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(54) PRINTING APPARATUS AND FEEDING CONTROL METHOD

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B41J 15/00 (2006.01)
G03G 15/00 (2006.01)
B41J 11/42 (2006.01)

(52) **U.S. Cl.**

CPC ***B41J 11/42*** (2013.01); ***G03G 15/652*** (2013.01); ***B41J 15/005*** (2013.01)
USPC **400/583**; 400/611; 400/618; 399/329

(58) **Field of Classification Search**

USPC 399/122, 322, 329, 67, 68; 400/583, 400/611, 618; 226/195, 122
See application file for complete search history.

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(57) **ABSTRACT**

According to the embodiment, a printing apparatus includes: a printing unit that forms an image on a web; a first feeding unit that feeds the web; a second feeding unit downstream of the printing unit in a feed direction; a buffer unit that has a buffer plate and absorbs flexure of the web generated by the two feeding units by operating the buffer plate; a first feeding control unit that causes the first feeding unit to execute a first deceleration operation; and a second feeding control unit that causes the second feeding unit to execute the first deceleration operation when a trigger for stopping the feed of the web has occurred, measures a feed amount of the web fed by the second feeding unit, and changes the first deceleration operation to a second deceleration operation based on the feed amount.

9 Claims, 8 Drawing Sheets

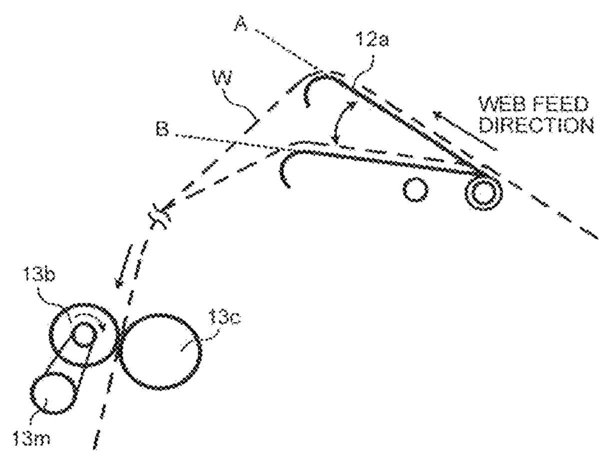

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FIG.1

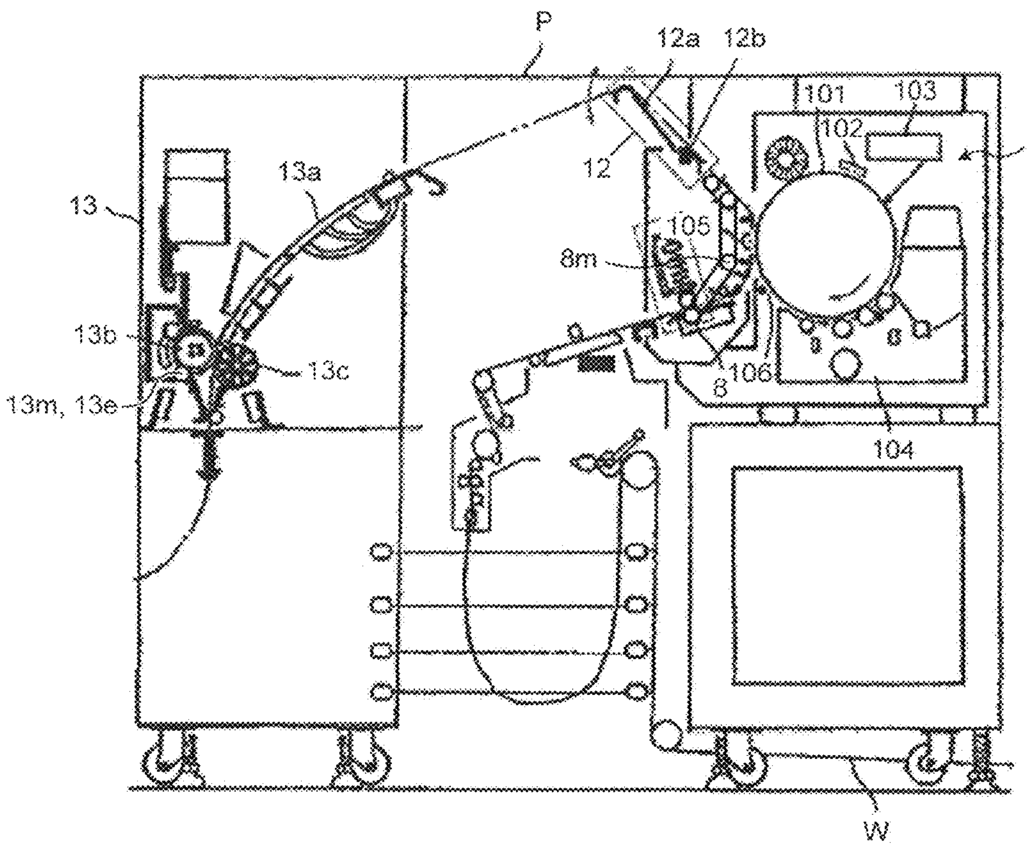

P
12a
12b
101
103
102
100
12
13
13a
105
8m
13b
13c
106
8
13m, 13e
104
W

FIG.2

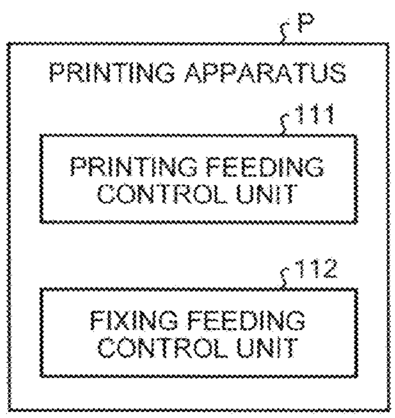

P
PRINTING APPARATUS
111
PRINTING FEEDING CONTROL UNIT
112
FIXING FEEDING CONTROL UNIT

FIG.3

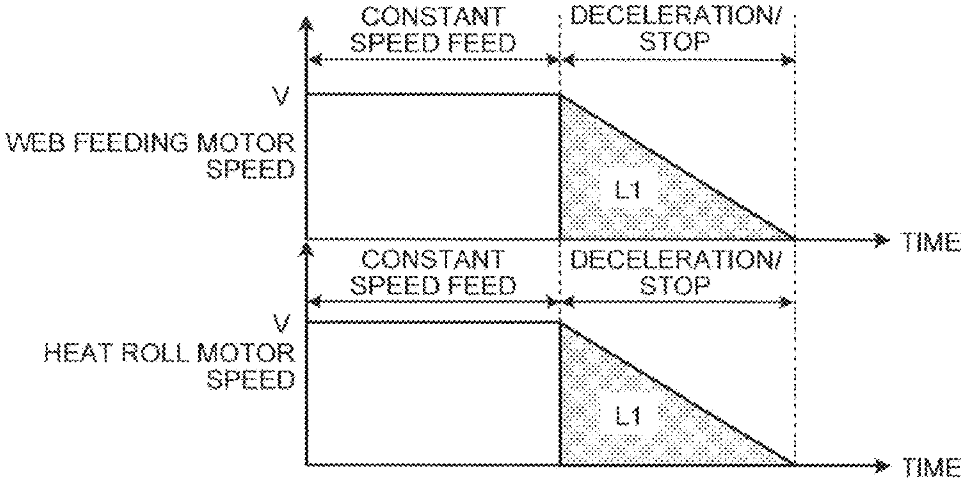

CONSTANT SPEED FEED
DECELERATION/ STOP
V
WEB FEEDING MOTOR SPEED
L1
TIME
CONSTANT SPEED FEED
DECELERATION/ STOP
V
HEAT ROLL MOTOR SPEED
L1
TIME

FIG.4

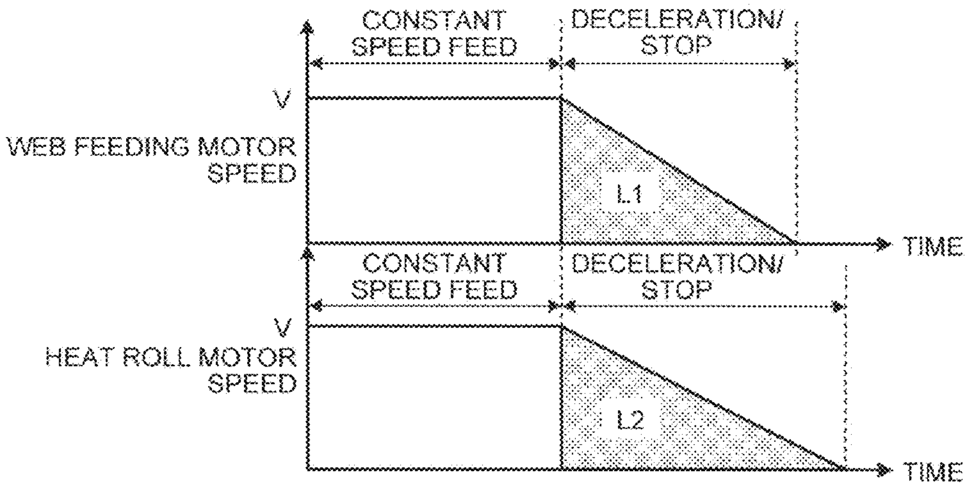

CONSTANT SPEED FEED
DECELERATION/ STOP
V
WEB FEEDING MOTOR SPEED
L1
TIME
CONSTANT SPEED FEED
DECELERATION/ STOP
V
HEAT ROLL MOTOR SPEED
L2
TIME

FIG.5

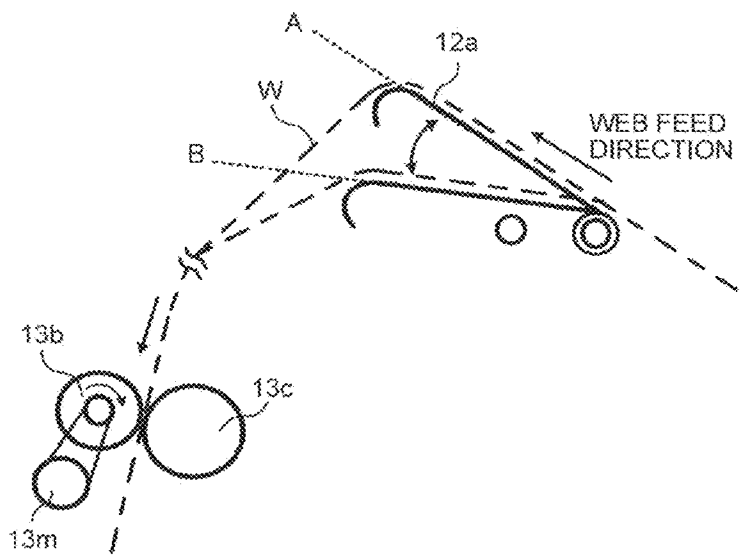

A
12a
W
WEB FEED
DIRECTION
B
13b
13c
13m

FIG.6

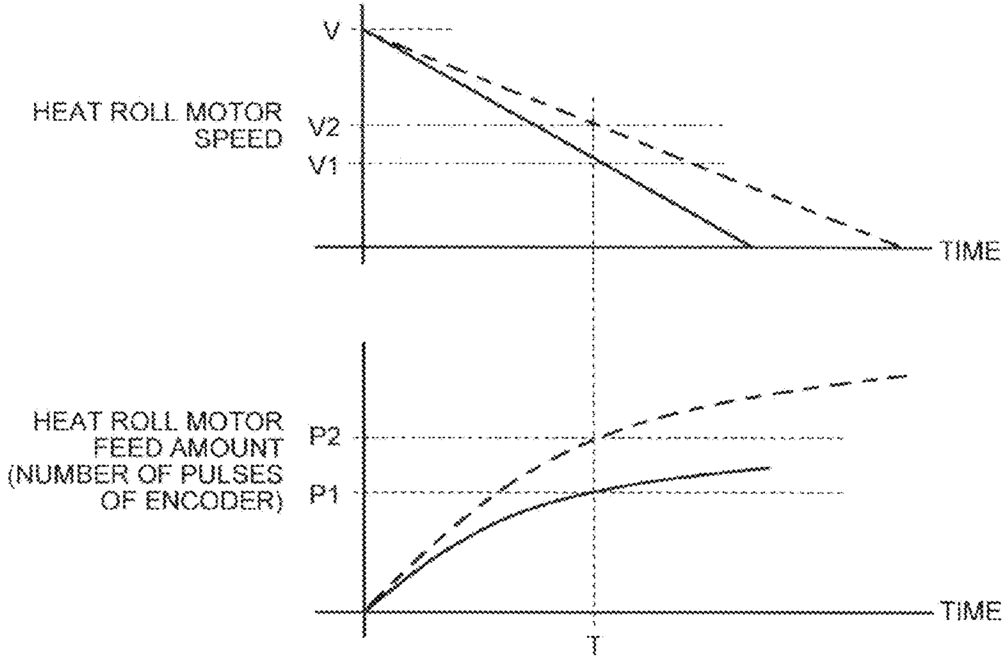

V
HEAT ROLL MOTOR
SPEED
V2
V1
TIME
HEAT ROLL MOTOR
FEED AMOUNT
(NUMBER OF PULSES
OF ENCODER)
P2
P1
TIME
T

FIG.7

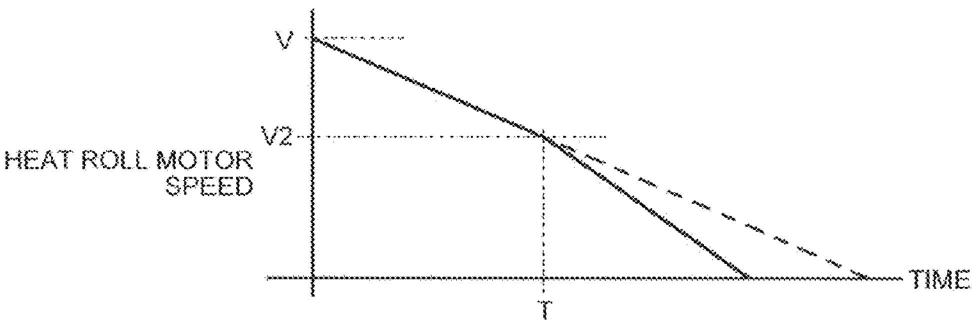

V
V2
HEAT ROLL MOTOR SPEED
TIME
T

FIG.8

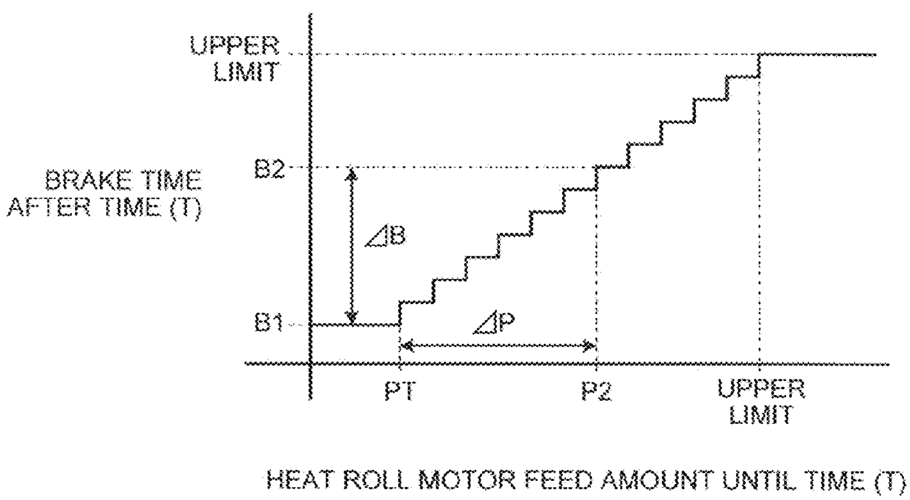
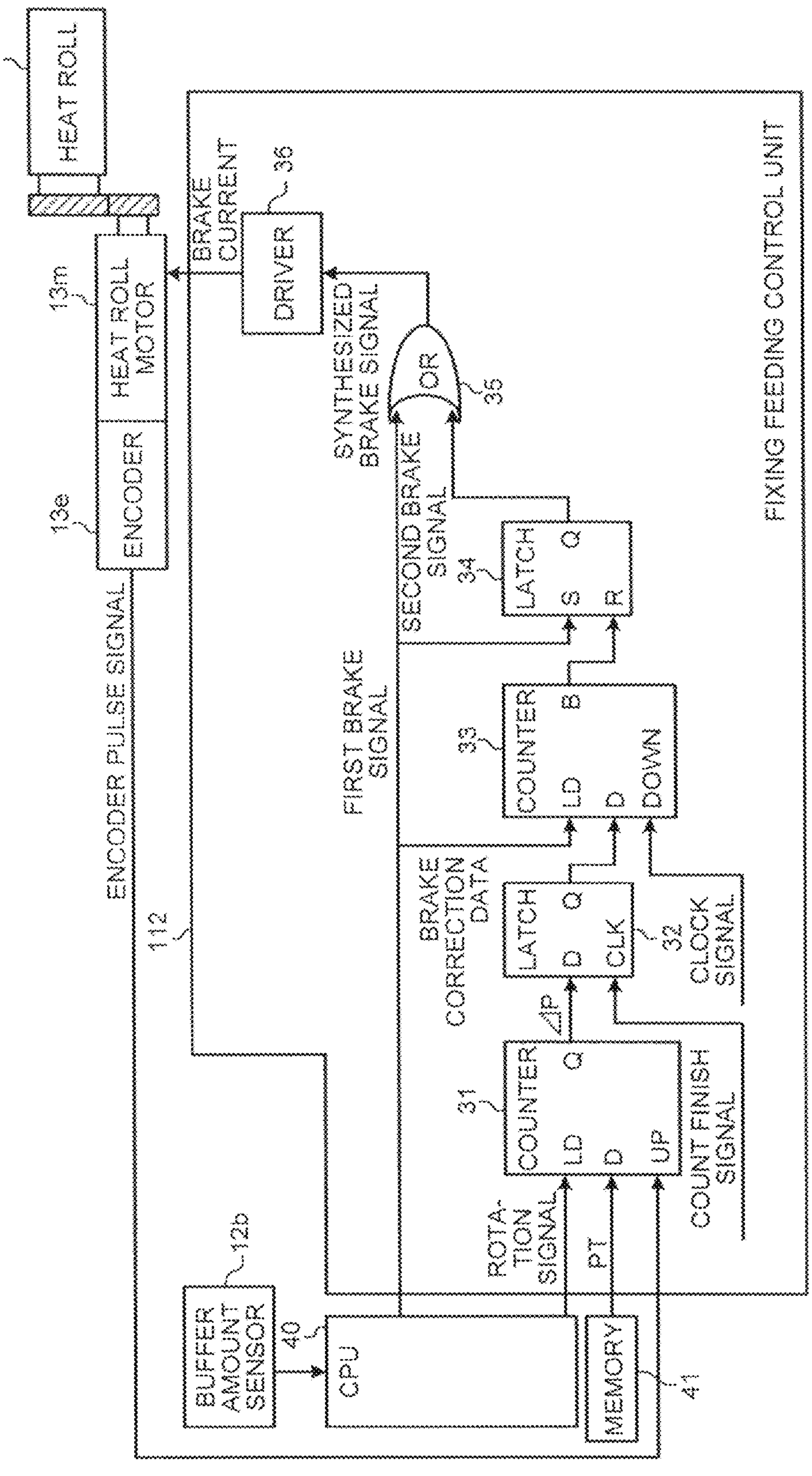

UPPER LIMIT
B2
BRAKE TIME AFTER TIME (T)
⊿B
B1
⊿P
PT
P2
UPPER LIMIT
HEAT ROLL MOTOR FEED AMOUNT UNTIL TIME (T)

FIG.9



13b
HEAT ROLL
13m
HEAT ROLL MOTOR
13e
ENCODER
ENCODER PULSE SIGNAL
BRAKE CURRENT
36
DRIVER
SYNTHESIZED BRAKE SIGNAL
OR
35
SECOND BRAKE SIGNAL
34
LATCH
S
R
Q
FIRST BRAKE SIGNAL
33
COUNTER
LD
D
DOWN
B
BRAKE CORRECTION DATA
LATCH
D
CLK
Q
32
CLOCK SIGNAL
⊿P
31
COUNTER
LD
D
UP
Q
COUNT FINISH SIGNAL
ROTATION SIGNAL
PT
112
FIXING FEEDING CONTROL UNIT
BUFFER AMOUNT SENSOR
12b
40
CPU
MEMORY
41

FIG.10

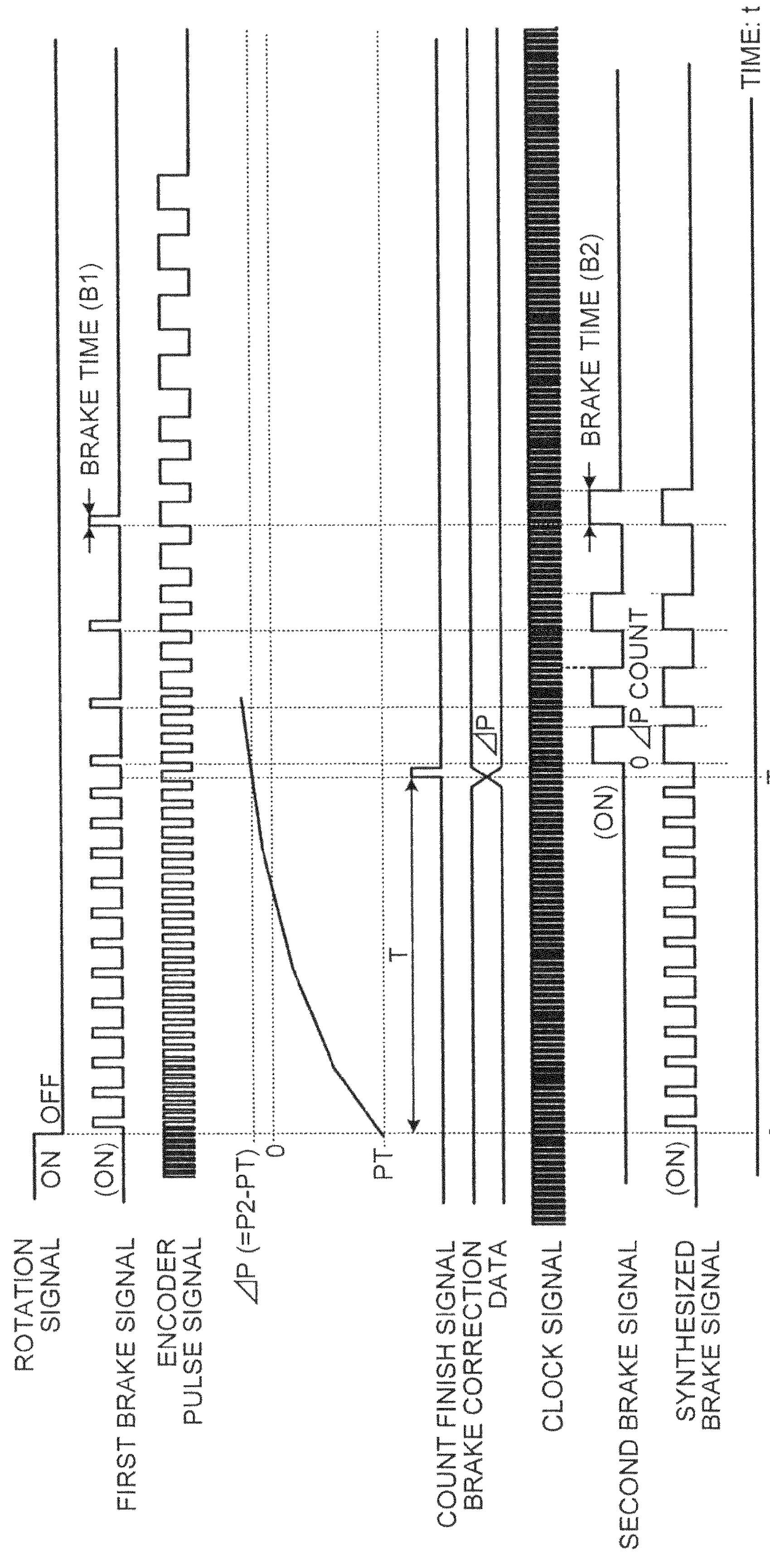

ROTATION SIGNAL
ON
OFF
FIRST BRAKE SIGNAL
(ON)
BRAKE TIME (B1)
ENCODER PULSE SIGNAL
⊿P (=P2-PT)
0
PT
T
COUNT FINISH SIGNAL
BRAKE CORRECTION DATA
⊿P
CLOCK SIGNAL
SECOND BRAKE SIGNAL
(ON)
BRAKE TIME (B2)
0
⊿P COUNT
SYNTHESIZED BRAKE SIGNAL
(ON)
0
T
TIME: t

FIG.11

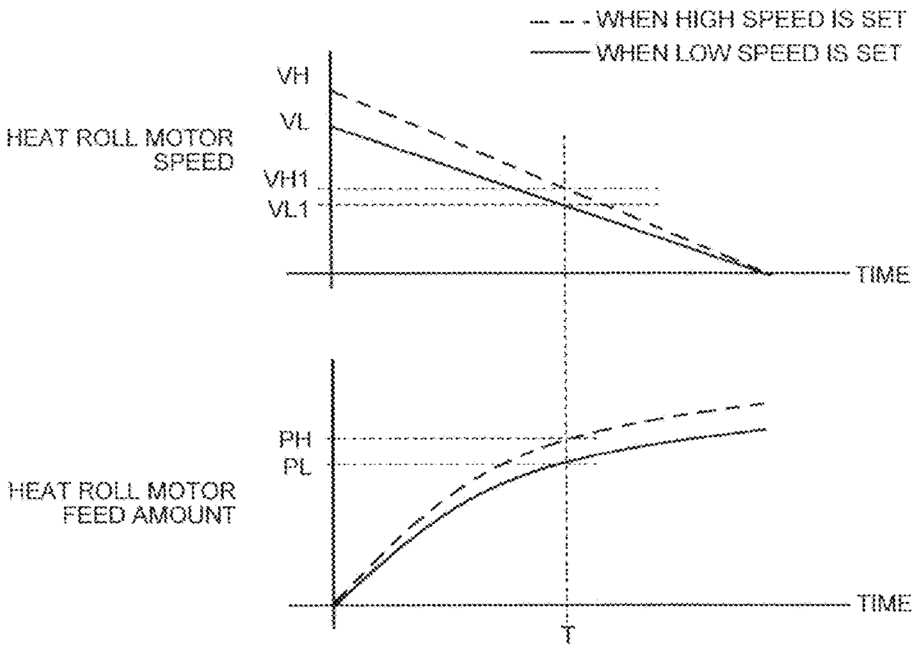
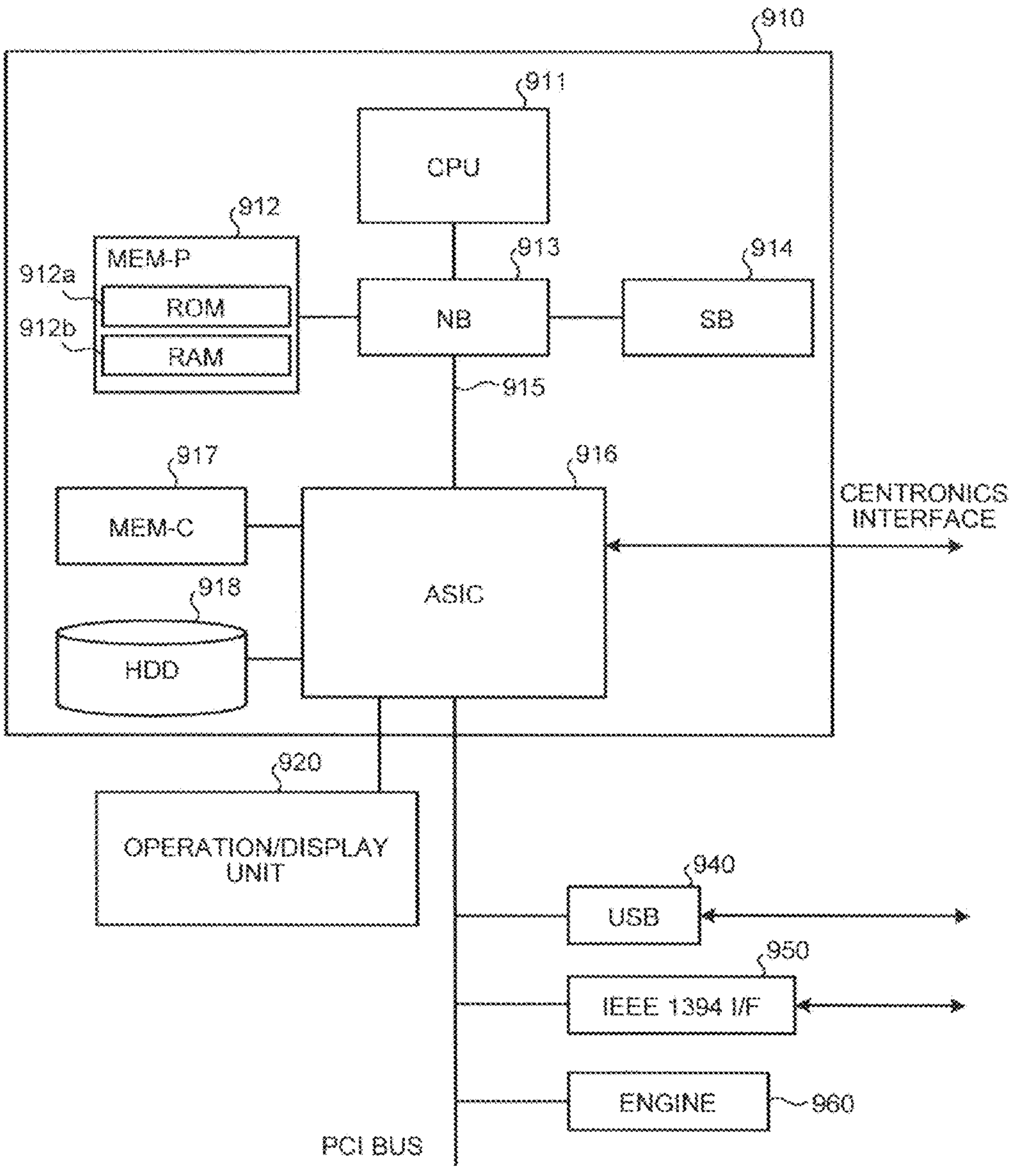

WHEN HIGH SPEED IS SET
WHEN LOW SPEED IS SET
VH
VL
HEAT ROLL MOTOR SPEED
VH1
VL1
TIME
PH
PL
HEAT ROLL MOTOR FEED AMOUNT
TIME
T

FIG.12


910
911
CPU
912
MEM-P
912a
ROM
912b
RAM
913
NB
914
SB
915
917
MEM-C
916
ASIC
CENTRONICS INTERFACE
918
HDD
920
OPERATION/DISPLAY UNIT
940
USB
950
IEEE 1394 I/F
ENGINE
960
PCI BUS

PRINTING APPARATUS AND FEEDING CONTROL METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to and incorporates by reference the entire contents of Japanese Patent Application No. 2011-203189 filed in Japan on Sep. 16, 2011 and Japanese Patent Application No. 2012-125337 filed in Japan on May 31, 2012.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a printing apparatus and a feeding control method.

2. Description of the Related Art

In a printing apparatus for printing an image on a web (for example, a roll sheet), although the web is fed by two feeding units, i.e., a printing feeding unit and a fixing feeding unit, since the printing feeding unit and the fixing feeding unit have a different driving source respectively, a difference occurs in web feed amounts by the two driving sources. To cope with the problem, the printing apparatus interposes a buffer unit having a buffer plate which generates reaction force in a direction and makes a circular arc motion between the printing feeding unit and the fixing feeding unit; and the difference between the web feed amounts is absorbed by changing an angle of the buffer plate.

When the angle of the buffer plate exceeds a predetermined range, there is a possibility that the web is break off, whereas when the angle of the buffer plate becomes smaller than the predetermined range, there is a possibility that the web is defectively fed due to an insufficient amount of tension. Accordingly, in the printing apparatus, it is necessary to control a feed of the web so that the angle of buffer plate falls within a predetermined range.

However, it is necessary for the printing feeding unit to feed the web so that a toner image is transferred to a determined position of the web in a printing unit. Accordingly, in the printing apparatus, ordinarily, the fixing feeding unit feeds the web so that the angle of buffer plate falls within the predetermined range.

When the feed of the web is stopped, it is necessary for the fixing feeding unit to generate brake force so that the feed of the web is stopped in a state that the angle of the buffer plate falls within the predetermined range, therefore, an optimum value of the brake force to be generated is different depending on a friction load of the web to the fixing feeding unit and a load of the web (sheet).

For example, Japanese Patent Application Laid-open No. 2011-170324 discloses a technology for determining brake force that is used to stop a feed of a web next time from a buffer amount of a buffer plate when the feed of the web is stopped.

For example, Japanese Patent Application Laid-open No. 2007-316411 discloses a technology for adjusting brake force based on a change of a feed amount of a web per each minute unit time when a feed of the web is decelerated.

Further, for example, Japanese Patent Application Laid-open No. 61-098373 discloses a technology for detecting a cycle of generation of encoder pulses generated by a rotation of a driving source; determining brake force according to the detected cycle of generation of the encoder pulses; generating the determined brake force; and decelerating and stopping a feed of a web.

However, in the technology disclosed in Japanese Patent Application Laid-open No. 2011-170324, since it is at the time when the feed of the web is stopped next time that optimum brake force is reflected, there is a possibility that the buffer plate cannot be stopped in an appropriate range at the time when for example the web is replaced and the like.

In the technology disclosed in Japanese Patent Application Laid-open No. 2007-316411, since there is a case in which it is difficult to identify the change of the feed amount per each minute unit time in a case in which the web is likely to stop and in a case the web is not likely to stop, there is a possibility that the buffer plate cannot be stopped in an appropriate range.

Further, in the technology disclosed in Japanese Patent Application Laid-open No. 61-098373, when, for example, a difference exists between loads of webs, there is a possibility that the buffer plate cannot be stopped in an appropriate range.

There is a need to provide a printing apparatus and a feeding control method capable of causing an angle of a buffer plate to be fallen within an appropriate range without depending on a type of a web.

SUMMARY OF THE INVENTION

It is an object of the present invention to at least partially solve the problems in the conventional technology.

According to one embodiment, a printing apparatus includes: a printing unit that forms an image on a web; a first feeding unit that feeds the web in the printing unit; a second feeding unit that feeds the web downstream of the printing unit in a feed direction; a buffer unit that has a buffer plate and absorbs flexure of the web generated by a feed difference between the first feeding unit and the second feeding unit by operating the buffer plate; a first feeding control unit that causes the first feeding unit to execute a deceleration operation for decelerating a feed speed of the web when a trigger for stopping the feed of the web has occurred; and a second feeding control unit that causes the second feeding unit to execute a first deceleration operation for decelerating the feed speed of the web when the trigger for stopping the feed of the web has occurred, measures a feed amount of the web fed by the second feeding unit during a period until a predetermined time passes, and changes the first deceleration operation executed by the second feeding unit to a second deceleration operation based on the feed amount.

According to another embodiment, feeding control method is provided executed in a printing apparatus. The printing apparatus includes: a printing unit that forms an image on a web; a first feeding unit that feeds the web in the printing unit; a second feeding unit that feeds the web downstream of the printing unit in a feed direction; and a buffer unit that has a buffer plate and absorbs flexure of the web generated by a feed difference between the first feeding unit and the second feeding unit by operating the buffer plate. The feeding control method includes: first feeding controlling that causes, when a trigger for stopping the feed of the web has occurred, by a first feeding control unit, the first feeding unit to execute a deceleration operation for decelerating a feed speed of the web; and a second feeding controlling that causes, when the trigger for stopping the feed of the web has occurred, by a second feeding control unit, the second feeding unit to execute a first deceleration operation for decelerating the feed speed of the web, measures a feed amount of the web fed by the second feeding unit during a period until a predetermined time passes, and changes the first deceleration operation executed by the second feeding unit to a second deceleration operation based on the feed amount.

The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view illustrating an example of a mechanical configuration of a printing apparatus of an embodiment;

FIG. **2** is a block diagram illustrating an example of a functional configuration of the printing apparatus of the embodiment;

FIG. **3** is an explanatory view illustrating an example of a feed amount of a web as a general purpose sheet fed by a printing feeding unit and a fixing feeding unit when a feed of the web is stopped;

FIG. **4** is an explanatory view illustrating an example of a feed amount of a web as a coating sheet fed by the printing feeding unit and the fixing feeding unit when a feed of the web is stopped;

FIG. **5** is an explanatory view illustrating an example of an angle of a buffer plate after the feed of the web is stopped;

FIG. **6** is an explanatory view illustrating an example of a feed speed and a feed amount of each type of a web fed by the fixing feeding unit when the feed of the web is stopped;

FIG. **7** is a view illustrating an example of a control executed by a fixing feeding control unit of the embodiment;

FIG. **8** is an explanatory view of an example of a determination method of brake force after a predetermined time which is determined by the fixing feeding control unit of the embodiment;

FIG. **9** is a circuit diagram illustrating an example of a circuit configuration of the fixing feeding control unit of the embodiment;

FIG. **10** is a timing chart diagram illustrating an example of a timing chart of the fixing feeding control unit of the embodiment;

FIG. **11** is an explanatory view illustrating an example of a feed speed and a feed amount of the web fed by the fixing feeding unit at each feed speed when the feed of the web is stopped; and

FIG. **12** is a block diagram illustrating an example of a hardware configuration of the printing apparatus of the embodiment and a modification.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of a printing apparatus and a feeding control method will be explained below in detail referring to attached drawings.

FIG. **1** is a schematic view illustrating an example of a mechanical configuration of the printing apparatus P of the embodiment. As illustrated in FIG. **1**, the printing apparatus P includes a printing unit **100**, a printing feeding unit **8** (an example of a first feeding unit), a fixing feeding unit **13** (an example of a second feeding unit), and a buffer unit **12**.

The printing unit **100** forms a toner image to a web W. The printing unit **100** has a photosensitive drum **101**, a charging unit **102**, an exposing device **103**, a developing device **104**, a transferring device **105**, and a toner adhesion amount sensor **106**. Note that the web W may be assumed to be a roll sheet in the embodiment, the web W is not limited to the roll sheet type. Further, in the embodiment, although the printing unit **100** of the printing apparatus P will be explained as to a configuration employing an electrophotography, the printing unit **100** is not limited thereto and may be, for example, a configuration employing an ink (liquid droplet) injection system by an inkjet system (for example, a line-type head). Even in a printing configuration employing the inkjet system, the configuration of the embodiment can be applied as the fixing feeding unit **13** which fixes ink on a web by subjecting the ink on a web surface to a heating/pressurizing treatment.

The photosensitive drum **101** is driven in rotation. The charging unit **102** charges the photosensitive drum **101**. The exposure device **103** projects an exposure pattern based on print data to the photosensitive drum **101**. With the operation, an electrostatic latent image is formed on the photosensitive drum **101**. The developing device **104** develops the electrostatic latent image formed on the photosensitive drum **101**. With the operation, a toner image is formed on the photosensitive drum **101**. The transferring device **105** transfers the toner image formed on the photosensitive drum **101** onto the web W fed by the printing feeding unit **8**. Note that a forming condition for forming the toner image is corrected according to an output of the toner adhesion amount sensor **106**.

The printing feeding unit **8** feeds the web W in the printing unit **100**. The printing feeding unit **8** has a web feeding motor **8*m*** and feeds the web W in such a manner that the web feeding motor **8*m*** drives feed rollers disposed upstream and downstream of the transferring device **105** via a transmission drive system.

The fixing feeding unit **13** feeds the web W and fixes the toner image formed on the web W. The fixing feeding unit **13** has a heat roll motor **13*m*** (an example of a DC servo motor), a heat roll **13*b***, a preheater **13*a***, a pressing roller **13*c***, and an encoder **13*e***. The fixing feeding unit **13** feeds the web W in such a manner that the heat roll motor **13*m*** drives the heat roll **13*b*** in which a heater is built in via a transmission drive system. The preheater **13*a*** causes the web W on which the toner image is formed to come into intimate contact therewith by negative pressure suction and heats the web W to a temperature near to a transition temperature of a toner resin. The heat roll **13*b*** and the pressing roller **13*c*** melt the toner image formed on the web W and fix the toner image to the web W. The encoder **13*e*** detects a rotation of the heat roll motor **13*m*** and outputs a pulse.

As described above, in the printing apparatus P of the embodiment, although the printing feeding unit **8** and the fixing feeding unit **13** feed the web W, since the printing feeding unit **8** and the fixing feeding unit **13** have a different driving source (the web feeding motor **8*m*** is used in the printing feeding unit **8**, and the heat roll motor **13*m*** is used in the fixing feeding unit **13**) respectively, a difference is caused between feed amounts of the web W.

The buffer unit **12** is interposed between the printing feeding unit **8** and the fixing feeding unit **13**. The buffer unit **12** has a buffer plate **12*a*** for generating reaction force in a direction and executing a circular arc motion and a buffer amount sensor **12*b*** for detecting an angle of the buffer plate **12*a***. The buffer unit **12** operates the buffer plate **12*a*** and absorbs flexure of the web W generated by a difference of feed between the printing feeding unit **8** and the fixing feeding unit **13**.

When the angle of the buffer plate **12*a*** makes the circular arc motion within a predetermined range, the web W can be held in a state in which a predetermined amount of tension is applied thereto. When the angle of the buffer plate **12*a*** exceeds the predetermined range, however, there is a possibility that the web W is cut off, whereas when the angle of the buffer plate **12***a* becomes smaller than the predetermined range, there is a possibility that the web W is defectively fed due to an insufficient amount of tension. Thus, in the printing apparatus P of the embodiment, the feed of the web is controlled so that the angle of the buffer plate **12***a* falls within the predetermined range.

FIG. **2** is a block diagram illustrating an example of a functional configuration of the printing apparatus P of the embodiment. As illustrated in FIG. **2**, the printing apparatus P includes a printing feeding control unit **111** (an example of a first feeding control unit) and a fixing feeding control unit **112** (an example of a second feeding control unit).

The printing feeding control unit **111** controls the printing feeding unit **8**. When, for example, a trigger for stopping the feed of the web W has occurred, the printing feeding control unit **111** causes the printing feeding unit **8** to execute a deceleration operation for decelerating a feed speed of the web W. Here the trigger is a time, case, situation, condition, or signal for the apparatus to stop feeding, which is generally indicated and transmitted by signal. In the printing feeding unit **8**, it is necessary for the printing unit **100** to feed the web W so that the toner image is transferred to a determined position of the web W. Accordingly, when the web W is fed, the printing feeding control unit **111** controls an amount of rotation of the web feeding motor **8***m* per unit time to a predetermined amount. As a result, the feed amount of the web W in the printing feeding unit **8** becomes constant regardless of a material (type) of the web W. Note that, in any of a case in which the web W is fed while being accelerated, a case in which the web W is fed at a constant speed, and a case in which the web W is fed while being decelerated, the printing feeding control unit **111** controls the amount of rotation per unit time of the web feeding motor **8***m*.

The fixing feeding control unit **112** controls the fixing feeding unit **13**. Specifically, the fixing feeding control unit **112** controls a rotation speed of the heat roll motor **13***m* so that the angle of the buffer plate **12***a* detected by the buffer amount sensor **12***b* while the web W is being fed falls within the predetermined range.

When, for example, the feed speed of the web W is decelerated, the fixing feeding control unit **112** causes the heat roll motor **13***m* to generate brake force so that the angle of the buffer plate **12***a* falls within the predetermined range. In the embodiment, the fixing feeding control unit **112** decelerates the feed speed of the web W by decelerating the rotation of the heat roll motor **13***m* by causing a brake current to periodically flow to the heat roll motor **13***m*. Note that when, for example, the heat roll motor **13***m* rotates clockwise at the time the web W is fed at the constant speed, the brake current is a current for rotating the heat roll motor **13***m* counterclockwise.

However, an optimum value of the brake force (brake current) is different depending on a friction load of the web W and a load of the web (sheet), i.e., depending on the material (type) of the web W to the fixing feeding unit **13** (the preheater **13***a*). Accordingly, when the brake force (brake current), which is generated to the fixing feeding unit **13** at the time the feed of the web W is stopped, is fixed regardless of the type of the web W, the angle of the buffer plate **12***a* may not be fallen within the predetermined range.

FIG. **3** is an explanatory view illustrating an example of the feed amount of the web W acting as a general purpose sheet and fed by the printing feeding unit **8** and the fixing feeding unit **13** when the feed of the web W is stopped, and FIG. **4** is an explanatory view illustrating an example of the feed amount of the web W acting as a coating sheet and fed by the printing feeding unit **8** and the fixing feeding unit **13** when the feed of the web W is stopped. In the examples illustrated in FIGS. **3** and **4**, it is assumed that the brake force (brake current) generated to the fixing feeding unit **13** is set to the same value. FIG. **5** is an explanatory view illustrating an example of the angle of the buffer plate **12***a* after the feed of the web W has been stopped in FIGS. **3** and **4**.

When the web W is the general purpose sheet, as illustrated in FIG. **3**, a feed amount L**1** of the web W fed by the printing feeding unit **8** (a brake distance of the web feeding motor **8***m*) agrees with a feed amount L**1** of the web W fed by the fixing feeding unit **13** (a brake distance of the heat roll motor **13***m*). As a result, as illustrated in FIG. **5**, the angle of the buffer plate **12***a* becomes A and the angle of the buffer plate **12***a* falls within the predetermined range.

In contrast, when the web W is the coating sheet, as illustrated in FIG. **4**, a feed amount L**2** of the web W fed by the fixing feeding unit **13** (the brake distance of the heat roll motor **13***m*) becomes larger than the feed amount L**1** of the web W fed by the printing feeding unit **8** (the brake distance of the web feeding motor **8***m*). This is because the coating sheet has a larger degree of sheet smoothness and a smaller friction load than those of the general purpose sheet. As a result, as illustrated in FIG. **5**, since the angle of the buffer plate **12***a* becomes B, there is a possibility that the angle of the buffer plate **12***a* may not be fallen within the predetermined range.

In an actual operation, although the feed of the web W is stopped once before the angle of the buffer plate **12***a* exceeds the predetermined range, a recovery operation is executed so that the angle of the buffer plate **12***a* becomes an optimum angle, and the feed of the web W is resumed, a throughput is reduced when the operation is executed.

In the embodiment, to make the angle of the buffer plate **12***a* fall within an appropriate range without depending on the type of the web W, when the trigger for stopping the feed of the web W has occurred, the fixing feeding control unit **112** causes the fixing feeding unit **13** to execute a first deceleration operation for decelerating the feed speed of the web W and measures the feed amount of the web W fed by the fixing feeding unit **13** until a predetermined time has passed. The fixing feeding control unit **112** changes the first deceleration operation executed by the fixing feeding unit **13** to a second deceleration operation based on the measured feed amount.

Specifically, the second deceleration operation is an operation for decelerating the feed speed of the web W more than the first deceleration operation, and when the measured feed amount is larger than a threshold value, the fixing feeding control unit **112** changes the first deceleration operation executed by the fixing feeding unit **13** to the second deceleration operation. Note that the fixing feeding control unit **112** measures a number of pulses output from an encoder **13***e* as the feed amount of the web W fed by the fixing feeding unit **13**.

That is, in the embodiment, attention is paid to that the feed amount (a speed change) of the web W after the fixing feeding unit **13** has been caused to execute the first deceleration operation is different depending on the type of the web W, and when the feed amount of the web W fed by the first deceleration operation is larger than the threshold value and it is necessary to more decelerate the feed speed, the fixing feeding unit **13** is caused to execute the second deceleration operation according to the feed amount of the web W fed by the first deceleration operation.

FIG. **6** is an explanatory view illustrating an example of the feed speed and the feed amount of each type of the web W fed by the fixing feeding unit **13** when the feed of the web W is stopped. In the example illustrated in FIG. **6**, it is assumed that the general purpose sheet (solid line) and the coating sheet (single-dashed line) are used as the type of the web W. Further, in the example illustrated in FIG. **6**, it is assumed that the brake force (the brake current) generated to the fixing feeding unit **13** has the same value in the general purpose sheet and in the coating sheet and is not changed until the feed of the web W is stopped.

In FIG. **6**, a time T illustrates a predetermined time. Although the time T is a value previously determined by experiment and set to 50 ms here, the time T is not limited thereto. As illustrated in FIG. **6**, the feed amount of the web W, which is fed by the fixing feeding unit **13** (the heat roll motor **13***m*) until the time T passed after the trigger for stopping the feed of the web W had occurred, occupies about 70% of the feed amount of the web W, which is fed by the fixing feeding unit **13** (the heat roll motor **13***m*) until the feed of the web W has been stopped after the trigger for stopping the feed of the web W had occurred even if the web W is any of the general purpose sheet and the coating sheet. The feed amount of the web W until the time T has passed is approximately proportional to the feed amount of the web W until the feed of the web W has been stopped. Accordingly, the fixing feeding control unit **112** can determine whether or not the brake force (the brake current) generated to the fixing feeding unit **13** is sufficient from the feed amount of the web W until the time T has passed.

For example, as illustrated in FIG. **6**, it is assumed that when the trigger for stopping the feed of the web W has occurred (when the web W has been fed at the constant speed), the feed speed of the web W fed by the fixing feeding unit **13** (the heat roll motor **13***m*) is V (inch/second). Further, it is assumed that the feed speed of the web W at the time T becomes $V1$ (inch/second) in the general purpose sheet and becomes $V2$ (inch/second) in the coating sheet as a result that the fixing feeding control unit **112** has caused the fixing feeding unit **13** to execute the deceleration operation (as a result of generation of the brake force).

In the case, the feed amount of the web W (inch) at the time T becomes $((V+V1)/2)\times T$ in the general purpose sheet and becomes $((V+V2)/2)\times T$ in the coating sheet. When a resolution of the encoder **13***e* (a number of pulses of the encoder when the web W is fed 1 inch) is illustrated by P and the feed amount of the web W is converted to the number of pulses of the encoder, the number of pulses in the general purpose sheet is illustrated by $P1=P\times((V+V1)/2)\times T$ and the number of pulses in the coating sheet is illustrated by $P2=P\times((V+V2)/2)\times T$. Since the feed speed of the web W at the time T is $V1<V2$, $P1<P2$ is established.

In the embodiment, as explained in FIG. **6**, the fixing feeding control unit **112** measures the number of pulses until the time T has passed as the feed amount of the web W until the time T has passed and compares the measured number of pulses with a threshold value. When the measured number of pulses is larger than the threshold value and the brake force (brake current) generated to the fixing feeding unit **13** is not sufficient, the fixing feeding control unit **112** increases the brake force (brake current) generated to the fixing feeding unit **13**.

When it is assumed, for example, that threshold value $PT=P1$, it is not necessary for the fixing feeding control unit **112** to change the brake force (brake current) in the general purpose sheet even after the time T has passed. In contrast, in the coating sheet, since the threshold value becomes $PT<P2$, as illustrated in FIG. **7**, the fixing feeding control unit **112** increases the brake force (brake current) after the time T has passed (a solid line and a broken line illustrate a case of a conventional control in which the brake force is not changed) and reduces the feed amount of the web W until the feed of the web W has been stopped.

FIG. **8** is an explanatory view of an example of a determination method of the brake force by the fixing feeding control unit **112** of the embodiment after the time T passes. In the example illustrated in FIG. **8**, although the fixing feeding control unit **112** controls the brake force by changing a brake time, the control method of the brake force is not limited thereto.

When the brake time that is periodically generated to the fixing feeding unit **13** until the time T has passed after the trigger for stopping the feed of the web W had occurred is illustrated by $B1$, the fixing feeding control unit **112** sets the brake time after the time T passes also to $B1$ when the number of pulses at the time T is equal to or less than the threshold value PT.

In contrast, when the number of pulses at the time T is $P2$ ($P2>$threshold value PT), the fixing feeding control unit **112** sets the brake time after the time T passed to $B2$ ($B2=B1+\Delta B$). That is, when the number of pulses at the time T has exceeded the threshold value PT, the fixing feeding control unit **112** increases a correction amount ΔB of the brake time in proportion to a difference value ΔP between the number of pulses and the threshold value PT.

However, when the brake time has been excessively increased, since there is a possibility that the heat roll motor **13***m* rotates backward and image quality is deteriorated in the fixing feeding unit **13**, in the embodiment, an upper limit is set to the brake time. Accordingly, when the number of pulses at the time T has exceeded a predetermined value, the brake time is kept to the upper limit value.

The fixing feeding control unit **112** of the embodiment will be explained in more detail.

The fixing feeding control unit **112** causes the fixing feeding unit **13** to execute the first deceleration operation based on a first brake signal. Further, the fixing feeding control unit **112** creates a second brake signal based on the measured feed amount and causes the fixing feeding unit **13** to execute the second deceleration operation based on a synthesized brake signal created by synthesizing the first brake signal and the second brake signal.

Note that although it is assumed that the first brake signal and the second brake signal are output each time the encoder **13***e* outputs a predetermined number of pulses, the timings at which the first brake signal and the second brake signal are output are not limited thereto. Further, an output time of the second brake signal is longer than an output time of the first brake signal, and the fixing feeding control unit **112** causes the fixing feeding unit **13** to execute the first deceleration operation while the first brake signal is being output and causes the fixing feeding unit **13** to execute the second deceleration operation while the synthesized brake signal is being output. Further, when the feed amount is larger than the threshold value, although the output time of the second brake signal is made longer, the output time is equal to or less than an upper limit value.

FIG. **9** is a circuit diagram illustrating an example of a circuit configuration of the fixing feeding control unit **112** of the embodiment, and FIG. **10** is a timing chart illustrating an example of a timing chart of the fixing feeding control unit **112** of the embodiment. As illustrated in FIG. **9**, the fixing feeding control unit **112** has a counter **31**, a latch **32**, a counter **33**, a latch **34**, an OR circuit **35**, and a driver **36**. Note that, in the embodiment, as illustrated in FIG. **9**, the first brake signal that is used mainly is created by software, and the second brake signal that is used when an abrupt brake is applied is created by a hardware circuit because the second brake signal has the predetermined time T as short as, for example, about 50 ms (FIG. **6**) and is required to execute a high speed process.

A CPU (Central Processing Unit) **40** outputs a rotation signal to the counter **31**. Further, when the rotation signal has changed from an "H" level to an "L" level, the CPU **40** creates the first brake signal and outputs the first brake signal to the counter **33**, the latch **34**, and the OR circuit **35**. With the operation, the printing apparatus P shifts from a print operation to a print stop operation, and the heat roll motor **13***m* which rotates at the constant speed starts a deceleration operation.

When the encoder **13***e* detects the rotation of the heat roll motor **13***m*, the encoder **13***e* outputs an encoder pulse signal to the counter **31**.

When the rotation signal changes from the "H" level to the "L" level, the counter **31** loads the threshold value PT from a memory **41** and starts to count the number of pulses from the encoder pulse signal. The counter **31** outputs a difference value ΔP (ΔP=P**2**−PT) between the counted number of pulses P**2** and the threshold value PT to the latch **32**. When the difference value ΔP has exceeded an upper limit value, however, the counter **31** outputs the upper limit value to the latch **32** as the difference value ΔP.

When the time T has passed after the rotation signal changes to the "L" level, since a count finish signal that has been input to the latch **32** changes from the "L" level to the "H" level, the latch **32** latches the difference value ΔP input from the counter **31** and outputs the difference value ΔP to the counter **33** as brake correction data.

The counter **33** loads the brake correction data (the difference value ΔP) from the latch **32**, and when the first brake signal has become the "H" level, the counter **33** counts down the brake correction data each time a clock signal is input, and when the brake correction data has become "0", the counter **33** makes a B output that has been output to the latch **34** to the "H" level.

The latch **34** outputs the second brake signal to the OR circuit **35**, and when the first brake signal has become the "H" level, the latch **34** makes the second brake signal to the "H" level, and when the B output has become the "H" level, the latch **34** makes the second brake signal to the "L" level.

The OR circuit **35** ORs the first brake signal with the second brake signal to thereby create the synthesized brake signal by synthesizing the first brake signal and the second brake signal and outputs the synthesized brake signal to the driver **36**.

While the synthesized brake signal is being made to the "H" level, the driver **36** causes the brake current to flow to the heat roll motor **13***m* and decelerates the feed of the web W.

As a result, the brake time until the time T becomes a time B**1** at which the first brake signal becomes the "H" level, and the brake time after the time T becomes a time B**2** at which the second brake signal becomes the "H" level.

Note that in an example illustrated in FIGS. **9** and **10**, the fixing feeding control unit **112** changes the first brake signal to the "H" level each time the encoder pulse signal is detected three times, and when the first brake signal changes to the "H" level, the second brake signal is also changed to "H" level. However, this is only an example of an operation, and timing and a cycle at which the second brake signal is changed to the "H" level are not limited thereto.

As described above, according to the embodiment, since the fixing feeding unit **13** is caused to execute the second deceleration operation according to the feed amount of the web W achieved by the first deceleration operation, the feed amount of the web W when the feed of the web W fed by the fixing feeding unit **13** has been stopped becomes a predetermined amount regardless of the type of the web W, and thereby the angle of the buffer plate **12***a* can be fallen within the appropriate range. Thus, even if the web W is any of the coating sheet having the large degree of smoothness and the general purpose sheet, since the feed amount of the web W when the feed of the web W fed by the fixing feeding unit **13** has been stopped can be made to the predetermined amount, the angle of the buffer plate **12***a* can be fallen within the appropriate range.

Further, in the embodiment, the brake time is changed by creating the synthesized signal by synthesizing the first brake signal and the second brake signal, which is created by a circuit, instead of changing a cycle at which the first brake signal created by the CPU becomes the "H" level. Thus, according to the embodiment, the brake time can be corrected at a higher speed than the method of changing the cycle at which the first brake signal becomes the "H" level.

Modification

Note that the embodiment is not limited to the embodiment mentioned above and can be variously modified.

For example, in the embodiment, the brake time of the first brake signal (the cycle at which the first brake signal becomes the "H" level) may be changed according to the angle of the buffer plate **12***a* when the feed of the web W has been started by the fixing feeding unit **13**. With the operation, a stop control of the heat roll motor **13***m* can be more accurately executed.

Further, when the printing apparatus P is, for example, a printing apparatus capable of switching two or more types of print speeds, the fixing feeding control unit **112** may use a threshold value according to a set print speed as the threshold value.

FIG. **11** is an explanatory view illustrating an example of the feed speed and the feed amount of the web W fed by the fixing feeding unit **13** at each feed speed when the feed of the web W has been stopped. In the example illustrated in FIG. **11**, it is assumed that the web W is the general purpose sheet and the feed speed of the web W is set to a high speed and a low speed. Further, in the example illustrated in FIG. **11**, it is assumed that although the brake force (brake current) generated to the fixing feeding unit **13** is not changed until the feed of the web W has been stopped, the brake force at the high speed is different from the brake force at the low speed so that the feed of the web W is stopped in the same time at any of the high speed and the low speed.

As illustrated in FIG. **11**, it is assumed that the feed speed of the web W fed by the fixing feeding unit **13** (the heat roll motor **13***m*) when the trigger for stopping the feed of the web W has occurred is VH (inch/second) at the high speed and VL (inch/second) at the low speed. Further, it is assumed that, as a result that the fixing feeding control unit **112** causes the fixing feeding unit **13** to execute the deceleration operation (as a result that the brake force is generated), the feed speed of the web W at the time T is VH**1** (inch/second) at the high speed and VL**1** (inch/second) at the low speed. In the case, when the feed amount (inch) of the web W at the time T is converted to the number of pulses of the encoder, the number of pulses at the high speed is $PH=P\times((VH+VH1)/2)\times T$ and the number of pulses at the low speed is $PL=P\times((VL+VL1)/2)\times T$.

As described above, even if the web W is the same, since the number of pulses is different at the high speed and at the low speed, in the modification, for example, a threshold value at the high speed is made to PTH (PTH=PH) and a threshold value at the low speed is made to PTL (PTL=PL). Note that the correction amount (ΔB/ΔP in FIG. **8**) of the second brake signal can be also changed by switching the cycle of the clock signal at the high speed and at the low speed.

Further, as illustrated in FIG. **11**, the feed amount of the web W when the feed of the web W has been stopped by the fixing feeding unit **13** becomes smaller at the low speed than at the high speed. Accordingly, when the deceleration of the heat roll motor **13***m* has been started at the low speed at the same timing as that at the high speed, the buffer plate **12***a* is stopped at a position higher than that at the high speed. Accordingly, actually, at the low speed, the CPU **40** delays the timing at which the rotation signal is changed to the "L" level than the timing at the high speed.

As described above, also in the printing apparatus capable of switching the two or more types of print speeds, since the feed amount of the web W when the feed of the web W fed by the fixing feeding unit **13** has been stopped can be made to the predetermined amount even if the web W is any of the coating sheet having the large degree of smoothness and the general purpose sheet, the angle of the buffer plate **12***a* can be fallen within the appropriate range.

Further, in the embodiment, although the fixing feeding unit **13** has been explained as the example of the second feeding unit, the second feeding unit is not limited thereto and may be any feeding mechanism for feeding the web (nip-feed) downstream of the printing unit **100** in a feed direction.

With the configuration, even if a mechanical configuration of a printing apparatus is a configuration such as the configuration disclosed in, for example, Japanese Patent Application Laid-open No. 2007-156315, that is, a configuration in which a web fed by a discharge roller and a pressing roller is fixed by non-contact fixing such as flash fixing and oven fix, the embodiment can be applied to the configuration. In the case, a feeding mechanism such as the discharge roller and pressing roll is preferably used as the second feeding unit.

Further, with the configuration, the embodiment can be applied even to an inkjet printing apparatus employing a mechanical configuration that is independently provided with a fixing mechanism and a feeding mechanism and to an inkjet printing apparatus employing a mechanical configuration that is not provided with a fixing mechanism.

Hardware Configuration

FIG. **12** is a block diagram illustrating an example of a hardware configuration of the printing apparatus P of the embodiment and the modification.

As illustrated in FIG. **12**, the printing apparatus P is configured such that a controller **910** is connected to an engine unit (Engine) **960** via a PCI (Peripheral Component Interconnect) bus. The controller **910** is a controller for controlling the printing apparatus P in its entirety, drawing, communication, and an input from an operation/display unit **920**. The engine unit **960** is an engine capable of being connected to the PCI bus and is a printer engine, for example, a white/black plotter, a one-drum color plotter, or a four-drum color plotter. The engine unit **960** includes also an image processing section such as an error diffusion section and a gamma conversion section in addition to an engine section.

The controller **910** has a CPU **911**, a north bridge (NB) **913**, a system memory (MEM-P) **912**, a south bridge (SB) **914**, a local memory (MEM-C) **917**, an ASIC (Application Specific Integrated Circuit) **916**, and a hard disc drive (HDD) **918** and is configured such that an AGP (Accelerated Graphics Port) bus **915** connects between the north bridge (NB) **913** and the ASIC **916**. In addition to the above-mentioned, the MEM-P **912** further includes a ROM **912***a* and a RAM **912***b*.

The CPU **911** controls the printing apparatus P in its entirety, has a chip set composed of the NB **913**, the MEM-P **912**, and the SB **914**, and is connected to other equipment via the chip set.

The NB **913** is a bridge for connecting the CPU **911** and the MEM-P **912**, the SB **914**, and the AGP bus **915** and has a memory controller for controlling read and write operations from and to the MEM-P **912**, a PCI master, and an AGP target.

The MEM-P **912** is a system memory used as a memory for storing a program and data, a memory for developing the program and the data, and a drawing memory of a printer and is composed of the ROM **912***a* and the RAM **912***b*. The ROM **912***a* is a memory dedicated for reading data and used as the memory for storing the program and the data, and the RAM **912***b* is a memory that can write and read data and is used as the memory for developing the program and the data and as the drawing memory of the printer.

The SB **914** is a bridge for connecting the NB **913** and a PCI device, and a peripheral device. The SB **914** is connected to the NB **913** via the PCI bus which is also connected with a network interface (I/F) section and the like.

The ASIC **916** is an IC (Integrated Circuit) that has a hardware element, is used to image processing, and has a role as a bridge for connecting the AGP bus **915**, the PCI bus, the HDD **918**, and the MEM-C **917**, respectively. The ASIC **916** is composed of a PCI unit for transferring data between a PCI target and an AGP master, an arbiter (ARB) acting as a core of the ASIC **916**, a memory controller for controlling the MEM-C **917**, DMACs (Direct Memory Access Controllers) for turning image data by a hardware logic and the like, and the engine unit **960** via the PCI bus. The ASIC **916** is connected with a USB (Universal Serial Bus) **940** and an IEEE1394 (the Institute of Electrical and Electronics Engineers 1394) interface (I/F) **950** via the PCI bus. The operation/display unit **920** is directly connected to the ASIC **916**.

The MEM-C **917** is a local memory used as an image buffer for copy and a code buffer, and the HDD **918** is a storage for storing image data, a program, font data, and a form.

The AGP bus **915** is a bus interface for a graphics accelerator card proposed to increase a speed of graphic processing and increases a speed of the graphics accelerator card by directly accessing the MEM-P **912** at a high throughput.

According to the embodiment, an angle of the buffer plate can be fallen within an appropriate range without depending on a type of the web is achieved.

Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

What is claimed is:

1. A printing apparatus, comprising:

a printing unit that forms an image on a web;

a first feeding unit that feeds the web in the printing unit;

a second feeding unit that feeds the web downstream of the printing unit in a feed direction;

a buffer unit that has a buffer plate and absorbs flexure of the web generated by a feed difference between the first feeding unit and the second feeding unit by operating the buffer plate;

a first feeding control unit that causes the first feeding unit to execute a deceleration operation for decelerating a feed speed of the web when a trigger for stopping the feed of the web has occurred; and a second feeding control unit that:

causes the second feeding unit to execute a first deceleration operation for decelerating the feed speed of the web when the trigger for stopping the feed of the web has occurred,

measures, with a sensor, a feed amount of the web fed by the second feeding unit during a period beginning at a first time and until a predetermined time passes, and

when the feed amount is larger than a threshold value, changes the first deceleration operation executed by the second feeding unit to a second deceleration operation based on the feed amount, wherein

the second deceleration operation is an operation for decelerating the feed speed of the web more than the first deceleration operation.

2. The printing apparatus according to claim **1**, wherein the second feeding control unit

causes the seconding feed unit to execute the first deceleration operation based on a first brake signal,

creates a second brake signal based on the feed amount, and

causes the second feeding unit to execute the second deceleration operation based on a synthesized brake signal obtained by synthesizing the first brake signal and the second brake signal.

3. The printing apparatus according to claim **2**, wherein

the second feeding unit comprises

a DC servo motor acting as a driving source for feeding the web; and

the sensor, the sensor being an encoder for detecting a rotation of the DC servo motor and outputting a pulse; and

the second feeding control unit measures a number of pulses output by the encoder as the feed amount of the web fed by the second feeding unit.

4. The printing apparatus according to claim **3**, wherein

the first brake signal and the second brake signal are output each time the encoder outputs a predetermined number of pulses.

5. The printing apparatus according to claim **4**, wherein

an output time of the second brake signal is longer than an output time of the first brake signal, and

the second feeding control unit

causes the second feeding unit to execute the first deceleration operation during a period in which the first brake signal is output, and

causes the second feeding unit to execute the second deceleration operation during a period in which the synthesized brake signal is output.

6. The printing apparatus according to claim **5**, wherein

the more the feed amount is larger than the threshold value, the more an output time of the second brake signal becomes longer.

7. The printing apparatus according to claim **6**, wherein

the output time of the second brake signal is equal to or less than an upper limit value.

8. The printing apparatus according to claim **1**, wherein

the second feeding control unit uses a threshold value according to a set print speed as the threshold value.

9. A feeding control method executed in a printing apparatus, wherein the printing apparatus includes:

a printing unit that forms an image on a web;

a first feeding unit that feeds the web in the printing unit;

a second feeding unit that feeds the web downstream of the printing unit in a feed direction; and

a buffer unit that has a buffer plate and absorbs flexure of the web generated by a feed difference between the first feeding unit and the second feeding unit by operating the buffer plate,

the feeding control method comprising:

first feeding controlling that causes, when a trigger for stopping the feed of the web has occurred, by a first feeding control unit, the first feeding unit to execute a deceleration operation for decelerating a feed speed of the web; and

a second feeding controlling including:

causing, when the trigger for stopping the feed of the web has occurred, by a second feeding control unit, the second feeding unit to execute a first deceleration operation for decelerating the feed speed of the web,

measuring, with a sensor, a feed amount of the web fed by the second feeding unit during a period beginning at a first time and until a predetermined time passes, and

changing, when the feed amount is larger than a threshold value, the first deceleration operation executed by the second feeding unit to a second deceleration operation based on the feed amount, wherein

the second deceleration operation is an operation for decelerating the feed speed of the web more than the first deceleration operation.

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