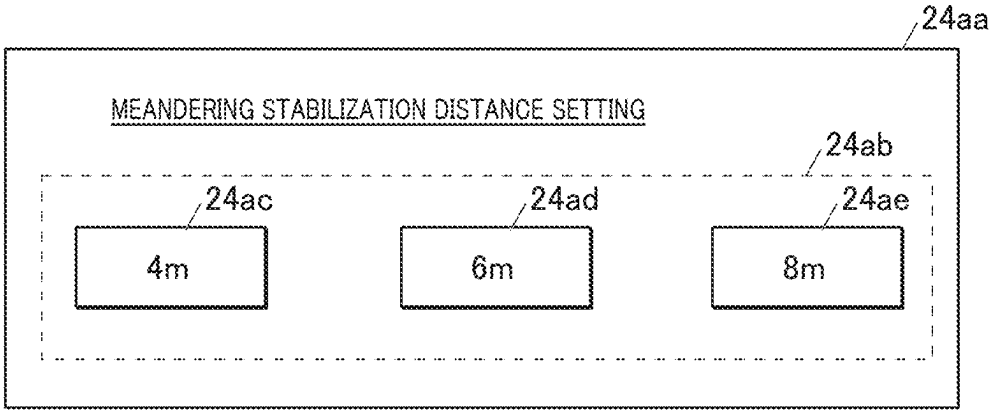

24aa
MEANDERING STABILIZATION DISTANCE SETTING
24ab
24ac
24ad
24ae
4m
6m
8m

FIG. 4

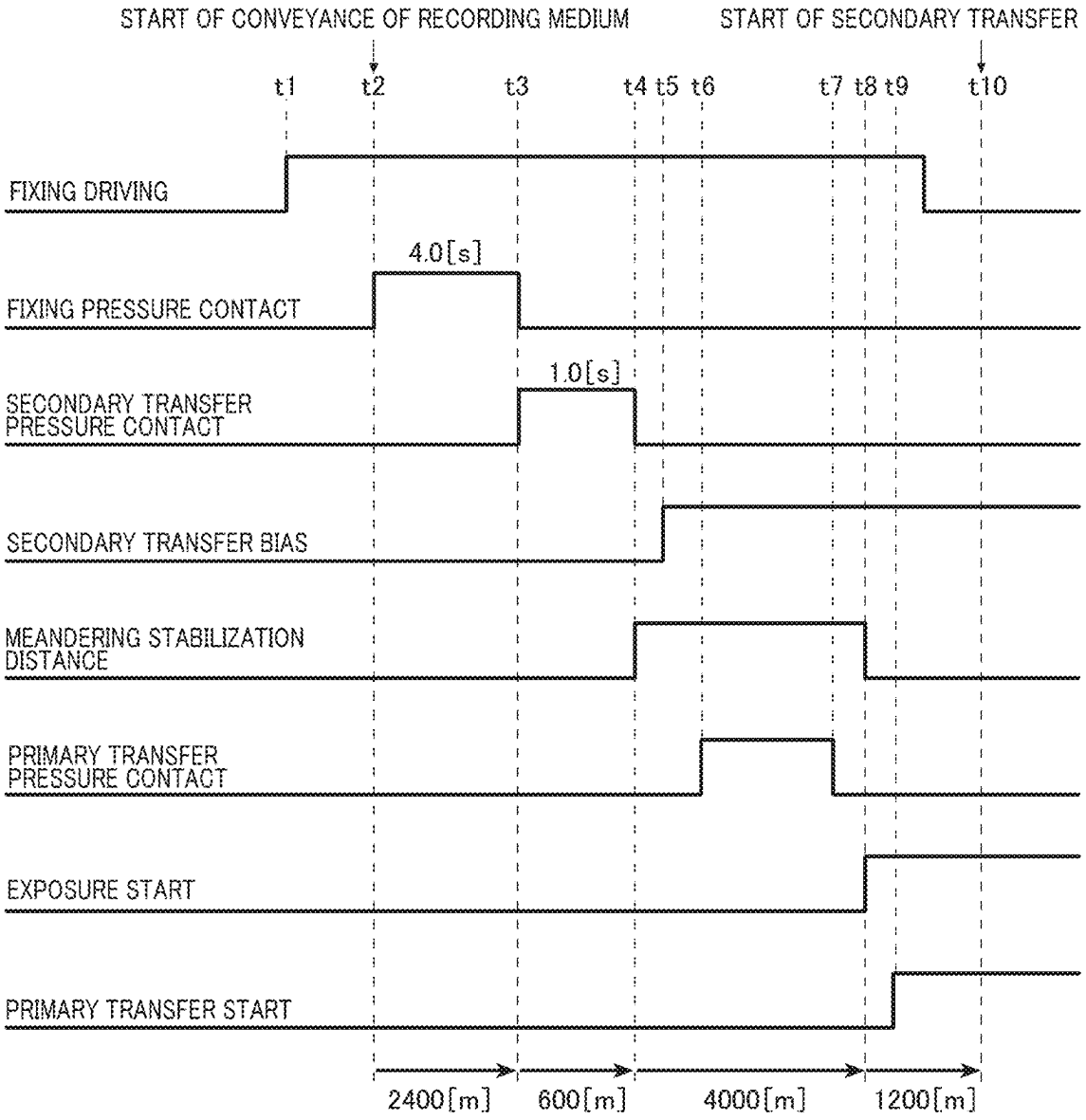


FIG. 5

SECONDARY TRANSFER BIAS ON TIMING	PAPER TYPE			ENVIRONMENT	COVERAGE
	STIFFNESS	FRICTION COEFFICIENT	RESISTANCE VALUE		
EARLIER	HIGH	HIGH	HIGH	LOW TEMPERATURE AND LOW HUMIDITY	LOW
LATER	LOW	LOW	LOW	HIGH TEMPERATURE AND HIGH HUMIDITY	HIGH

IMAGE FORMING APPARATUS AND STORAGE MEDIUM

CROSS REFERENCE TO RELATED APPLICATIONS

The present invention claims priority under 35 U.S.C. § 119 to Japanese Application No. 2023-085294, filed May 24, 2023, the entire contents of which being incorporated herein by reference.

BACKGROUND OF THE INVENTION

Technical Field

The present invention relates to an image forming apparatus and a storage medium.

Description of Related Art

Conventionally, there has been known an image forming apparatus that performs control for suppressing color misregistration, image defect, paper wrinkle, and the like generated in forming an image on continuous paper.

In this regard, the following image forming apparatus is described in Japanese Unexamined Patent Publication No. 2016-198971. Specifically, the apparatus can perform control to start image formation after the meandering of the continuous paper is stabilized after the start of conveyance of the continuous paper. That is, the apparatus can change the run-up distance until the meandering of the continuous sheet is stabilized after the start of the conveyance of the continuous paper.

The following image forming apparatus is described in Japanese Unexamined Patent Publication No. 2016-109699. Specifically, the apparatus suppresses color misregistration by controlling the number of rotations of the fixing roller based on a speed difference between a speed of the intermediate transfer belt and a conveyance speed of a sheet conveyed to the fixing roller. The apparatus performs control such that a fixing speed is faster than a transfer speed.

SUMMARY OF THE INVENTION

The image forming apparatus applies a bias voltage to the transfer roller when the toner image is secondarily transferred to the sheet. An attraction force between the sheet and the intermediate transfer belt changes before and after the bias voltage is applied to the transfer roller.

A case where meandering of the sheet is suppressed by making the fixing speed higher than the transfer speed as in the conventional technology will be described. In this case, when the attraction force between the sheet and the intermediate transfer belt changes as described above, the load applied to the intermediate transfer belt changes. When the load applied to the intermediate transfer belt changes, the speed of the intermediate transfer belt changes, and color misregistration may occur.

When the speed of the intermediate transfer belt changes, the tension applied to the sheet between the transfer section and the fixing section becomes unstable, resulting in unstable conveyance of the sheet. Thus, when the sheet enters the fixing section, paper wrinkles may occur. In a case where the conveyance of the sheet becomes unstable, the sheet to be conveyed undulates and the sheet contacts a belt of the fixing section before the toner image is fixed, so that an image defect generates in some cases.

As described above, in the related art, there is a possibility that the problems of the occurrence of the color misregistration, the image defect, the paper wrinkle, and the like cannot be sufficiently suppressed.

An object of the present invention is to provide an image forming apparatus and a storage medium capable of further suppressing occurrence of color misregistration, image defect, and paper wrinkling in an image forming operation on a continuous recording medium.

To achieve at least one of the abovementioned objects, according to an aspect of the present invention, an image forming apparatus reflecting one aspect of the present invention includes: an image forming apparatus including: an image former that includes an intermediate transferer to which a toner image is primarily transferred to perform primary transfer, and a secondary transferer to which a transfer bias for secondarily transferring the toner image on the intermediate transferer to a continuous recording medium is applied; a conveyor that is arranged on a downstream side of the image former in a conveyance direction of the continuous recording medium and conveys the continuous recording medium; and a hardware processor that controls a speed of the intermediate transferer and a speed of the continuous recording medium conveyed by the conveyor, wherein the hardware processor controls a timing at which the transfer bias is applied to the secondary transferer, performs control such that the speed of the continuous recording medium conveyed by the conveyor is higher than the speed of the intermediate transferer, and starts application of the transfer bias to the secondary transferer after the secondary transferer is pressed against the intermediate transferer and before the primary transfer is started.

To achieve at least one of the abovementioned objects, according to an aspect of the present invention, a storage medium reflecting one aspect of the present invention is a non-transitory storage medium storing a computer readable program for a computer in an image forming apparatus including: an image former that includes an intermediate transferer to which a toner image is primarily transferred to perform primary transfer, and a secondary transferer to which a transfer bias for secondarily transferring the toner image on the intermediate transferer to a continuous recording medium is applied; and a conveyor that is arranged on a downstream side of the image former in a conveyance direction of the continuous recording medium and conveys the continuous recording medium, the program causing the computer to perform controlling that is controlling a speed of the intermediate transferer and a speed of the continuous recording medium conveyed by the conveyor, wherein the program causes the computer to control a timing at which the transfer bias is applied to the secondary transferer, perform control such that the speed of the continuous recording medium conveyed by the conveyor is higher than the speed of the intermediate transferer, and start application of the transfer bias to the secondary transferer after the secondary transferer is pressed against the intermediate transferer and before the primary transfer is started.

BRIEF DESCRIPTION OF THE DRAWINGS

The advantages and features provided by one or more embodiments of the invention will become more fully understood from the detailed description given hereinbelow and the appended drawings which are given by way of illustration only, and thus are not intended as a definition of the limits of the present invention, wherein:

FIG. **1** is a diagram illustrating an example of a schematic configuration of an image forming system in the present invention,

FIG. **2** is a functional block diagram illustrating a control configuration of the image forming system in the present invention,

FIG. **3** is a diagram illustrating an example of a setting screen of a meandering stabilization distance,

FIG. **4** is a timing chart when image formation is started; and

FIG. **5** is a diagram illustrating a timing at which the application of the secondary transfer bias is started.

DETAILED DESCRIPTION

Hereinafter, one or more embodiments of the present invention will be described with reference to the drawings. However, the scope of the invention is not limited to the disclosed embodiments.

Structure of an image forming system according to the present embodiment is described below.

(1. Configuration of Image Forming System)

FIG. **1** is a diagram illustrating an example of a schematic configuration of an image forming system **1**. FIG. **2** is a functional block diagram illustrating a control configuration of the image forming system **1**.

The image forming system **1** is a system that uses a recording medium PM (continuous recording medium), which is continuous paper such as roll paper or a continuous film, and forms an image on the recording medium PM.

As shown in FIG. **1**, the image forming system **1** includes a sheet feed device **10**, an image forming apparatus **20**, and a winding device **30** from an upstream side along a conveyance direction of a recording medium PM.

(1-1. Configuration of Sheet Feed Device)

The sheet feed device **10** feeds the recording medium PM to the image forming apparatus **20**.

The sheet feed device **10** includes a sheet feed section **11** and a sheet feed adjustment section **12**.

In the housing of the sheet feed section **11**, for example, as illustrated in FIG. **1**, the sheet feed section **11** holds a recording medium PM in the form of a roll such that the recording medium PM can be rolled around a support shaft **111**. The sheet feed section **11** conveys the recording medium PM wound around the support shaft **111** to the sheet feed adjustment section **12** at a constant speed via a plurality of rollers. The plurality of rollers are, for example, a delivery roller, a paper feed roller, and the like.

Although only one recording medium PM is illustrated in FIG. **1**, the sheet feed section **11** may hold a plurality of consecutive recording media.

The sheet feed adjustment section **12** is located downstream of the sheet feed section **11** and upstream of the image forming apparatus **20** in the conveyance direction of the recording medium PM.

The sheet feed adjustment section **12** conveys the recording medium PM conveyed from the sheet feed section **11** to the image forming apparatus **20**. The sheet feed adjustment section **12** absorbs a speed difference between a conveyance speed of the recording medium PM in the sheet feed section **11** and a conveyance speed of the recording medium PM in the image forming apparatus **20**. Specifically, the sheet feed adjustment section **12** holds the recording medium PM in a slack state as illustrated in FIG. **1**, and adjusts the feeding of the recording medium PM to the image forming apparatus **20**.

(1-2. Configuration of Image Forming Apparatus)

The image forming apparatus **20** forms an image on the recording medium PM. The image forming apparatus **20** is positioned on the downstream side of the sheet feed adjustment section **12** and on the upstream side of the winding device **30** in the conveyance direction of the recording medium PM.

As illustrated in FIG. **2**, the image forming apparatus **20** includes a conveyance section **21**, an image forming section **22** (image former), a fixing section **23** serving as a conveyor, an operation display part **24**, a controller **25** (i.e., hardware processor), a storage section **26**, a communication section **27**, and an document reading section **29**.

The conveyance section **21** is a conveyance mechanism for the recording medium PM inside the image forming apparatus **20**. The conveyance section **21** conveys, for example, with a plurality of rollers, the recording medium PM conveyed from the sheet feed adjustment section **12** to the image forming section **22** and the fixing section **23** in this order, and ejects the recording medium PM.

As illustrated in FIG. **1**, the conveyance section **21** includes a registration section **21***a* located on the upstream side of the image forming section **22**.

The registration section **21***a* includes registration rollers and conveys the recording medium PM to the transfer section. The transfer section is a nip portion formed by an intermediate transfer belt B and a transfer roller T, which will be described later.

The registration section **21***a* corrects the inclination of the recording medium PM conveyed from the sheet feed device **10** and adjusts the conveyance timing of the recording medium PM.

The image forming section **22** forms a toner image by electrophotography and transfers the toner image onto the recording medium PM.

As illustrated in FIG. **1**, the image forming section **22** includes photosensitive drums (Y, M, C, and K) as image bearers, an intermediate transfer belt B as an intermediate transferer, and a transfer roller T as a secondary transferer.

The intermediate transfer belt B is an endless belt. The image forming section **22** winds the intermediate transfer belt B around a plurality of rollers and supports it so that it can run.

The transfer roller T is pressed by the intermediate transfer belt B and is driven to rotate.

The image forming section **22** uniformly charges the photosensitive drums (Y, M, C, and K). Thereafter, the image forming section **22** scans and exposes the photosensitive drum with a laser beam on the basis of image data for each color to form an electrostatic latent image on the photosensitive drum. Next, the image forming section **22** causes toner of each color to adhere to the electrostatic latent image on the photosensitive drum to form a toner image of each color, and sequentially transfers the toner image onto the intermediate transfer belt B (primary transfer). As a result, the image forming section **22** forms a toner image (color image) in which layers of the respective colors (Y, M, C, and K) are superimposed on the intermediate transfer belt B. Next, the image forming section **22** applies a bias (transfer bias) having a polarity opposite to that of the toner to the transfer roller T. Thus, the image forming section **22** transfers the toner images formed on the intermediate transfer belt B onto the recording medium PM (secondary transfer).

The fixing section **23** fixes the toner image secondarily transferred onto the recording medium PM.

As illustrated in FIG. **1**, the fixing section **23** includes a pair of rollers, namely, a heating roller **231** and a pressure roller **232**, for pinching the recording medium PM therebetween.

The fixing section **23** heats the heating roller **231** to a predetermined temperature by a heater as a heat source.

The fixing section **23** urges the pressure roller **232** toward the heating roller **231** by an unillustrated elastic member.

The fixing section **23** applies heat and pressure to the recording medium PM by passing the recording medium PM, onto which the toner image has been transferred, through a nip part between the heating roller **231** and the pressure roller **232**, to thereby fuse and fix the toner image onto the recording medium PM.

The operation display part **24** includes a display part **24***a* and an operation part **24***b*.

The display part **24***a* includes a display screen and displays various kinds of information on the screen.

The operation part **24***b* is used for input of various instructions by a user.

The controller **25** includes, for example, a central processing unit (CPU), a random access memory (RAM), and the like. The CPU of the controller **25** reads various programs such as a system program and a processing program stored in the storage section **26**, and loads the programs to the RAM. The CPU of the controller **25** executes various processes in accordance with the expanded program.

For example, the controller **25** controls the communication section **27** to receive a job, image data, and the like transmitted from an external apparatus. The controller **25** controls the image forming section **22** so as to form an image on the recording medium PM based on the received job, image data, and the like.

The storage section **26** includes, for example, a hard disk drive (HDD) and a semiconductor nonvolatile memory.

The storage section **26** stores various programs such as a system program and a processing program to be executed by the controller **25** and data necessary for executing these programs.

The communication section **27** includes a communication control card such as a LAN card. The communication section **27** transmits and receives various types of data to and from an external device connected to a communication network such as a local area network (LAN) or a wide area network (WAN).

The document reading section **29** includes an automatic document feeder (ADF) and an image reading section such as a charge coupled device (CCD).

The document reading section **29** reads an image of a document based on setting information accepted by the operation part **24***b* and generates image date representing the read image. Specifically, the document reading section **29** conveys a document placed on a document tray of the ADF to an exposure glass that is a reading position. Alternatively, the user places the document on the platen glass. Next, the document reading section **29** reads an image on one side or both sides of the document by the image reading section and generates image data thereof.

In the present embodiment, as shown in FIG. **2**, the controller **25** integrally controls the entire image forming system **1**, but the present invention is not limited thereto. Each of the sheet feed device **10** and the winding device **30** may include a controller.

The image forming apparatus **20** may be a multi-function peripheral (MFP) having, in addition to an image forming function, a copy function, a scan function, a facsimile function, and the like.

(1-3. Configuration of Winding Device)

The winding device **30** is positioned on the downstream side of the image forming apparatus **20** in the conveyance direction of the recording medium PM.

The winding device **30** includes a winding adjustment section **31**, a post-processing section **32**, and a winding section **33**.

The winding adjustment section **31** is located downstream of the image forming apparatus **20** and upstream of the post-processing section **32** in the conveyance direction of the recording medium PM.

The winding adjustment section **31** conveys the recording medium PM conveyed from the image forming apparatus **20** to the post-processing section **32**. The winding adjustment section **31** absorbs a speed difference between a conveyance speed of the recording medium PM in the image forming apparatus **20** and a conveyance speed of the recording medium PM in the post-processing section **32**. Specifically, the winding adjustment section **31** sags and holds the recording medium PM as illustrated in FIG. **1** and adjusts the ejection of the recording medium PM from the image forming apparatus **20**.

The post-processing section **32** is located downstream of the winding adjustment section **31** and upstream of the winding section **33** in the conveyance direction of the recording medium PM.

The post-processing section **32** performs post-processing on the recording medium PM conveyed from the winding adjustment section **31**. The post-processing is, for example, cutting, crease processing, perforation processing, creasing, foil stamping, varnish processing, various kinds of bookbinding, curl correction processing, or the like.

In the housing of the winding section **33**, for example, as illustrated in FIG. **1**, the winding section **33** holds the recording medium PM in a roll shape by winding the recording medium PM around a support shaft **331**. The winding section **33** winds the recording medium PM conveyed from the post-processing section **32** around the support shaft **331** at a constant speed via a plurality of rollers. The plurality of rollers are, for example, a pickup roller and a sheet ejection roller.

(2. Operation of Image Forming System)

Next, the operation of the image forming system **1** in the present embodiment will be described.

(2-1. Operation of Applying Tension to Recording Medium)

The image forming apparatus **20** that forms an image by an electrophotographic method performs the following control when conveying the recording medium PM that is a continuous recording medium. Specifically, the tension control is control for applying tension to the recording medium PM in order to perform stable conveyance without a jam by suppressing deviation, meandering, and the like of the recording medium PM.

The controller **25** applies tension to the recording medium PM by performing control such that the more downstream a unit is provided in the conveyance direction of the recording medium PM, the faster the speed of the unit is. To be more specific, controller **25** performs control such that the conveyance speed of recording medium PM by fixing section **23**, the speed of intermediate transfer belt B, and the speed of recording medium PM by registration section **21***a* gets higher in this order.

That is, controller **25** controls the speed of intermediate transfer belt B (an intermediate transferer) and the speed of recording medium PM (a continuous recording medium) conveyed by fixing section **23** (a conveyor). The controller **25** functions as a first controller.

Controller **25** serving as the first controller performs control such that the speed of recording medium PM (continuous recording medium) conveyed to fixing section **23** (conveyor) is higher than the speed of intermediate transfer belt B (intermediate transferer).

(2-2. Operation of Setting Meandering Stabilization Distance)

In the image forming system **1**, the conveyance of the recording medium PM may not be stable immediately after the start of the conveyance of the recording medium PM, and the recording medium PM may meander. When an image is formed while the recording medium PM is meandering, the quality of the image deteriorates. If the cutting process is performed by the post-processing section **32** while the recording medium PM is meandering, the cutting position is shifted from the original position.

Therefore, when the recording medium PM is used as the target sheet of the print job, the controller **25** conveys the recording medium PM by a predetermined distance before image formation in order to keep the meandering of the recording medium PM within a predetermined allowable range. The predetermined distance is a meandering stabilization distance. Thereafter, the controller **25** starts image formation after the meandering of the recording medium PM falls within a predetermined allowable range and the conveyance of the recording medium PM is stabilized.

Before executing a print job, the controller **25** receives a setting operation of the meandering stabilization distance by the user via the operation part **24***b*.

To be specific, the controller **25** allows the display part **24***a* to display a screen **24***aa* for setting meandering stabilization distances illustrated in FIG. **3**.

The controller **25** displays a distance-setting button **24***ab* on the setting screen **24***aa*.

The distance-setting buttons **24***ab* include a "4 m" button **24***ac*, a "6 m" button **24***ad*, and an "8 m" button **24***ae*. The user can select only one of the "4 m" button **24***ac*, the "6 m" button **24***ad*, and the "8 m" button **24***ae*.

The distance-setting button **24***ab* is a button for setting a distance for conveying the recording medium PM to suppress meandering after the image forming system **1** becomes ready for printing. The controller **25** executes the print job after conveying the recording medium PM by the distance.

The meandering stabilization distance set by the distance-setting button **24***ab* is not limited to the example illustrated in FIG. **3**.

(2-3. Operation at the Start of Image Formation)

FIG. **4** is a time chart when image formation is started in the image forming system **1**.

At a timing t**1**, the controller **25** controls the fixing section **23** to start driving the fixing section **23**.

At timing t**2**, controller **25** controls fixing section **23** to start pressure contact (fixing pressure contact) between heating roller **231** and pressure roller **232**.

At timing t**2**, the controller **25** controls the sheet feed device **10** to start conveying the recording medium PM.

At timing t**3**, the controller **25** controls the fixing section **23** to complete the crimping of the heating roller **231** and the pressure roller **232**.

At timing t**3**, the controller **25** controls the image forming section **22** to start pressure contact of the transfer roller T with the intermediate transfer belt B (secondary transfer pressure contact).

The timings t**2** to t**3** are, for example, 4.0 sec. The conveyance distance of the recording medium PM between the timings t**2** and t**3** is, for example, 2400 mm.

At timing t**4**, the controller **25** controls the image forming section **22** to complete the pressure-contact of the transfer roller T with the intermediate transfer belt B.

At the timing t**4**, the controller **25** controls the conveyance section **21** to start conveying the recording medium PM by the meandering stabilization distance.

The timings t**3** to t**4** are, for example, 1.0 sec. The conveyance distance of the recording medium PM between the timings t**3** and t**4** is, for example, 600 mm.

At timing t**5**, the controller **25** controls the image forming section **22** to start applying a bias (secondary transfer bias) to the transfer roller T.

At timing t**6**, the controller **25** controls the image forming section **22** to start pressure contact (primary transfer pressure contact) of the photosensitive drums (Y, M, C, and K) to the intermediate transfer belt B.

At timing t**7**, the controller **25** controls the image forming section **22** to complete the pressure contact (primary transfer pressure contact) of the photosensitive drums (Y, M, C, and K) to the intermediate transfer belt B.

At the timing t**8**, the controller **25** controls the conveyance section **21** to complete the conveyance of the recording medium PM by the meandering stabilization distance.

At timing t**8**, the controller **25** controls the image forming section **22** to start scanning exposure of the photosensitive drum Y with a laser beam.

The conveyance distance of the recording medium PM between timings t**4** and t**8** is, for example, 4000 mm.

At timing t**9**, the controller **25** controls the image forming section **22** to start the transfer (primary transfer) of the toner image from the photosensitive drum Y to the intermediate transfer belt B.

At timing t**10**, the controller **25** controls the image forming section **22** to start transfer (secondary transfer) of the toner image from the intermediate transfer belt B to the recording medium PM.

The conveyance distance of the recording medium PM between the timings t**8** and t**10** is, for example, 1200 mm.

As described above, the controller **25** controls the timing at which the secondary transfer bias (transfer bias) is applied to the transfer roller T (secondary transferer). The controller **25** functions as a second controller.

Between timings t**4** and t**9**, the controller **25** starts applying a bias (transfer bias) to the transfer roller T. That is, the controller **25** as the second controller starts application of the secondary transfer bias (transfer bias) to the transfer roller T after the transfer roller T (secondary transferer) is pressed against the intermediate transfer belt B (intermediate transferer) (after completion of the secondary transfer pressure contact) and before the primary transfer is started.

The controller **25** starts applying a bias (transfer bias) to the transfer roller T between timings t**4** and t**8**. That is, the controller **25** as the second controller starts application of the secondary transfer bias (transfer bias) to the transfer roller T after the transfer roller T (secondary transferer) is pressed against the intermediate transfer belt B (intermediate transferer) (after completion of the secondary transfer pressure contact) and before exposure of the photosensitive drum (image bearer) by the image forming section **22** is started.

When the secondary transfer bias is applied to the transfer roller T, the speed of the intermediate transfer belt B changes, and the tension to be applied to the recording medium PM becomes unstable.

However, as described above, by starting the application of the secondary transfer bias to the transfer roller T before

the primary transfer is started or before the exposure of the photosensitive drum is started, the following effect is obtained.

Specifically, the image forming apparatus **20** can perform the primary transfer and the secondary transfer after the elapse of a predetermined time from the start of the application of the secondary transfer bias to the transfer roller T by the image forming apparatus **20**. The state after the predetermined time has elapsed is a state in which the speed of the intermediate transfer belt B is stable. Thus, color misregistration and image defect can be suppressed in the image forming operation on the recording medium PM that is a continuous recording medium.

The image forming apparatus **20** can perform the secondary transfer in a state where the conveyance speed of the recording medium PM and the tension to be applied to the recording medium PM are stable. Accordingly, it is possible to suppress the image defect by suppressing the paper wrinkle and the waving of the recording medium PM which is the continuous recording medium.

The controller **25** starts applying a bias (transfer bias) to the transfer roller T between timings t**4** and t**8**. That is, after starting conveyance of the recording medium PM (continuous recording medium) and before starting printing, the controller **25** as the second controller starts application of the secondary transfer bias (transfer bias) to the transfer roller T (secondary transferer) while the recording medium PM (continuous recording medium) is being conveyed by the meandering stabilization distance (predetermined distance).

The recording medium PM conveyed during the conveyance of the recording medium PM by the meandering stabilization distance becomes waste sheet. The recording medium PM conveyed while the speed of the intermediate transfer belt B, the conveyance speed of the recording medium PM, and the tension applied to the recording medium PM are stabilized becomes waste sheet.

However, as described above, the following effects can be obtained by starting the application of the secondary transfer bias to the transfer roller T while the recording medium PM is being conveyed by the meandering stabilization distance. Specifically, it is possible to reduce waste sheet that occurs before the start of printing.

It is preferable that the timings t**4** to t**5** are within 1.0 sec.

That is, the controller **25** as the second controller starts to apply the secondary transfer bias (transfer bias) to the transfer roller T immediately after the transfer roller T (secondary transferer) is pressed against the intermediate transfer belt B (intermediate transferer) (immediately after the completion of the secondary transfer pressure contact).

Thus, the image forming apparatus **20** can secure the longest time for stabilizing the speed of the intermediate transfer belt B, the conveyance speed of the recording medium PM, and the tension to be applied to the recording medium PM. Therefore, it is possible to further stabilize the speed of the intermediate transfer belt B, the conveyance speed of the recording medium PM, and the tension applied to the recording medium PM. Therefore, it is possible to further reduce waste sheet generated due to image defect.

The controller **25** applies a bias of the voltage 1000 V to the transfer roller T at the start of application of the bias to the transfer roller T (timing t**5**). Thereafter, the controller **25** gradually increases the voltage of the bias applied to the transfer roller T to 2000 V by timing t**9**.

The voltage value of the bias to be applied to the transfer roller T is not limited to the above example. The voltage value may be a value corresponding to an environmental condition in the image forming apparatus **20**.

That is, the controller **25** as the second controller applies the second voltage (e.g., 1000 V) lower than the first voltage (e.g., 2000 V) as the secondary transfer bias at the timing of starting the application of the secondary transfer bias (transfer bias) to the transfer roller T (secondary transferer). The controller **25** as a second controller applies a first voltage (e.g., 2000 V) as the secondary transfer bias at a timing when the primary transfer is started.

Applying the secondary transfer bias having the smaller voltage value at the timing of starting the application of the secondary transfer bias to the transfer roller T produces the following effects. Specifically, it is possible to suppress a rapid change in the load applied to the intermediate transfer belt B. As a result, it is possible to shorten the time for stabilizing the speed of the intermediate transfer belt B, the conveyance speed of the recording medium PM, and the tension applied to the recording medium PM.

Controller **25** sets the transfer speed for recording medium PM to −0.2% of the reference speed at the start of application of the bias to transfer roller T (timing t**5**). The reference speed is a speed that is determined in advance according to a paper type or the like and is a speed defined as a system speed of the image forming apparatus **20**. The reference speed is, for example, 600 mm/sec. Thereafter, the controller **25** gradually returns the setting of the transfer speed onto the recording medium PM to the reference speed by timing t**9**.

That is, the controller **25** as the first controller serves as the second controller to make the speed of the intermediate transfer belt B (intermediate transferer) slower than the reference speed at the timing when the application of the secondary transfer bias (transfer bias) to the transfer roller T (secondary transferer) is started.

The following effects are obtained by making the speed of the intermediate transfer belt B slower than the reference speed at the timing of starting the application of the secondary transfer bias to the transfer roller T. Specifically, a rapid change in the speed of the intermediate transfer belt B can be suppressed. As a result, it is possible to shorten the time for stabilizing the speed of the intermediate transfer belt B, the conveyance speed of the recording medium PM, and the tension applied to the recording medium PM.

A load applied to intermediate transfer belt B when the toner image is secondarily transferred to recording medium PM changes according to the following conditions. Specifically, the condition is a paper type of the recording medium PM, an environmental condition in the image forming apparatus **20**, coverage of a job image of the print job, or the like.

Therefore, after the timing t**4**, the controller **25** changes the timing (timing t**5**) at which the secondary transfer bias is applied to the transfer roller T in accordance with the above-described condition. To be specific, the controller **25** changes the timing t**5** in accordance with the paper type of the recording medium PM, the environmental conditions inside the image forming apparatus **20**, or the coverage of the job image of the print job.

FIG. **5** shows an example of the timing at which the application of the secondary transfer bias is started.

As illustrated in FIG. **5**, when the stiffness of the recording medium PM is higher than a predetermined value, the controller **25** makes the timing at which the application of the secondary transfer bias is started earlier than a predetermined reference timing.

When the stiffness of the recording medium PM is equal to or less than a predetermined value, the controller **25** makes the timing at which the application of the secondary transfer bias is started later than a predetermined reference timing.

In a case where the friction coefficient of the recording medium PM is higher than a predetermined value, the controller **25** makes the timing of starting the application of the secondary transfer bias earlier than a predetermined reference timing.

If the coefficient of friction of the recording medium PM is less than or equal to a predetermined value, the controller **25** makes the timing at which to start applying the secondary transfer bias later than a predetermined reference timing.

When the resistance value of the recording medium PM is higher than a predetermined value, the controller **25** makes the timing to start the application of the secondary transfer bias earlier than a predetermined reference timing.

When the resistance value of the recording medium PM is equal to or less than a predetermined value, the controller **25** makes the timing of starting the application of the secondary transfer bias later than a predetermined reference timing.

That is, the controller **25** as a second controller starts application of the secondary transfer bias (transfer bias) to the transfer roller T (secondary transferer) at a timing corresponding to the paper type of the recording medium PM (continuous recording medium).

As shown in FIG. **5**, in the case where the environmental condition in the image forming apparatus **20** is low temperature and low humidity, the controller **25** makes the timing for starting the application of the secondary transfer bias earlier than a predetermined reference timing.

In a case where the environmental condition in the image forming apparatus **20** is hot and humid, the controller **25** makes the timing at which the application of the secondary transfer bias is started later than a predetermined reference timing.

That is, the controller **25** as a second controller starts application of the secondary transfer bias (transfer bias) to the transfer roller T (secondary transferer) at a timing depending on an environmental condition in the image forming apparatus **20**.

As shown in FIG. **5**, when the coverage of the job image is lower than a predetermined value, the controller **25** makes the timing of starting the application of the secondary transfer bias earlier than a predetermined reference timing.

When the coverage of the job image is a predetermined value or more, the controller **25** makes the timing at which the application of the secondary transfer bias is started later than a predetermined reference timing.

That is, the controller **25** as the second controller starts application of the secondary transfer bias (transfer bias) to the transfer roller T (secondary transferer) at a timing depending on the coverage of the job image.

As described above, the image forming apparatus **20** according to the present embodiment includes the image forming section **22** including the intermediate transferer (intermediate transfer belt B) to which the toner images are primarily transferred, and the secondary transferer (transfer roller T) to which a transfer bias (secondary transfer bias) for secondarily transferring the toner images on the intermediate transferer to the continuous recording medium (recording medium PM) is applied.

The image forming apparatus **20** according to the present embodiment includes a conveyor (fixing section **23**) that is disposed downstream from the image forming section **22** in the conveyance direction of the continuous recording medium and conveys the continuous recording medium.

The image forming apparatus **20** according to the present embodiment includes a first controller (controller **25**) that controls the speed of the intermediate transferer and the speed of the continuous recording medium conveyed by the conveyor.

The image forming apparatus **20** according to the present embodiment includes the second controller (controller **25**) that controls the timing of applying the transfer bias to the secondary transferer.

The first controller performs control such that the speed of the continuous recording medium conveyed by the conveyor is higher than the speed of the intermediate transferer.

The second controller starts applying the transfer bias to the secondary transferer after the secondary transferer is pressed against the intermediate transferer and before the primary transfer is started.

In the image forming apparatus **20** according to the present embodiment, the image forming section **22** includes an image bearer (photosensitive drum) that bears toner.

The second controller (controller **25**) starts applying the transfer bias (secondary transfer bias) to the secondary transferer (fixing section **23**) after the secondary transferer is pressed against the intermediate transferer (intermediate transfer belt B) and before the exposure of the image bearers by the image forming section **22** is started.

Thus, after a predetermined time has elapsed since the start of application of the secondary transfer bias to the transfer roller T by the image forming apparatus **20**, the image forming apparatus **20** can perform the primary transfer and the secondary transfer. The state after the lapse of the predetermined time by advancing the timing of starting the application of the secondary transfer bias as compared with the conventional case is a state in which the speed of the intermediate transfer belt B is more stable as compared with the conventional case. Thus, color misregistration and image defect can be further suppressed in the image forming operation on the recording medium PM, which is a continuous recording medium.

The image forming apparatus **20** can perform the secondary transfer in a state where the conveyance speed of the recording medium PM and the tension to be applied to the recording medium PM are more stable than ever. Accordingly, it is possible to further suppress the image defect by suppressing the paper wrinkle and the waving of the recording medium PM which is the continuous recording medium.

In the image forming apparatus **20** according to the present embodiment, the second controller (controller **25**) starts applying the transfer bias (secondary transfer bias) to the secondary transferer (transfer roller T) while the continuous recording medium (recording medium PM) is being conveyed by a predetermined distance (meandering stabilization distance) after the start of conveyance of the continuous recording medium and before the start of printing.

Therefore, it is possible to reduce waste sheets generated before the start of printing.

In the image forming apparatus **20** according to the present embodiment, the second controller (controller **25**) starts applying the transfer bias (secondary transfer bias) to the secondary transferer (transfer roller T) immediately after the secondary transferer is pressed against the intermediate transferer (intermediate transfer belt B).

Thus, the image forming apparatus **20** can secure the longest time for stabilizing the speed of the intermediate transfer belt B, the conveyance speed of the recording medium PM, and the tension to be applied to the recording

medium PM. Therefore, it is possible to further stabilize the speed of the intermediate transfer belt B, the conveyance speed of the recording medium PM, and the tension applied to the recording medium PM. Therefore, it is possible to further reduce waste sheet generated due to image defect.

In the image forming apparatus **20** according to the present embodiment, the second controller (controller **25**) applies the second voltage lower than the first voltage as the transfer bias at the timing of starting the application of the transfer bias (secondary transfer bias) to the secondary transferer (transfer roller T). The second controller applies a first voltage as the transfer bias at a timing when the primary transfer is started.

Therefore, it is possible to suppress a rapid change in the load applied to the intermediate transfer belt B. As a result, it is possible to shorten the time for stabilizing the speed of the intermediate transfer belt B, the conveyance speed of the recording medium PM, and the tension applied to the recording medium PM.

In the image forming apparatus **20** according to the present embodiment, the first controller (controller **25**) makes the speed of the intermediate transferer (intermediate transfer belt B) slower than a reference speed at the timing when the second controller (controller **25**) starts applying the transfer bias (secondary transfer bias) to the secondary transferer (transfer roller T).

Therefore, a rapid change in the speed of the intermediate transfer belt B can be suppressed. As a result, it is possible to shorten the time for stabilizing the speed of the intermediate transfer belt B, the conveyance speed of the recording medium PM, and the tension applied to the recording medium PM.

In the image forming apparatus **20** according to the present embodiment, the second controller (controller **25**) starts applying the transfer bias (secondary transfer bias) to the secondary transferer (transfer roller T) at a timing corresponding to the paper type of the continuous recording medium (recording medium PM).

Therefore, the application of the secondary transfer bias to the transfer roller T can be started at an optimum timing corresponding to the paper type of the recording medium PM.

In the image forming apparatus **20** according to the present embodiment, the second controller (controller **25**) starts applying the transfer bias (secondary transfer bias) to the secondary transferer (transfer roller T) at a timing corresponding to an environmental condition in the image forming apparatus **20**.

Therefore, the application of the secondary transfer bias to the transfer roller T can be started at an optimum timing corresponding to the environmental condition in the image forming apparatus **20**.

In the image forming apparatus **20** according to the present embodiment, the second controller (controller **25**) starts application of the transfer bias (secondary transfer bias) to the secondary transferer (transfer roller T) at a timing corresponding to the coverage of the job image.

Therefore, the application of the secondary transfer bias to the transfer roller T can be started at an optimum timing corresponding to the coverage of the job image.

Note that embodiments to which the present invention can be applied are not limited to those described above and can be appropriately modified without departing from the spirit and scope of the present invention.

For example, although the controller **25** functions as the first controller and the second controller in the above embodiment, it is not limited thereto. In a case where any of the apparatuses other than the image forming apparatus **20** included in the image forming system **1** includes a controller, the controller may function as the first controller and the second controller.

Although embodiments of the present invention have been described and illustrated in detail, the disclosed embodiments are made for purposes of illustration and example only and not limitation. The scope of the present invention should be interpreted by terms of the appended claims.

What is claimed is:

1. An image forming apparatus comprising:

an image former that includes an intermediate transferer to which a toner image is primarily transferred to perform primary transfer, and a secondary transferer to which a transfer bias for secondarily transferring the toner image on the intermediate transferer to a continuous recording medium is applied;

a conveyor that is arranged on a downstream side of the image former in a conveyance direction of the continuous recording medium and conveys the continuous recording medium; and

a hardware processor that controls a speed of the intermediate transferer and a speed of the continuous recording medium conveyed by the conveyor, wherein

the hardware processor controls a timing at which the transfer bias is applied to the secondary transferer, performs control such that the speed of the continuous recording medium conveyed by the conveyor is higher than the speed of the intermediate transferer, and starts application of the transfer bias to the secondary transferer after the secondary transferer is pressed against the intermediate transferer and before the primary transfer is started.

2. The image forming apparatus according to claim **1**, wherein

the image former includes an image bearer that carries toner, and

the hardware processor starts the application of the transfer bias to the secondary transferer after the secondary transferer is pressed against the intermediate transferer and before exposure of the image bearer by the image former is started.

3. The image forming apparatus according to claim **1**, wherein the hardware processor starts the application of the transfer bias to the secondary transferer while the continuous recording medium is conveyed by a predetermined distance after start of conveyance of the continuous recording medium and before start of printing.

4. The image forming apparatus according to claim **1**, wherein the hardware processor starts the application of the transfer bias to the secondary transferer immediately after the secondary transferer is pressed against the intermediate transferer.

5. The image forming apparatus according to claim **1**, wherein the hardware processor applies a second voltage smaller than a first voltage as the transfer bias at a timing at which the application of the transfer bias to the secondary transferer is started and applies the first voltage as the transfer bias at a timing at which the primary transfer is started.

6. The image forming apparatus according to claim **1**, wherein the hardware processor makes the speed of the intermediate transferer slower than a reference speed at a timing at which the application of the transfer bias to the secondary transferer is started.

7. The image forming apparatus according to claim 1, wherein the hardware processor starts the application of the transfer bias to the secondary transferer at a timing corresponding to a paper type of the continuous recording medium.

8. The image forming apparatus according to claim 1, wherein the hardware processor starts the application of the transfer bias to the secondary transferer at a timing corresponding to an environmental condition in the image forming apparatus.

9. The image forming apparatus according to claim 1, wherein the hardware processor starts the application of the transfer bias to the secondary transferer at a timing corresponding to coverage of a job image.

10. A non-transitory storage medium storing a computer readable program for a computer in an image forming apparatus including: an image former that includes an intermediate transferer to which a toner image is primarily transferred to perform primary transfer, and a secondary transferer to which a transfer bias for secondarily transferring the toner image on the intermediate transferer to a continuous recording medium is applied; and a conveyor that is arranged on a downstream side of the image former in a conveyance direction of the continuous recording medium and conveys the continuous recording medium, the program causing the computer to perform controlling that is controlling a speed of the intermediate transferer and a speed of the continuous recording medium conveyed by the conveyor, wherein

the program causes the computer to control a timing at which the transfer bias is applied to the secondary transferer, perform control such that the speed of the continuous recording medium conveyed by the conveyor is higher than the speed of the intermediate transferer, and start application of the transfer bias to the secondary transferer after the secondary transferer is pressed against the intermediate transferer and before the primary transfer is started.

* * * * *